Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Qs

Unit Name: Surficial deposits (Holocene and Pleistocene)

Map Unit Description

Alluvium in stream-channel, flood-plain, and terrace deposits; talus, colluvium, landslide deposits, rock glaciers, and glacial deposits (till, outwash, and glacial lake deposits)

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Qt

Unit Name: Travertine (Holocene and Pleistocene)

Map Unit Description

Exposures limited to the Gardiner area in southwesternmost part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Qy

Unit Name: Lava Creek Tuff of Yellowstone Group (Pleistocene)

Map Unit Description

Rhyolitic ash-flow tuff in Gardiner area in southwesternmost part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Qb

Unit Name: Basalt (Pleistocene)

Map Unit Description

Basalt flows in Gardiner area in southwesternmost part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tv

Unit Name: Absaroka Volcanic Supergroup (Eocene)

Map Unit Description

Volcanic and volcaniclastic rocks including basaltic, andesitic, and dacitic flows and flow breccias, rhyolitic ash-flow tuff and vitrophyre, tuff breccias, lahars, agglomerates, agglutinates, conglomerate, and minor andesitic and dacitic intrusive bodies

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: TKf

Unit Name: Fort Union Formation (Paleocene and Upper Cretaceous)

Map Unit Description

Conglomerate, sandstone, and shale in southeast corner of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kal

Unit Name: Andesite (Upper Cretaceous)

Map Unit Description

Lava flows in Sliderock Mountain area in northern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kll

Unit Name: Lahars of Livingston Group (Upper Cretaceous)

Map Unit Description

Lahar deposits; mostly clast supported; minor intercalated ash-flow tuff, lava flows, flow breccias, and epiclastic conglomerate, sandstone, siltstone, and mudstone

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Klc

Unit Name: Sedimentary rocks of Livingston Group (Upper Cretaceous)

Map Unit Description

Epiclastic conglomerate, sandstone, siltstone, and mudstone

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kad

Unit Name: Andesite (Upper Cretaceous)

Map Unit Description

Lava flows and flow breccias at or near base of Livingston Group

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ku

Unit Name: Sedimentary rocks (Upper and Lower Cretaceous), undivided

Map Unit Description

Sandstone, shale, limestone, and conglomerate. Used in Sliderock Mountain area and along a fault in center of study area, where the stratigraphic assignment of these Cretaceous sedimentary rocks could not be determined with certainty

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kus

Unit Name: Sedimentary rocks (Upper Cretaceous)

Map Unit Description

Includes Eagle Sandstone, Telegraph Creek Formation, Cody Shale, Frontier Formation, and Montana Group. Sandstone and shale

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kls

Unit Name: Sedimentary rocks (Lower Cretaceous)

Map Unit Description

Includes Mowry Shale, Thermopolis Shale, Kootenai Formation, and Cloverly Formation. Sandstone, shale, limestone, and conglomerate

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: JT_rs

Unit Name: Sedimentary rocks (Jurassic and Triassic)

Map Unit Description

Includes Morrison Formation, Ellis Group, and Chugwater Formation. Sandstone, shale, and limestone

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Pz

Unit Name: Undifferentiated sedimentary rocks (Paleozoic)

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: PMs

Unit Name: Sedimentary rocks (Permian, Pennsylvanian, and Mississippian)

Map Unit Description

Includes Phosphoria, Quadrant, and Amsden Formations and Madison Group. Limestone, shale, sandstone, and dolomite

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: DOs

Unit Name: Sedimentary rocks (Devonian and Ordovician)

Map Unit Description

Includes Three Forks Shale, Jefferson Formation, and Bighorn Dolomite. Shale, limestone, and dolomite

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: OCs

Unit Name: Sedimentary rocks (Ordovician and Cambrian)

Map Unit Description

Includes Bighorn Dolomite, Grove Creek Formation, Snowy Range Formation, Pilgrim Limestone, Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone. Dolomite, limestone, sandstone, siltstone, and shale. Limited to the Cooke City area in south-central part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Cs

Unit Name: Sedimentary rocks (Cambrian)

Map Unit Description

Includes Grove Creek Formation, Snowy Range Formation, Pilgrim Limestone, Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone. Limestone, sandstone, siltstone, and shale

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: TKi

Unit Name: Intermediate and felsic intrusive rocks (Tertiary or Late Cretaceous)

Map Unit Description

Laccoliths, plugs, dikes, sills, and irregular-shaped bodies of fine-grained and porphyritic rhyolite, dacite, quartz latite, andesite, and diorite

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ti

Unit Name: Intermediate and felsic rocks (Eocene)

Map Unit Description

Dikes, sills, and irregular-shaped bodies. Andesite, quartz latite, dacite, and rhyolite; commonly porphyritic

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tdp

Unit Name: Dacite porphyry (Eocene)

Map Unit Description

Stock, laccoliths, sills, dikes (not shown on map), plugs, and irregular-shaped bodies. Includes some andesitic and rhyolitic rocks

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tgr

Unit Name: Granodiorite porphyry of Emigrant Peak area (Eocene)

Map Unit Description

Stock near head of Emigrant Creek on south flank of Emigrant Peak in western part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tdi

Unit Name: Diorite porphyry and basaltic andesite (Eocene)

Map Unit Description

Small stock (or plug) at head of Mill Creek in western part of study area, and plugs northwest of Cooke City

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tmz

Unit Name: Monzodiorite of Independence district area (Eocene)

Map Unit Description

Stock, at Monument Peak in central part of study area, composed of multiple phases of andesitic intrusive breccia, monzodiorite, quartz monzodiorite, and quartz monzonite; cut by minor granite dikes

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tlp

Unit Name: Dacite porphyry of Lulu Pass (Eocene)

Map Unit Description

Laccolith and dikes (not shown on map) about 3 mi (5 km) north-northwest of Cooke City

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tbh

Unit Name: Breccia of Homestake mine area (Eocene)

Map Unit Description

Explosion-collapse breccia pipe, about 2.2 mi (3.5 km) north of Cooke City, composed of blocks of Cambrian sedimentary rocks, porphyritic intrusive rocks, volcanic rocks, and Precambrian gneissic rocks in chloritic matrix; altered and mineralized; intruded by later dikes of rhyolite and quartz latite porphyry

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tba

Unit Name: Breccia of Alice E mine area (Eocene)

Map Unit Description

Collapse(?) breccia, about 1 mi (1.6 km) north of Cooke City, composed of blocks of Cambrian sedimentary rocks in a pulverized rock-flour matrix; locally altered and mineralized; intruded by later dikes of quartz latite porphyry

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Thm

Unit Name: Dacite porphyry of Henderson Mountain (Eocene)

Map Unit Description

Stock and dike (not shown on map) about 1 mi (1.6 km) north of Cooke City

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Th

Unit Name: Dacite porphyry of Homestake mine area (Eocene)

Map Unit Description

Stock, sills, dikes (not shown on map), and irregular-shaped bodies, about 2 mi (3.2 km) north of Cooke City; contains abundant rounded, commonly embayed quartz phenocrysts; commonly altered and locally mineralized

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tfm

Unit Name: Complex of Fisher Mountain area (Eocene)

Map Unit Description

Stock(?) composed of aphanitic and fine-grained porphyritic dacite, rhyolite, and quartz latite and felsite breccia, about 2.8 mi (4.5 km) north of Cooke City; intruded by quartz-rich dacite and porphyritic and aphanitic dikes (not shown on map); strongly feldspathized, silicified, sericitized and (or) argillitized, and pyritized

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Tsb

Unit Name: Diorite of Scotch Bonnet Mountain (Eocene)

Map Unit Description

Stock and irregular-shaped intrusive bodies about 3.3 mi (5.3 km) north of Cooke City

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ta

Unit Name: Andesite and trachyandesite porphyry (Eocene)

Map Unit Description

Sills in Cooke City area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ka

Unit Name: Andesite (Late Cretaceous)

Map Unit Description

Dikes in Sliderock Mountain area in northern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kd

Unit Name: Diorite of Sliderock Mountain (Late Cretaceous)

Map Unit Description

Stock; variable grain size and textures may indicate multiple phases; locally altered

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ki

Unit Name: Rhyolite and quartz latite porphyry (Late Cretaceous)

Map Unit Description

Sills, dikes (not shown on map), and irregular-shaped bodies in Goose Lake area, about 6.5 mi (10.5 km) north- northeast of Cooke City

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Kgl

Unit Name: Syenite of Goose Lake (Late Cretaceous)

Map Unit Description

Stock, about 7 mi (11.3 km) north- northeast of Cooke City, composed of multiple phases of syenite and monzonite of variable grain sizes and textures; locally altered and mineralized

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: P_Am

Unit Name: Mafic intrusive rocks (Proterozoic and Archean)

Map Unit Description

Includes sills, dikes, stock, and irregular-shaped bodies of alkali olivine dolerite, metadolerite, metanorite, metagabbro, and quartz dolerite, and dikes of uncertain or unknown affinities

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ahd

Unit Name: Hornblende quartz diorite (Archean

Map Unit Description

Small bodies associated with quartz monzonite (Agr) south of eastern exposures of the Stillwater Complex (Asw units)

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Agr

Unit Name: Granitic intrusive rocks (Archean)

Map Unit Description

Includes stocks and irregular-shaped bodies of fine-, medium-, and coarse-grained quartz monzonite and aplite south of eastern exposures of the

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw7

Unit Name: Upper anorthosite, upper gabbro, and upper mixed zones

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw6

Unit Name: Middle anorthosite zone

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw5

Unit Name: Middle mixed, middle gabbro, and lower mixed zones

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw4

Unit Name: Lower anorthosite zone

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw3

Unit Name: Lower gabbro and norite zones

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw2

Unit Name: Bronzitite zone

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Asw1

Unit Name: Peridotite zone

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Agn

Unit Name: Granitic gneiss (Archean)

Map Unit Description

Predominantly granitic gneiss and migmatite; commonly consists of alternating bands of more felsic and more mafic gneiss; contains inclusions of metasedimentary and metaigneous rocks

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: An

Unit Name: Metanorite and metagabbro (Archean)

Map Unit Description

Stock-like mass composed of metanorite and metagabbro cropping out in southeastern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Aum

Unit Name: Ultramafic rocks (Archean)

Map Unit Description

Irregular-shaped bodies and lenses of olivine-bearing rocks and serpentinite cropping out in southeastern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: As

Unit Name: Biotite schist (Archean)

Map Unit Description

Includes minor quartzite, iron-formation, and amphibolite

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Aag

Unit Name: Amphibolite and hornblende gneiss (Archean)

Map Unit Description

Mostly tabular and lensoid bodies enclosed in granitic gneiss and migmatite

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Aga

Unit Name: Amphibolite and gneiss (Archean)

Map Unit Description

Includes trondhjemitic gneiss-amphibolite, paragneiss, and heterogeneous gneiss sequences, as well as trondhjemitic gneiss, tonalitic gneiss, and amphibolite; minor schist, quartzite, and iron-formation

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Anc

Unit Name: Nappe complex (Archean)

Map Unit Description

Sheet-like, allochthonous package of rock units in northwestern part of study area. Includes Barney Creek Amphibolite, George Lake Marble, and Jewel Quartzite. Amphibolite, dolomitic marble, marble, and quartzite; minor schist and iron-formation

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Aqa

Unit Name: Quartzite and amphibolite (Archean)

Map Unit Description

Interlayered quartzite and orthoamphibolite; minor schist

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Ash

Unit Name: Schist and hornfels (Archean)

Map Unit Description

Metasedimentary rocks consisting predominantly of schist and hornfels with minor quartzite, amphibolite, and iron-formation; contact metamorphosed to hornblende-hornfels and pyroxene-hornfels facies at and near base of Stillwater Complex. Host for Homestake-type gold deposits near Jardine in southwestern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: Am

Unit Name: Undifferentiated metamorphic rocks (Archean)

Map Unit Description

Includes amphibolite, micaceous quartzite, and some gneiss. Also includes some small bodies of chromite-bearing serpentinite. Limited to southeastern part of study area

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Absk_Beartooth_rect

Map Title

Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana

Map name: Absaroka Beartooth

Map Unit Symbol: d

Unit Name: Dikes and sills of andesite and basalt (Eocene or Precambrian, age uncertain)

Map Unit Description

Map Citation

Van Gosen, B. S., Elliot, J. E., LaRock, E. J., du Bray, E. A., Carlson, R. R., and Zientek, M. L., 2000, Generalized geologic map of the Absaroka-Beartooth study area, south-central Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-2338, 1:126,720, 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tp

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, MAFIC ANALCIME PHONOLITE (MIDDLE EOCENE)

Map Unit Description

Flows, flow breccias, agglomerate, and thin plant bearing waterlaid volcanic sediments; red, green, and gray; phenocrysts of analcime, augite, biotite and rare sanidine; occurs only in southwestern Bearpaw Mountains, forms topographic highs, rests unconformably on older volcanic rocks, but lower part may be interlayered with porphyritic analcime trachyte; fossil plants indicate middle Eocene age; maximum thickness about 1,500 feet, on Mt. Bearpaw

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tt

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, PORPHYRITIC ANALCIME TRACHYTE (MIDDLE EOCENE)

Map Unit Description

Flows and flow breccias; greenish-gray to light gray; phenocrysts of analcime and sanidine, pronounced trachytic texture of sanidine in groundmass; youngest felsic volcanic rocks, in part unconformable over older volcanic rocks and in part interlayered with the uppermost older mafic and felsic volcanic flows; extrusive equivalent of porphyritic potassic syenite; maxi-mum thickness about 1.500 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tfy

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, FELSIC VOLCANIC FLOWS (MIDDLE EOCENE)

Map Unit Description

Flows and flow breccias of porphyritic latite and quartz latite; light gray, gray, brown; green celadonitic alteration is common; phe-nocrysts of potassium feldspar, plagioclase, augite, hornblende and biotite; quartz in groundmass only; interlayered with mafic and felsic pyroclastic rocks and mafic flows; as mapped includes some felsic pyroclastic rocks; extrusive equivalent of porphyritic latite; maximum thickness about 5000 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tfp

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, FELSIC PYROCLASTIC ROCKS (MIDDLE EOCENE)

Map Unit Description

Agglomerate, tuff-breccia, lapilli tuff, tuff, water-laid volcanic sediments, and coarse mudflow deposits; contains more than 50 percent fragments of felsic volcanic rocks; inclusions of biotite pyroxenite and Precambrian basement rocks are locally abundant; commonly forms lowermost volcanic unit, particularly in northwestern part; in part deposited in local early collapse basins; fossil plants and fish indicate middle Eocene age; maximum thickness about 3000 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tmv

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, MAFIC VOLCANIC FLOWS (MIDDLE EOCENE)

Map Unit Description

Flows and flow-breccias of phonolite and mafic phono-lite; brown, red and purple; phenocrysts of olivine, augite, biotite, analcime, and rare leucite in groundmass of augite, potassium feldspar and analcime; natrolite, analcime and calcite are common alteration products; interlayered with felsic flows and felsic and mafic pyroclastic rocks; as mapped includes some mafic pyroclastic rocks; extrusive equivalent of shonkinite, syenite, and possibly of monzonite; maxi-mum thickness about 5000 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tmp

Unit Name: BEARPAW MOUNTAINS VOLCANIC ROCKS, MAFIC PYROCLASTIC ROCKS (MIDDLE EOCENE)

Map Unit Description

Agglomerate, tuff-breccia, lapilli tuff, tuff, water-laid volcanic sediments and mudflow deposits; contains more than 50 percent frag-ments of mafic volcanic rocks; inclusions of biotite pyroxenite and Precambrian basement rocks are locally abundant; commonly forms lowermost volcanic unit, particularly in the southeastern part; in part deposited in local early collapse basins; fossil plants and fish indicate middle Eocene age; maximum thickness about 3000 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tpi

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, MAFIC ANALCIME PHONOLITE (MIDDLE EOCENE)

Map Unit Description

Dikes and plugs; gray to greenish gray; fine-grained, porphyritic, phenocrysts of analcime, augite, biotite, and rare sanidine; oc-curs only in western Bearpaw Mountains; youngest intrusive rock; intrudes part of extrusive equivalent, mafic analcime phonolite

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tps

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, PORPHYRITIC POTASSIC SYENITE (MIDDLE EOCENE)

Map Unit Description

Dikes, sills, plugs and stocks; light gray to green; fine - to coarse-grained; as mapped includes a wide variety of subsilicic-alka-lic rocks (pseudoleucite-sodalite tinguaite, nepheline tinguaite, aegirine-nepheline syenite, all restricted to the central and western Bearpaw Mountains) and silicic alkalic rocks (porphyritic syenite, the only variety of this rock type in the eastern Bearpaw Mountains); fine-grained varieties typically have phenocrysts of tabular zoned potassium feldspar, and aegirine, with or without pseudoleucite, nepheline and sodalite, in a fine-grained green or gray groundmass; rock type associated with most sulfide deposits; plug in Rocky Boy stock contains carbonatite vein-dikes; cut by mafic analcime phonolite in western Bearpaw Mountains; in eastern Bearpaw Mountains, generally the youngest rock type, with exception of one dike of porphy-ritic latite

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tm

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, MONZONITE (MIDDLE EOCENE)

Map Unit Description

Dikes, sills, plugs and stocks; light to dark gray; fine- to medium-grained, locally porphyritic; predominantly mafic; felsic varieties rare; contains potassium feldspar and plagioclase in varying ratio, augite, and subordinate olivine, biotite, and hornblende; lacks quartz, feldspathoidal varieties rare; occurs only in western half of Bearpaw Mountains; postdates most porphyritic latite and shonkinite intru-sions, and is cut by porphyritic potassic syenite; fine-grained dikes not mapped sep-arately from porphyritic latite

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tl

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, PORPHYRITIC LATITE (MIDDLE EOCENE)

Map Unit Description

Dikes, sills, laccoliths, and stocks; light gray to brown; fine-grained felsic porphyritic rocks; most contain less than 20 percent mafic minerals; phenocrysts of augite ubiquitous; phenocrysts of potassium feldspar, plagioclase, biotite, and hornblende in varying amount characterize separate varieties; ground-mass of feldspar, augite and quartz; may represent several episodes of intrusion, post-dates most but not all shonkinite-syenite intrusions

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Ts

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, SHONKINITE AND SYENITE (MIDDLE EOCENE)

Map Unit Description

Dikes, sills, laccoliths, plugs and stocks; gray to black; fine- to coarse-grained, porphyritic and equi-granular; mafic mineral content of shonkinite more than 40 percent, mafic syenite 20 to 40 percent, and syenite less than 20 percent; includes subsilicic-alkalic and silicic alkalic varieties; contains augite, biotite and dominantly potassic feldspar, with or without olivine, plagioclase, nepheline, pseudoleucite, apatite, and analcime or interstitial quartz; many varieties weather to biotite-rich soil with no outcrop; represents several episodes of intrusion, and is the earliest intrusive rock in the eastern Bearpaw Mountains

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tbp

Unit Name: BEARPAW MOUNTAINS INTRUSIVE ROCKS, BIOTITE PYROXENITE (MIDDLE EOCENE)

Map Unit Description

Small stocks; dark green to black; coarse-grained; contains augite and biotite in ratios from 10:1 to 1:1, less than 10 percent total of apatite, potassium feldspar, plagioclase, olivine and sulfides; transitional to mafic varieties of shonkinite; occurs only in Rocky Boy stock in western Bearpaw Mountains where it is the earliest intrusion; similar biotite pyroxenites with less apatite occur as in-clusions in other igneous rocks

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name Bearpaw Mountains

Map Unit Symbol Tw

Unit Name WASATCH FORMATION (LOWER EOCENE)

Map Unit Description

Non-marine; shale, bentonitic clay-stone and siltstone, variegated red, pink, lavender, light green, yellow, gray and white, with calcareous concretionary nubbles; cross-bedded fine- to coarse-grained sandstone, light gray, brown and green, with channel lenses of boulder conglomer-ate in upper part containing clasts of argillite and quartzite from the Precambrian Belt supergroup, of porphyritic igneous rocks, and of limestone and dolomite derived from the Rocky Mountains uplift to the west or southwest; clasts locally crushed, fractured and recemented; fossil plants and vertebrates indicate early Eocene age; formation incomplete, top missing due to pre-volcanic erosion or tectonic disruption or both; maximum measured thickness 800 feet, original maximum thickness prob-ably exceeded 1000 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Tf

Unit Name: FORT UNION FORMATION (PALEOCENE)

Map Unit Description

Non-marine; sandstone, thin-bedded and massive thick-bedded, light brown to light yellow, with brown sandstone con-cretions; siltstone, claystone and shale, light-colored to greenish; carbonaceous shale and coal, locally mined; abundant fossil plants indicate Paleocene age; maximum thickness about 1300 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Khf

Unit Name: HELL CREEK FORMATION AND FOX HILLS SANDSTONE, UNDIVIDED (UPPER CRETACEOUS)

Map Unit Description

Combined thickness 480 to 600 feet. Hell Creek Forma-tion: non-marine; sandstone, locally massive, gray to light brown, with brown sand-stone concretions; siltstone, claystone and shale, white, light-colored and drab, in part calcareous, with abundant calcareous concretionary nubbles; carbonaceous bentonitic claystone, brownish gray; near base, persistent beds of carbonaceous shale and coal, locally- mined; rare fossil plants and vertebrates indicate latest Cre-taceous age; thickness 420 to 500 feet. Fox Hills Sandstone: marine; thin-bedded to massive; light gray, brown, yellow, with brown sandstone concretions; minor in-terbedded shale and siltstone, brown and gray; locally contains diagnostic marine fossils; thickness 60 to 100 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kb

Unit Name: BEARPAW SHALE (UPPER CRETACEOUS)

Map Unit Description

Marine shale and silty shale, gray to brownish gray, with bentonite beds, light gray to cream, prominent in lower one third; numerous horizons of ovoid, massive or septarian, gray limestone concretions and red-brown iron-manganese-rich claystone concretions; marine fossils common, diagnostic species of Baculites define 5 faunal zones; upper 70 to 200 feet is transi-tion lithology of thin-bedded sandstone, siltstone and shale, brown to brownish gray; lower one-third contains numerous markers which correlate well in resistivity logs, but correlation of parts of upper two-thirds is less reliable in part because of tectonic disruption; total thickness approximately 1000 to 1200 feet but uncertain because of lack of complete undisturbed section

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kj

Unit Name: JUDITH RIVER FORMATION (UPPER CRETACEOUS)

Map Unit Description

Predominantly non--marine; sandstone, light brown to yellow, locally gas bearing; siltstone, claystone and shale, white, light yellow, greenish, light gray; concretionary sandstone and siltstone; near the top one or more beds rich in oyster shells and several carbona-ceous shales and coals, locally mined; locally uppermost beds are marine clay-rich white sandstone; locally lowermost sandstone contains marine fossils; vertebrate fossils common; in resistivity logs, correlation of non-marine sandstones is uncertain because of lateral lensing, but correlation of marine sandstones is feasible for 5 to 10 miles laterally; thickness 540 to 670 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kcs

Unit Name: CLAGGETT SHALE (UPPER CRETACEOUS)

Map Unit Description

Marine shale, brownish gray to brown, bentonite beds prominent in lower 80 feet; several horizons of ovoid orange-yellow septarian limestone concretions; upper 30 to 200 feet is transition lithology of alter-nating thin-bedded brown shale, siltstone and sandstone, with one or more massive sandstone members totaling as much as 120 feet, locally gas bearing; resistivity logs 1 to 3 miles apart are nearly identical, and many markers can be correlated for wells 10 to 20 miles apart; total thickness 450 to 680 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Ke

Unit Name: EAGLE SANDSTONE (UPPER CRETACEOUS)

Map Unit Description

Marine and brackish-water sand-stone, light brown to white, and interbedded shale, siltstone, and carbonaceous mud-stone and shale; contains as many as three massive sandstone members, some or all of which may contain gas; lower 70 to 170 feet massive sandstone (Virgelle Sand-stone Member) in southwest part; upper 20 to 130 feet is transition lithology of al-ternating thin glauconitic sandstone, chert pebble conglomerate, siltstone and shale; sandstone members and shaly interbeds can be correlated by electric logs 5 to 10 miles laterally; thickness 140 to 300 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol:

Unit Name: COLORADO SHALE (UPPER AND LOWER CRETACEOUS)

Map Unit Description

Thickness 1740 to 1910 feet; resistivity logs of the Colorado Shale are almost identical for wells 1 to 3 miles apart, and many markers can be correlated for 10 to 20 miles, excepting the Telegraph Creek Member in which correlation of markers is uncertain for more than 1 to 2 miles because of lateral facies changes and possible tectonic disruption, and excepting the upper part of the Niobrara Shale Member in the western plains where a sandy facies obscures markers which are correlative further east

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kcu

Unit Name: UPPER PART OF COLORADO SHALE (UPPER CRETACEOUS)

Map Unit Description

Major gravity slide planes are near base and near marker Y, a bentonitic bed about 550 feet above base; total thickness 750 to 870 feet. Includes in descending order: Telegraph Creek Member: transition lithology of alternating thin-bedded sandstone, siltstone and shale, gray to brownish gray; locally massive sandstone up to 50 feet thick, may be gas-bearing; thickness 0 to 170 feet. Niobrara Shale and Carlile Shale Members (combined for mapping) : marine shale, dark gray to brownish gray, and minor siltstone, bentonite beds, septarian calcareous claystone concretions and concretionary lime-stone lenses; lower 100 to 200 feet (Carlile Shale Member) black shale with distinc-tive rusty-weathering iron-rich claystone concretions; thickness 610 to 850 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kc

Unit Name: MIDDLE AND LOWER PARTS OF COLORADO SHALE (UPPER AND LOWER CRETACEOUS)

Map Unit Description

Combined in cross section ABCD; thickness 950 to 1070 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kcm

Unit Name: MIDDLE PART OF COLORADO SHALE (UPPER CRETACEOUS)

Map Unit Description

Total thick-ness 170 to 290 feet. Includes in descending order: Greenhorn Limestone Member: limestone, sandy, thin-bedded, gray; calcareous and non-calcareous siltstone, dark shale and bentonite; marine fossils abundant; thickness 10 to 50 feet. Belle Fourche Shale Member: shale, black, minor gray sandstone and siltstone, bentonite; distinc-tive sandstone bed contains black chert grit; iron-manganese claystone concretions near base; thickness 140 to 270 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kcl

Unit Name: LOWER PART OF COLORADO SHALE (LOWER CRETACEOUS)

Map Unit Description

Total thickness 740 to 800 feet. Includes in descending order: Mowry Shale Member: shale, sili-ceous, light-bluish-gray, with prominent bentonite beds near top; fish-scale imprints abundant, thickness 60 to 110 feet; Newcastle Sandstone and Skull Creek Shale Members (combined for mapping): shale, gray to black, and abundant thin beds of sandstone, siltstone, mudstone and concretionary iron-rich claystone, drab to rusty, thickness 270 to 360 feet. Fall River Sandstone Member: upper 40 to 70 feet sand-stone, light gray to light brown, irregularly bedded, containing chert-pebble con-glomerate; lower part black shale with minor thin sandstone and siltstone beds, lower 30 feet contains phosphatic nodules;_ thickness 300 to 430 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Kk

Unit Name: KOOTENAI FORMATION (LOWER CRETACEOUS)

Map Unit Description

Non-marine; upper half shale, mudstone, and siltstone, variegated dark red, purple, green and brown, and cross--bedded sandstone, white, light brown and green; lower half interbedded massive cross-bedded sandstone, light brown, white and gray, and siltstone and shale, gray to brown; prominent massive coarse-grained sandstone with salt-and-pepper texture (Third Cat Creek Sandstone of local usage) near base is locally conglomeratic, con-tains cobbles and pebbles of quartzite, chert, silicified limestone and vein quartz; thickness 290 to 400 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Je

Unit Name: ELLIS GROUP (UPPER AND MIDDLE JURASSIC)

Map Unit Description

Total thickness 280 to 550 feet. Includes in descending order: Swift Formation: marine, massive and thin--bedded light brown sandstone, brown siltstone and dark gray shale, with brown concretionary limestone lenses, uppermost 20 to 40 feet may be equivalent to Mor-rison Formation, thickness 70 to 230 feet. Rierdon Formation: massive to thin--bedded gray limestone, and thin-bedded argillaceous limestone and calcareous shale, gray to, yellowish-gray, thickness 70 to 190 feet. Piper Formation (correlative with Sawtooth Formation to southwest): upper part (Bowes Member of Nordquist, 1955) massive to thin-bedded, gray, sandy, and oolitic limestone, calcareous sandstone, shale and dark gray algal limestone; middle part (Firemoon Limestone Member of Nordquist, 1955) thick-bedded limestone, dark gray, with thin shaly interbeds; basal part (Tampico Shale Member of Nordquist, 1955) shale, calcareous siltstone, sand-stone and conglomerate; Bowes and Firemoon Members contain oil in Bowes Field and elsewhere in northern part of map area; Piper Formation thins southward and eastward, thickness 0 to 260 feet

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Mm

Unit Name: MADISON GROUP (UPPER AND LOWER MISSISSIPPIAN)

Map Unit Description

Total thickness 650 to 1050 feet, variable due to pre-Middle Jurassic erosion. Includes in descending order: Mission Canyon Limestone and Lodgepole Limestone; exposures limited to uppermost 200 feet; Mission Canyon Limestone: massive limestone, light gray to dark gray, with abundant lenses and nodules of gray chert; crinoidal and coralline fossils abundant; contains oil and gas elsewhere in Montana

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Bearpaw_geo_rect

Map Title

Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana

Map name: Bearpaw Mountains

Map Unit Symbol: Pz

Unit Name: PALEOZOIC SEDIMENTARY ROCKS, UNDIVIDED (MISSISSIPPIAN, DEVONIAN, ORDOVICIAN, AND CAMBRIAN)

Map Unit Description

(Shown only in cross section). Total thickness about 3000 to 3400 feet. Includes, in descending order, Mission Canyon and Lodgepole Limestones of Madison Group, Three Forks Shale, Jefferson Lime-stone, Maywood Formation, Bighorn Dolomite, Emerson Formation, and Flathead Sandstone

Map Citation

Hearn, B.C., Jr., 1976, Geologic and tectonic maps of the Bearpaw Mountains area, north-central Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-919, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: TKw

Unit Name: WILLOW CREEK FORMATION (PALEOCENE AND UPPER CRETACEOUS)

Map Unit Description

Variegated mudstone with some thin beds of sandstone. Upper part of the Willow Creek Formation is bright reddish-brown mudstone in beds as thick as 3 feet, interbedded with gray, gray-green, and tan-gray mudstone (Mudge and Earhart, 1983). Lower part of Willow Creek Formation is variegated mudstone, dominantly grayish green, gray, and locally tan, pinkish gray, purple, and red brown. Some thin interbeds contain irregular-shaped, tufa-like nodules that probably contain barite. Thin, gray, poorly sorted fine- to medium-grained sandstone beds locally. Weathers to badland topography where outcrops are extensive. At least 770 feet thick in north part of mapped area

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Ksm

Unit Name: ST. MARY RIVER FORMATION (UPPER CRETACEOUS)

Map Unit Description

Mostly greenish-gray to grayish olive mudstone interbedded with thin beds of fine-grained sandstone. Some poorly indurated, gray-brown to tan-gray, cross-bedded sandstone beds fill small channels within the formation. Thin (3 feet) bed of carbonaceous shale, near the base of the St. Mary River Formation, commonly is overlain by a thin (3 feet) oyster bed (Mudge and Earhart, 1983). The St. Mary River Formation weathers to badland topography. Thickness is about 980 feet in the northern part of the reservation (Stebinger, 1916). The St. Mary River Formation is similar in lithology to the Two Medicine Formation; both consist of nonmarine sedimentary rocks

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kh

Unit Name: HORSETHIEF SANDSTONE AND HORSETHIEF-BEARPAW TRANSITION UNIT (UPPER CRETACEOUS)

Map Unit Description

The Horsethief Sandstone is gray to gray-brown, fine- to medium-grained marine sandstone, commonly cross-bedded. Titaniferous magnetite sandstone locally is present in the upper 20-40 feet of the formation (Mudge and Earhart, 1983). Large calcareous concretions locally are present in the middle part. The Horsethief Sandstone is as thick as 165 feet and it forms prominent bluffs and ridges.

The Horsethief-Bearpaw transition unit is dark-gray marine mudstone, interbedded with thin, fine- to medium-grained sandstone (Cobban, 1955). The sandstone beds are thicker and more abundant in the upper part. The unit is as thick as 400 feet in northern areas and it thins southward

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kb

Unit Name: BEARPAW SHALE (UPPER CRETACEOUS)

Map Unit Description

The Bearpaw Shale is mostly dark-gray marine shale with ferruginous concretions, some bentonite beds, and thin layers of sandstone (Cobban, 1955). Selenite (gypsum) crystals are common on many weathered surfaces. The Bearpaw Shale is nearly 400 feet thick north of the Two Medicine River; it thins southward to about 225 feet along Blacktail Creek, where it is much sandier and contains beds of fine-grained, cross-bedded sandstone as thick as 15 feet

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Ktm

Unit Name: TWO MEDICINE FORMATION (UPPER CRETACEOUS)

Map Unit Description

Nonmarine mudstone with some sandstone. Upper and middle parts mostly gray-green to gray mudstone with reddish-gray, red-brown, and purple interbeds. Fossils are common in the upper 490 feet, including dinosaur bones and pelecypods. The lower 560 feet contains many thick beds of gray- to greenish-gray sandstone interbedded with gray-green, olive-drab, and gray mudstone (Mudge and Earhart, 1983). Sandstone beds in the lower part are poorly indurated, fine- to medium-grained, massive to thinly bedded, and locally as thick as 165 feet. Thin coal beds are present at the top and base of the formation and in a zone about 250 feet above the base (Stebinger, 1916). The Two Medicine Formation has a maximum thickness of about 2,200 feet. Where outcrops are extensive, the Two Medicine Formation erodes into badland topography, as does the St. Mary River Formation

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kvt

Unit Name: VIRGELLE SANDSTONE AND TELEGRAPH CREEK FORMATION (UPPER CRETACEOUS)

Map Unit Description

The Virgelle Sandstone is light-gray, moderately thick-bedded, fine-grained marine sandstone (Mudge and Earhart, 1983). Locally, it contains cross-bedded, iron-impregnated beds that weather to form large concretions. Dark brownish-gray, resistant titaniferous magnetite sandstone as thick as 20 feet is present at the top of the formation. The Virgelle Sandstone is 165 to 200 feet thick and it forms conspicuous hogbacks and escarpments.

The Telegraph Creek Formation is a transitional unit between the underlying Marias River Shale and the overlying Virgelle Sandstone. It is similar to the transitional unit between the Bearpaw Shale and the Horsethief Sandstone (Mudge and Earhart, 1983). The Telegraph Creek consists mainly of gray mudstone interbedded with fine-grained sandstone. Sandstone beds are thicker toward the top of the formation and locally are cross-bedded and ripple marked. The thickness of the Telegraph Creek Formation ranges from about 120 to 165 feet (Erdmann and others, 1946)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Km

Unit Name: MARIAS RIVER SHALE (UPPER CRETACEOUS)

Map Unit Description

Chiefly dark-gray, marine mudstone from about 900 to 1,200 feet thick. The Marias River Shale is divided into four members (not mapped) which are, in descending order, the Kevin, Ferdig, Cone, and Floweree Members (Cobban and others, 1976)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kbl

Unit Name: BLACKLEAF FORMATION (LOWER CRETACEOUS)

Map Unit Description

Gray, marine mudstone and interbedded sandstone. The Blackleaf Formation is divided into four members (not mapped) which are, in descending order, the Bootlegger, Vaughn, Taft Hill, and Flood Members (Cobban and others, 1976). Only the Vaughn and Flood Members are present in the southwestern part of the reservation, where the formation is about 718 feet thick (Mudge and Earhart, 1991)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kk

Unit Name: KOOTENAI FORMATION (LOWER CRETACEOUS)

Map Unit Description

Gray-green and maroon mudstone and many greenish-gray sandstone beds. The sandstone is mostly poorly sorted, fine to coarse grained, and commonly cross-bedded (Mudge and Earhart, 1991). Lenticular beds of conglomerate are present locally at bases of some of the sandstone units. Brown, iron-stained nodules are common in the mudstone beds. A brownish-gray limestone unit present near the top of the formation contains lenses of gastropod and pelecypod shells. The Kootenai Formation is from 640 to 980 feet thick

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kbk

Unit Name: BLACKLEAF AND KOOTENAI FORMATIONS (LOWER CRETACEOUS)

Map Unit Description

Shown where parts of both formations are present but are too thin to map separately

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Kmp

Unit Name: MOUNT PABLO FORMATION (LOWER CRETACEOUS)

Map Unit Description

Nonmarine limestone, mudstone, and sandstone in upper part, mudstone interbedded with sandstone in middle part, and sandstone and conglomerate in lower part (Mudge and Earhart, 1983). The Mount Pablo Formation is about 177 feet thick (Mudge and Earhart, 1991)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: KJm

Unit Name: MOUNT PABLO FORMATION, MORRISON FORMATION, AND ELLIS GROUP (LOWER CRETACEOUS AND UPPER AND MIDDLE JURASSIC)

Map Unit Description

Upper Jurassic Morrison Formation is not mapped separately; it is only about 16 feet thick southwest of the mapped area (Mudge and Earhart, 1991). Much of the Morrison Formation was removed by erosion prior to Cretaceous sedimentation

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Je

Unit Name: ELLIS GROUP (UPPER AND MIDDLE JURASSIC)

Map Unit Description

The Ellis Group is divided into three formations (not mapped) which are, in descending order, the Swift, Rierdon, and Sawtooth Formations. They have a combined thickness of about 460 feet in the vicinity of Swift Reservoir (Cobban, 1945). The Swift Formation consists of very fine-grained to fine-grained sandstone and shale. The Rierdon Formation consists mostly of gray shale with thin beds of hard limestone. The Sawtooth Formation consists of siltstone, gray shale, and very fine-grained sandstone (Mudge and Earhart, 1991)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Mm

Unit Name: MADISON GROUP (MISSISSIPPIAN)

Map Unit Description

The Madison Group is divided into two formations; the upper formation is the Castle Reef Dolomite and the lower is the Allan Mountain Limestone (Mudge and Earhart, 1991). It consists mostly of limestone and dolomite. The Madison Group is about 1,345 feet thick in the Birch Creek Basin south of Swift Reservoir

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Du

Unit Name: THREE FORKS, JEFFERSON, AND MAYWOOD FORMATIONS, UNDIVIDED (UPPER AND MIDDLE DEVONIAN)

Map Unit Description

These formations consist mainly of limestone and dolomite and have a combined thickness of about 985 feet (Mudge and Earhart, 1991)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Cu

Unit Name: CAMBRIAN ROCKS

Map Unit Description

Consist of as much as 490 feet of dolomite, shale, and limestone (Mudge and Earhart, 1991)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_bed_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation bedrock geology

Map Unit Symbol: Yu

Unit Name: MIDDLE PROTEROZOIC ROCKS

Map Unit Description

Proterozoic rocks include two formations, the Greyson Formation and the Altyn Formations, and they are present only on mountain peaks above the Lewis Thrust Fault. The Greyson Formation consists mainly of argillite and siltite, whereas the Altyn Formation consists mainly of limestone and dolomite

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qal

Unit Name: ALLUVIUM (HOLOCENE and PLEISTOCENE)

Map Unit Description

Unconsolidated gravel, sand, silt, and clay beneath flood plains of major streams. Includes some outwash gravel and sand from piedmont glaciers. Alluvium is thin beneath most flood plains but is thick in some fan deposits. Thick deposits are present at St. Mary, where alluvial fans from Divide and Wild Creeks filled the glacial channel now occupied by Upper and Lower St. Mary Lakes. Drill holes in the St. Mary area penetrated as much as 188 feet of alluvium and lake sediment without reaching bedrock (Alden, 1932)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qlt

Unit Name: LANDSLIDE DEPOSITS AND TILL (QUATERNARY)

Map Unit Description

Areas of landslides and glacial till with many rock outcrops. Much of this area formerly was covered by piedmont glaciers. Where present, till generally is a thin veneer overlying bedrock. Steeper slopes are mostly characterized by discontinuous landslide deposits and rock outcrops. Landslide deposits largely consist of rock debris or retransported surficial deposits

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qtp

Unit Name: TILL DEPOSITED BY PIEDMONT GLACIERS (PLEISTOCENE--WISCONSIN STAGE)

Map Unit Description

Gravelly to clayey till in ground moraine and in terminal, recessional, and lateral moraines. Includes gravel deposits in narrow buried channels and meltwater channels. Thickness of till typically is from 1 to 15 feet, although in many areas thickness may be more than 50 feet. During the Wisconsin Stage of glaciation, moraines were formed by glaciers flowing eastward and northeastward from the high mountains onto the plains along the valleys of St. Mary River, Cut Bank Creek, Two Medicine River, and Birch Creek. Includes areas of landslide deposits on steep slopes east of St. Mary River and in upper Cut Bank Creek basin

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qlb

Unit Name: DISCONTINUOUS LAKE DEPOSITS (PLEISTOCENE)

Map Unit Description

Glacial lake deposits include laminated clay and silt, some stratified sand and gravel, and scattered granitic pebbles, cobbles, and boulders. More than 30 feet of silt deposited in glacial Lake Cut Bank is exposed in some coulees (Alden, 1932). In much of the area formerly occupied by glacial lakes, lake deposits are thin or have been removed by erosion

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qgo

Unit Name: NONGLACIAL GRAVEL AND OUTWASH (PLEISTOCENE)

Map Unit Description

Chiefly coarse gravel and cobbles in sand matrix. Includes nonglacial fluvial terrace and pediment gravel deposits that were reworked by glacial meltwater. Also includes sand and gravel deposited as outwash from melting glaciers. Thickness of the sand and gravel locally is more than 38 feet

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qtc

Unit Name: TILL DEPOSITED BY CONTINENTAL ICE SHEETS (PLEISTOCENE)

Map Unit Description

Pebbly clay loam or loam till containing numerous granitic and metamorphic pebbles, cobbles, and boulders from Canada. The till is 15 to 70 feet thick in lower Birch Creek and Two Medicine River drainage basins and about 50 feet thick along the St. Mary River at the International Boundary. Includes till units deposited during the late Wisconsin and Illinoisan glaciations

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Qd

Unit Name: DRIFT OF PRE-WISCONSIN MOUNTAIN GLACIERS (PLEISTOCENE AND POSSIBLY PLIOCENE)

Map Unit Description

Consists mostly of unsorted subrounded to subangular gravel, cobbles, and boulders with minor amounts of sand, silt, and clay. The drift includes multiple till beds in some locations (Richmond, 1986). In places, the drift is cemented by calcium carbonate

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: QTg

Unit Name: TERRACE AND PEDIMENT GRAVEL (PLEISTOCENE AND PLIOCENE)

Map Unit Description

Chiefly coarse gravel and rounded to subangular cobbles with some sand and silt. Gravel and cobbles are mostly quartzite and argillite clasts derived from mountains to the west. Includes some glacial outwash overlying pediment gravel near Fox Creek and Starr School. The deposits typically overlie planated erosional surfaces cut into bedrock. The terrace and pediment surfaces were mapped as number 3 benches by Alden (1932). Terrace and pediment gravel typically is from 5 to 40 feet thick

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: Tg2-Tg1

Unit Name: OLDER GRAVEL (PLIOCENE)

Map Unit Description

Coarse gravel and rounded cobbles with sand and silt. Gravel and cobbles are mostly quartzite and argillite clasts derived from the mountains to the west. The sediments were deposited by braided streams on planated erosion surfaces and, as a result of topographic inversion, now are erosional remnants on high ridge tops and on broad northeastward sloping pediment surfaces. The highest and oldest gravel (Tg1) generally is from 5 to 20 feet thick and the second highest gravel (Tg2) is from 5 to 40 feet thick. The Tg1 and Tg2 gravel deposits are the deposits of the number 1 and 2 benches as mapped by Alden (1932)

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Blkfeet_sur_rect

Map Title

Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana

Map name: Blackfeet Reservation surfical deposits

Map Unit Symbol: BR

Unit Name: BEDROCK, UNDIVIDED

Map Unit Description

Rock outcrops or bedrock with a thin cover of soil, colluvium, or residuum

Map Citation

Cannon, M. R., 1996, Geology and ground-water resources of the Blackfeet Indian Reservation, northwestern Montana: U.S. Geological Survey Hydrologic Investigations Series, HA-0737, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Qa

Unit Name: Alluvial deposits (Quaternary)

Map Unit Description

Includes modern alluvium, and alluvial-fan and glacial-outwash deposits of post-Pinedale glaciation, as thick as 15 m. Gravel, silt, and brownish-stained clay deposits, about 15 m thick, fill an ancient northerly trending channel of Twin Creek, northeast of Horse Ridge; the degree of weathering and soil formation indicate they are older than the glaciation in the area and may be as old as late Tertiary

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Qg

Unit Name: Glacial deposits (Quaternary)

Map Unit Description

Glacial outwash and till of Pinedale and younger glaciations. Present along the sides of the South Fork Flathead River from Big Prairie north to Damnation Creek. Younger glaciations extended a short distance down valley from cirques and deposited glacial till along valley sides and outwash gravels on valley floors. Remaining glaciers are Grant Glacier at Mount Grant and Stanton Glacier at Great Northern Mountain in the northwestern part of the map area. Probably as thick as 155 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Qc

Unit Name: Colluvial deposits (Quaternary)

Map Unit Description

Mantle parts of other surficial deposits on most hillsides and talus deposits along base of cliffs. Probably include some glacial and alluvial deposits. Thickness as much as 60 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Qls

Unit Name: Landslide deposits (Quaternary)

Map Unit Description

Rock debris widespread, but only the larger deposits are mapped. Most are formed from Cambrian rocks, but a few are Precambrian rocks. The largest active landslide (about 10.5 km long and 3.2 km wide) contains both younger Precambrian and Cambrian rocks and is on the southwest slope of Dean Ridge. Thickness may be as much as 245 m to 300 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Tu

Unit Name: Tertiary rocks (upper Miocene? to upper Eocene)

Map Unit Description

Sedimentary rocks locally in stream banks of South Fork Flathead River and Twin Creek (Mudge and Earhart, 1978). Near mouth of Burnt Creek, a conglomerate, interbedded with medium to coarse sand, locally fills small channels and is overlain by about 60 m of gray-brown sandstone. The beds strike N. 55º W. and dip 32º NE. The conglomerate consists of rounded fragments of Paleozoic and Belt-age rocks as much as 15 cm across. Fragments of conglomerate are present in stream gravel bars in many tributaries of the Flathead River from Bartlett Creek north to Damnation Creek.

Between Burnt and Bartlett Creeks there is very coarse boulder-bearing gravel overlain by siltstone and interbedded granular gravel; the beds strike N. 30º W., and dip 25º NE. There is also a yellowish-gray silt bed about 1.2 m thick which overlies a 1.2 m red-brown siltstone. A bed in the yellowish-gray silt, 15 cm thick, contains four 2.5 cm beds of coaly siltstone.

On Twin Creek there is a conglomerate with a thin travertine deposit. Conglomerate is gray, heavily iron stained, and consists of sub rounded to rounded fragments of carbonate rocks

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: TKi

Unit Name: Sills (early Tertiary or latest Cretaceous)

Map Unit Description

Trachyandesite sills intruded Lower Cretaceous rocks in the upper reaches of the Middle Fork Flathead River, on both sides of North Fork Sun River, and from Bear Creek south to the south boundary of the Renshaw Mountain addition. The sills in most of the Sun River drainage and Renshaw Mountain addition are discussed by Mudge (1972).

Although the sills mostly intruded strata of the lower sandstone beds of the Flood Member of the Blackleaf Formation, they are seen up section in the Vaughn Member at Bridge Creek. Farther north at Headquarters Creek sills gradually cut down section into the Kootenai Formation. The sills are fine grained, gray brown, and locally near margin contain thin bands of rhyolite that are parallel to the contact with adjacent sedimentary rocks. The sills are as thick as 185 m (Mudge, 1972). In most places the adjacent strata are slightly altered for a distance of only about 3 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ktm

Unit Name: Two Medicine Formation (Upper Cretaceous)

Map Unit Description

Exposed in many places along the North Fork Sun River. Only the lowermost 609 m of the nonmarine strata are present in the map area. Consists of gray to green mudstone interbedded with poorly sorted, very coarse grained sandstone, some thick maroon and purple mudstone beds. Lower part of formation contains lenses of coal and carbonaceous shale (Mudge, 1966a) and at the junctions of both Lick and Moose Creeks with the North Fork Sun River a conglomerate bed about 0.6 m thick

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Kv

Unit Name: Virgelle Sandstone (Upper Cretaceous)

Map Unit Description

Consists of moderately thick beds of light-gray, cross-bedded, well-sorted, fine- to medium-grained marine sandstone. In the northern exposures, near Gates Park, the upper beds contain dark-gray-brown titaniferous sandstone. The uppermost ilmenite-bearing unit at the top of the Virgelle is about 2.4 m thick. Another zone that contains less ilmenite is a few meters below the upper zone. Thickness about 60 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Kt

Unit Name: Telegraph Creek Formation (Upper Cretaceous)

Map Unit Description

Exposed in the North Fork of the Sun River, is a marine transitional unit between the underlying Marias River Shale (Km) and the overlying Virgelle Sandstone (Kv). Mainly beds of dark-gray sandstone and some sandy shale that are cross-bedded, ripple marked, and contain mudcracks. Thickness about 167 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Km

Unit Name: Marias River Shale (Upper Cretaceous)

Map Unit Description

Mostly dark gray marine mudstone with some very thin beds of sandstone and bentonite exposed in stream banks of the North and South Forks of the Sun River (Mudge, 1972). Pelecypods and ammonites are common. Total thickness about 520 m (Mudge, 1966b). Divided into four members by Cobban and others (1959, 1976), which are in descending order, the Kevin, Ferdig, Cone, and Floweree Members. The Kevin Member is about 305 m of dark-gray calcareous, locally fossiliferous mudstone with abundant bentonite beds as thick as 0.5 m. The Ferdig Member is about 107 m thick, and consists of gray noncalcareous mudstone and sandstone in a clayey matrix. In the South Fork Sun River drainage, the upper part is mostly gray sandstone with many shale partings, abundant organic trails and burrows, and some pelecypods. The Cone Member is about 30.5 m thick, and consists of fossiliferous thin beds of calcarenite that have a petroliferous odor. A thick bentonite bed (about 2 m) is in the upper part of the Cone in a stream bank of the South Fork of the Sun River, about 1 km northeast of Bear Creek. The Floweree Member is noncalcareous dark-gray shale 9 m to 12 m thick

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Kb

Unit Name: Blackleaf Formation (Upper and Lower Cretaceous)

Map Unit Description

Consists of three members, which are, in descending order, the Vaughn, Taft Hill, and Flood Members. Exposed in the valley of the North and South Forks Sun River and in the upper drainages of the Middle Fork Flathead River. The Blackleaf Formation ranges in thickness from about 203 m in the southeast to about 260 m in the north and 488 m in the South Fork Sun River area. The Bootlegger Member (uppermost member of the Blackleaf on the Sweetgrass arch) is not present in the map area. The nonmarine Vaughn Member ranges in thickness from 92 m to possibly as much as 214 m and consists mainly of greenish-gray mudstone with thin beds of sandstone, bentonitic shale, and bentonite; bentonite beds are as thick as 38 cm. Locally the Vaughn Member contains channel fillings of conglomerate and sandstone; near Teton Pass, above a tributary south of upper Bowl Creek contains beds of coal and bituminous shale. The marine Taft Hill Member, as thick as 110 m, consists of fossiliferous gray mudstone with interbeds of fine-grained sandstone. Iron-rich manganese nodules, in pods as thick as 0.6 m, are located about 1.6 km north of Sheep Mountain. Only the lower part of the Taft Hill is present in the northern part of the map area. The upper part of the member appears to interfinger with the nonmarine clastics typical of the Vaughn Member. The marine Flood Member, 41 m to 92 m thick consists of thin sandstone beds in the lower part and a relatively thick sandstone bed in the upper part, separated by thick dark-gray shale that commonly contains coarsely crystalline phosphatic nodules as much as 13 cm across

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Mainly maroon and grayish-green nonmarine mudstone with numerous lenticular, poorly sorted, greenish-gray sandstone beds and with local channels filled with grayish -green sandstone and conglomeratic sandstone. Very thin lentils of magnetite-bearing sandstone in Deep Creek; elsewhere magnetite is commonly scattered through the sandstone beds. The basal unit of the Kootenai present locally is the well-indurated poorly sorted light-gray Sunburst Sandstone Member which is as thick as 15 m. Formation ranges in thickness from 198 m to more than 305 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: KJ

Unit Name: Cretaceous and Jurassic Rocks

Map Unit Description

The Lower Cretaceous rocks comprise the nonmarine Mount Pablo Formation whereas the Jurassic rocks comprise the nonmarine Morrison Formation (Upper Jurassic) and the marine Ellis Group (Upper and Middle Jurassic). The Mount Pablo Formation (Mudge and Rice, 1982) comprises most of the former western facies of the Morrison in the eastern part of the map area as described by Mudge (1972); Mount Pablo contains the Cut Bank Sandstone Member and strata described by Cobban (1945) that are equivalent to the lowermost part of the Moulton Member of the Kootenai Formation in the subsurface in the Cut Bank area. The Mount Pablo Formation contains gray to gray-green mudstone and shale in the upper part with a prominent light-gray thick-bedded limestone sequence, 6 m to 9 m thick. The middle part contains mostly bright reddish brown mudstone and locally grayish-green and gray mudstone and sandstone. A sandstone unit, locally referred as the "Upper Cut Bank Sand," lies about 12 m to 18 m above the basal Cut Bank Sandstone Member; it is as much as 6 m of coarse- to fine-grained, medium-gray to gray-brown cross-bedded sandstone. The Cut Bank Sandstone Member, at the base of the Mount Pablo, ranges in thickness from about 9 m to 30 m. It is very coarse to medium grained and cross-bedded, and contains some wood fragments. Conglomerate is common at the base of the member as well as at various other horizons; it has well-rounded pebbles of black chert, some limonitic nodules, silicified limestone, and locally some pebbles of Precambrian Belt Supergroup rocks in a coarse-grained sand matrix. The Mount Pablo Formation ranges in thickness from 45 m to 60 m and rests unconformably on the Morrison Formation.

The Morrison Formation consists of gray-green to olive-drab mudstone with some thin beds of very fine grained sandstone. Nodules of gray-brown limestone are common and in most places thin tenses of gray-brown limestone are in the upper part. Ranges in thickness from about 2 m to more than 33 m. Variation in thickness is a result of pre-Mount Pablo Formation erosion.*The Ellis Group is divided into three formations by Cobban (1945) which are, in descending order, the Swift, Rierdon, and Sawtooth. The Swift Formation (Upper Jurassic) consists of a thinly bedded grayish-brown sandstone in the upper part, and a dark-gray shale member in the lower part; it ranges in thickness from 30 m to 46 m. The Rierdon Formation (Middle Jurassic) consists of beds of gray calcareous claystone and siltstone with many thin beds of limestone and numerous barite nodules as much as 15 cm across; numerous pelecypods and ammonites are common; it ranges in thickness from 30 m to 46 m. The Sawtooth Formation (Middle Jurassic) consists of an upper yellowish-gray calcareous fossiliferous siltstone member, a middle dark-gray shale member, and a lower gray fine-grained sandstone member. Phosphate pellets are common in the upper siltstone member. The shale member varies considerably in thickness from 5 m in the southeast to more than 77 m in the north. In many places, such as in the upper reaches of Blacktail Gulch, Deep Creek, and Biggs Creek, the lower sandstone member is absent and the shale member rests unconformably on Mississippian rocks. In these areas the lower part of the shale member contains a heavily iron-impregnated zone which ranges in thickness from a few centimeters to more than 1.2 m. The Sawtooth Formation ranges in thickness from 9.1 m to 68.9 m. The Sawtooth rests unconformably on Mississippian carbonate rocks

Map Citation

Geologic map unit descriptions

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Mu

Unit Name: Madison Group (Upper and Lower Mississippian)

Map Unit Description

East of the map area, divided into two formations and five members by Mudge and others (1962) but mapped as a single unit in the map area. The youngest formation, the Castle Reef Dolomite, is divided into two members; the oldest formation, the Allan Mountain Limestone, is divided into three members. The Mississippian rocks range in thickness from 275 m to 519 m, attaining the maximum thickness at Cabin Creek.

The Castle Reef (Upper and Lower Mississippian) is mostly light gray, thick-bedded fine- to coarse-crystalline dolomite with some dolomitic limestone and limestone in the lower part. The formation contains some corals and brachiopods. Coarsely crystalline beds with abundant crinoidal debris are at various horizons. Lenses and nodules of chert are common. The upper Sun River Member consists of light-gray, thin to thick beds of very fine to coarse-crystalline dolomite. The lower member consists mostly of dolomite and some limestone in the western outcrop; limestone beds increase in abundance to the east. The Castle Reef ranges in thickness from 77 m to 300 m.

The Allan Mountain (Lower Mississippian) is mainly medium to dark gray fossiliferous limestone with some dolomitic limestone. It ranges in thickness from 163 m to 199 m. The upper member consists of thin- to thick-bedded limestone, magnesium limestone, and dolomitic limestone. Some beds are coarsely crystalline porous encrinites, but these beds are more abundant at Slategoat Mountain than in the Sawtooth Range to the east. The middle member is primarily a thin-bedded limestone in the western part of the Sawtooth Range, but contains some dolomitic limestone in the eastern part; characteristically contains lenses and nodules of chert 2.5-10 cm thick that are 15-25 cm apart. The lower member, which is absent as a result of thrust faulting in many of the eastern ridges, consists of very thinly bedded argillaceous dolomitic limestone and shale

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Du

Unit Name: Devonian rocks

Map Unit Description

Widespread in the eastern and central parts of the northerly trending mountain ridges in the eastern proposed additions and adjacent parts of the Bob Marshall and Great Bear Wildernesses, and in the valley of the South Fork Flathead River. The Devonian rocks range in thickness from about 290 m in the eastern outcrop area (Mudge, 1972) to more than 460 m at Lone Butte in the western outcrop area (Sloss and Laird, 1946); thickness about 460 m at Slategoat Mountain.

The Three Forks Formation (Upper Devonian) consists of beds of evaporite solution breccia (Sloss and Laird, 1945; Mudge, 1972) and some interbedded dolomite. In the western outcrop area the formation is all breccia and contains some fragments from the overlying Mississippian strata. The amount of breccia is less in the eastern outcrop area where thin beds of dolomite comprise most of the section. The breccia consists of angular blocks of pale-yellowish-brown dolomite and dolomitic limestone; locally very porous. The Three Forks ranges in thickness from about 15 m in the eastern outcrop area to about 185 m in the western outcrop area.

The Jefferson Formation (Upper Devonian) contains the Birdbear Member at the top and a lower unnamed member. The Birdbear consists mostly of pale-yellowish-brown, very fine to finely crystalline dolomite beds that pinches and swells. The lower member consists mostly of thin to thick beds of grayish-brown limestone, dolomitic limestone, and dolomite. Locally it contains one or more beds of evaporite solution breccia. Corals and brachiopods are at various horizons. Ranges in thickness from about 245 m in the eastern and western exposures to 190 m in the central exposure at Slategoat Mountain.

The Maywood Formation (Upper and Middle Devonian) is divisible into two unnamed members (Mudge, 1972). The upper member consists of thinly bedded limestone and dolomitic limestone. Mostly grayish brown, mottled to pale yellowish orange to yellowish gray on weathered beds (Mudge, 1972). The lower member is mostly greenish gray dolomitic mudstone with some maroon beds. Locally there is a coarse-grained sandstone at the base. The Maywood ranges in thickness from about 30 m in the eastern outcrop to more than 115 m in the western outcrop. The Maywood rests unconformably on Cambrian carbonate rocks

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Cu

Unit Name: Cambrian rocks

Map Unit Description

The Cambrian rocks have been divided into nine formations by Deiss (1939) which are, in descending order, the Devils Glen Dolomite, Switchback Shale, Steamboat Limestone, Pentagon Shale, Pogoda [sic] Limestone, Dearborn Limestone, Damnation Limestone, Gordon Shale, and Flathead Sandstone. The limestone formations contain considerable calcareous mudstone in the east but mostly limestone in the west. The Cambrian rocks thicken to the west and southwest from about 495 m at Pentagon Mountain to about 710 m at Kid Mountain (Deiss, 1939).

The Devils Glen Dolomite (Upper Cambrian) is thick-bedded light-gray dolomite, and in most places forms a prominent, light-gray cliff. Ranges in thickness from about 32 m at Pagoda Mountain (Deiss, 1939) in the west to as much as 167 m at Nineteen Mountain (Mudge, 1972) in the southeast and about 60 m to the north (Mudge and Earhart, 1983).

The Switchback Shale (Upper and Middle Cambrian) is mostly calcareous, greenish-gray thinly laminated clayey shale with thin local interbeds of dolomite, limestone, sandstone, and conglomerate in the eastern outcrop. Locally some brachiopods. In the west contains considerable limestone. Ranges in thickness from about 35 m at Pentagon Mountain to 23 m at Pagoda Mountain (Deiss, 1939), 77 m at Nineteen Mountain, and 82 m at Arsenic Mountain (Mudge, 1972; Mudge and Earhart, 1983).

The Steamboat Limestone (Middle Cambrian) consists of two parts in the western outcrop, a lower shaly interval and a thicker upper limestone and dolomite interval (Deiss, 1939; Mudge, 1972); farther west in the Twin Creek area, it is mostly limestone (Johns, 1970). In the eastern outcrop, in the Sawtooth Range, it is about equal parts of alternating limestone and dolomite and calcareous shale. The carbonates are hard nodular, dark-gray to yellowish-brown, thinly bedded, finely crystalline with nodules and lentils of dark-yellowish-orange, limey siltstone. Thin beds of intraformational conglomerate are locally present. The mudstone units are mainly grayish green, noncalcareous, clayey shale with interbedded calcareous siltstone and claystone. Some trilobites and brachiopods. Thickness 92 m in Dearborn Canyon, 66 m at Pentagon Mountain, 81 m at Pagoda Mountain (Deiss. 1939), and 67 m at Nineteen Mountain (Mudge, 1972).

The Pentagon Shale (Middle Cambrian) is present as a clastic wedge that extends from about 22 km south of Pentagon Mountain (Deiss, 1939) to about 7 km north of Pentagon Mountain. It is a calcareous gray to tan-gray, thick-bedded fossiliferous shale with some platy, blue-gray argillaceous limestone in upper part (Deiss, 1939; Mudge and Earhart, 1983). Thickness as much as 88 m.

The Pagoda Limestone (Middle Cambrian) consists of an upper limestone member and a lower shale member. In the Twin Creek area, Johns (1970) noted that the Pagoda contained much less shale than it does to the east in the southern part of the Lewis and Clark Range. The upper member is finely crystalline, pale-yellowish-brown, very thin bedded limestone and thin- to thick-bedded dolomitic limestone and dolomite; forms a very prominent cliff. The lower member consists of grayish-green thinly laminated to nodular, clay shale with some gray-brown limestone and minor sandstone; fossils are locally present in limestone beds. Thickens to the south and west, from about 53 m along the Continental Divide in the central part of the map area to about 107 m at Pagoda Mountain, and 111 m near Prairie Reef (Deiss, 1939).

The Dearborn Limestone (Middle Cambrian) consists of an upper, finely crystalline, pale-yellowish-brown to gray, very thinly and irregularly bedded limestone unit and a lower mudstone unit of gray to gray-green, clayey shale with some sandy shale and trilobites (Mudge and Earhart, 1983). In the Twin Creek area, contains much less shale than it does to the east in the southern part of the Lewis and Clark Range (Johns, 1970). Ranges in thickness from 67 m to 106 m and averages about 90 m (Deiss, 1939).

The Damnation Limestone (Middle Cambrian) consists of thinly bedded, finely crystalline, medium- to dark-gray dolomitic limestone and limestone with laminae of grayish-orange to yellowish-gray siltstone. Mottled, grayish-orange limestone beds (Mudge and Earhart, 1983). Trilobites in lower part of formation (Deiss, 1939). Thickness 31 m on the Continental Divide near Cliff Mountain, thickening northward to 58 m at Pentagon Mountain and southward to 45 m at Prairie Reef (Deiss, 1939).

The Gordon Shale (Middle Cambrian) is widespread in the map area. In the east it is mainly a dark-gray to gray-brown, very thinly laminated shale with a greenish tint. It contains many thin beds of sandstone and some beds of limestone. In places, limestone contains glauconite, algal structures, fossil fragments, limestone chips, and quartz grains (Mudge, 1972; Mudge and Earhart, 1983). Organic burrows and trails are common in the lower beds and trilobites are in the upper strata (Deiss, 1939). To the west, at Whitcomb Peak, the lower part is green fissile shale that weathers pale green. Near the center of the formation there is a 6 m lens of reddish quartzite which is overlain by green and maroon fissile shale; shale has several thin limestone lenses, of which one contains brachiopod and trilobite fragments (Johns 1970). Thickens southward and westward from 43 m, at Pentagon Mountain to about 90 m along the Continental Divide near Cliff Mountain; farther southward it thins to 60 m at Prairie Reef (Deiss, 1939). From Pentagon Mountain thickens northwest to 105 m at Whitcomb Peak (Johns, 1970). This above average thickness of the formation may be a result of local thickening from repetition through faulting (Johns, 1970).

The Flathead Sandstone (Middle Cambrian) consists of thin- to thick-bedded, noncalcareous, yellowish-gray, poorly sorted, poorly indurated, fine- to coarse-grained, cross-bedded quartzose sandstone with scattered quartz pebbles. Commonly contains organic trails and burrows and specks of brown hematite (Mudge and Earhart, 1983). Ranges in thickness from 10 m to 35 m, and rests unconformably on rocks of the Belt Supergroup

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Zd

Unit Name: Diorite (Late Proterozoic)

Map Unit Description

Mostly diorite and quartz diorite with minor diorite-gabbro and monzonite sills and locally dikes. Dark gray, weathers grayish brown. Dated at 750±5 Ma by K-Ar method (J.D. Obradovich, oral commun., 1966; Obradovich and Peterman, 1968). Widespread throughout map area (Mudge and Earhart, 1983)

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ygr

Unit Name: Garnet Range Formation (Middle Proterozoic)

Map Unit Description

Underlies Cambrian rocks on the west side of the South Fork Flathead River and Danaher Creek, on the east side of South Fork Flathead River between Hodag and Lower Twin Creeks, and on the west side of the ridge that extends north from Twin Peaks through Rampart and Pagoda Mountains to Dean Ridge and Gunsight Peak. To the east locally exposed near the Continental Divide from Wall Creek Cliffs south to White River Pass. Elsewhere in the eastern outcrop it was eroded prior to Middle Cambrian sedimentation. Consists of pale-olive to medium-gray thin beds of fine-grained micaceous quartzite and interbedded olive-gray thin- to thick-bedded micaceous siltite. Beds of siltite appear to be more abundant than beds of quartzite, except along the Scapegoat Wilderness boundary where quartzite is more abundant. Most beds are speckled with hematite and limonite. Crossbeds, flute casts, ripple marks, and minute channel-fill features are common. At the Camp Creek section is 250 m thick and at the Brown Sandstone Peak section is about 250 m thick (Sommers, 1966). Elsewhere in the map area is as thick as 275 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ym

Unit Name: McNamara Formation (Middle Proterozoic)

Map Unit Description

Crops out on ridges on both sides of the South Fork Flathead River and Danaher Creek, and along the central part of the map area extending north from Trident Peaks to Capitol Mountain. Eroded prior to Middle Cambrian sedimentation in all of the eastern outcrop area, except between Bear Creek and the southern boundary of the map area. In the southern part of the map area, divisible into two unnamed members, an upper dominantly reddish brown fine-grained, micaceous quartzite, and a lower dominantly grayish-green siltite (Sommers, 1966; Mudge and others, 1974). These units are distinctive north to about Helen Mountain, but farther north and west the entire formation is dominantly a grayish-green siltite. The change in facies is accompanied by a thickening of the formation to the north. The lower member also contains some thin beds of argillite and quartzite and locally some reddish-gray siltite. The quartzite beds are fine to medium grained, micaceous and thin bedded with ripple marks; minute cross-bedding; load casts common. Thin beds of glauconitic sandstone are common. Locally a greenish-gray stromatolitic limestone and edgewise conglomerate is in the upper part. In the northern part of the map area, the formation is mostly thin bedded, grayish-green siltite with some thin beds of greenish-gray and reddish-brown quartzite. Sedimentary structures and glauconite are less common than in the southern outcrop. Thickness 810 m in the Camp Creek area thickening to 935 m at Brown Sandstone Peak 8 km to the north (Sommers, 1966). Formation thickens uniformly to the north to a thickness of about 1,650 m at Pivot Mountain

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ybo

Unit Name: Bonner Quartzite (Middle Proterozoic)

Map Unit Description

Distinctive unit that forms resistant hillside ledges and smooth rounded knobs on ridges. Exposed on both sides of the South Fork Flathead River and Danaher Creek, along both sides of the Continental Divide, and at Red Plume Mountain. Absent in the area between Lookout Mountain and the upper reaches of Clark Creek in the eastern outcrop area where it was eroded prior to Middle Cambrian sedimentation. Consists mainly of pink, pale-red, and pinkish-gray, poorly sorted quartzite in beds that range in thickness from 30 cm to 75 cm. Composed of rounded to subrounded fine- to medium-grained quartz with minor amounts of feldspar. Many beds contain cross-laminations and some ripple marks. Locally some angular fragments of red argillite. Ranges in thickness from 235 m to 245 m along the eastern and northern outcrop area. Thickness on the east side of the Swan Range is 350 m and in the Camp Creek section is 385 m

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation (Middle Proterozoic)

Map Unit Description

Mostly bright reddish brown thinly laminated micaceous siltite, argillite, and thin- to thick-bedded quartzite. Grayish-green siltite with local interbedded dark-gray fissile shale is widespread in the upper part of the formation. In the area south of Sunburst Lake, numerous grayish-green beds are in the lower part of the formation. A distinctive thick sequence of quartzite beds in the middle part of the formation in the southeastern part of the area diminishes as a prominent unit to the north; in Camp Creek area, Sommers (1966) noted 170 m thick sequence of poorly sorted, fine- to coarse-grained, pinkish-gray to reddish-brown quartzite beds less than 1 m thick. Elsewhere the quartzite beds are fine to medium grained. Minute cross-laminations, ripple marks, and mud crack fillings common. In many places beds contain angular fragments of red argillite; some load casts, rill marks, and raindrop impressions. In the eastern outcrop area, glauconite is common in the lower beds and locally present in the upper beds. In the area north of Glenn Creek, the lower part of the formation contains light-gray beds of stromatolitic and oolitic limestone. Salt-crystal casts are widespread in the upper part of the formation, beneath the widespread greenish-gray unit. To the northwest the salt-crystal casts are at various horizons throughout the formation. Thickness increases from east to west; about 555 m thick in the eastern outcrop, about 835 m in the central outcrop at Camp Creek, and about 2,180 m in the Swan Range

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yan

Unit Name: Sill (Middle Proterozoic)

Map Unit Description

A diabase sill of Middle Proterozoic age crops out only in the northern part of the Flathead Range. Lithology is like that of the sill and lava of the Purcell Basalt in Glacier National Park, which has been dated 1075 Ma by Hunt (1962). The lava is in the lower part of the Shepard Formation in the Park. At the north end of the Flathead Range, the sill intruded the uppermost beds of the Spokane Formation. Because of poor exposure, thickness not determined

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ysh

Unit Name: Shepard Formation (Middle Proterozoic)

Map Unit Description

Mostly micaceous siltite, dolomitic siltite, and some silty limestone and argillite. The clastic beds are mostly greenish gray that weather grayish yellow. One or more maroon beds are in the lower half of the formation. In the eastern outcrop an edgewise conglomerate about 15 cm thick is near the base of the formation; elsewhere a stromatolitic limestone occurs near the base and locally at other stratigraphic horizons in the formation. In the northern outcrop, Childers (1963) noted distinctive beds of edgewise micrite-pebble conglomerate and calcareous siltstone breccia in the upper part of the formation. Glauconite is widespread in sandstone lentils in the upper half of the Shepard in the eastern outcrop (Mudge, 1972) and sparse in strata to the west. Contains abundant ripple marks, minute cross-laminations, load casts, and mud cracks. Thickness 250 m in the eastern outcrop and 900 m in the western outcrop

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ysn

Unit Name: Snowslip Formation (Middle Proterozoic)

Map Unit Description

Mostly pale red to reddish brown and greenish gray beds of argillite, siltite, and some thin beds of very fine to fine-grained quartzite. South of Glacier National Park, Childers (1963) describes as mostly green and reddish quartzites and argillites with a basal unit of sandy argillite breccia. The lower part of the formation contains a stromatolite zone called Collenia undoso zone 2 by Rezak (1957). Farther west and southwest the lower part of the formation locally contains carbonate beds, some of which are oolitic and stromatolitic, interbedded with grayish-green argillite and siltite. Carbonate beds are less common in the lower part of the Snowslip in the Swan Range, In the central, eastern, and southern outcrop areas the strata are mostly pale red to reddish brown. The quartzites are thin to very thin bedded, and very fine to fine grained. Stromatolitic and oolitic limestone, and locally flat pebble conglomerate occur at various horizons. Cross-bedding, minute laminae, ripple marks, and mud cracks are common. Thickens uniformly to the west from the eastern outcrop; about 215 m thick in the east, 680 m thick in the Camp Creek section (Sommers, 1966), and 1,660 m thick in the Swan Range to the west. Thickness about 975 m in the northwestern part of the map area

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yh

Unit Name: Helena Formation (Middle Proterozoic)

Map Unit Description

Mainly thin to thick bedded limestone, dolomite, and calcitic dolomite with some interbeds of dolomitic siltite and argillite. The clastic beds are gray to dark gray and are more widespread in the upper and lower parts of the formation. The carbonate beds are light to medium gray and weather yellowish gray to grayish orange. Carbonate beds as thick as 1.8 m in the upper part contain stromatolites, oolites, or edgewise conglomerate; molar tooth structures which consist of vertical ribbons, blobs, horizontal mats, lenses, and pods that differentially weather to form crenulating patterns are common (O'Connor, 1967). Thickens north, west, and south from the southwestern part of the Sun River area where thickness is about 205 m (Mudge, 1972); thickens to about 1,660 m in the southern part of the Scapegoat Wilderness (Mudge and others, 1974), to about 2,865 m in the Swan Range, and to 1,985 m in the Flathead Range

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yes

Unit Name: Empire and Spokane Formations (Middle Proterozoic)

Map Unit Description

Undivided only in eastern and southeastern outcrops where the Empire is locally absent or too thin to map as separate unit

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ye

Unit Name: Empire Formation (Middle Proterozoic)

Map Unit Description

Transitional unit between the Helena and Spokane Formations. Mainly a greenish-gray calcareous to dolomitic argillite with some purplish-weathering dark-red siltite beds. Contains some interbeds of dolomite, quartzite, and locally stromatolitic and oolitic carbonate rock. Quartzites are poorly sorted, very fine to medium grained, and locally carbonate cemented. In the northwestern part of the map area the quartzite bed is thick bedded, very light gray to almost white, and partly recrystallized units. As thick as 180 m in the northwestern exposures, and as thick as 610 m in the southern part of the Scapegoat Wilderness (Mudqe and others, 1974)

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Ys

Unit Name: Spokane Formation (Middle Proterozoic)

Map Unit Description

Consists mostly of pale-purplish-red and grayish-red strata with some greenish-gray interbeds. Mostly thinly bedded siltite with some argillite and thin- to thick-bedded quartzites. Commonly interbedded with the siltites are thin laminae of argillite, which are a darker hue than the siltite. Minute cross-bedding, ripple marks, desiccation cracks, and mud chips are locally in the strata. Quartzite beds are micaceous, very fine to medium grained and thicker and slightly more metamorphosed in the northern exposures than similar beds in the eastern exposures; commonly weather a very light gray. Only about 425 m of the Spokane is present in the Sun River area where the lower part of the formation is omitted by thrust faulting. Thickness 1,405 m in the Swan Range and 1,525 m to the north in the Flathead Range

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yg

Unit Name: Greyson Formation (Middle Proterozoic)

Map Unit Description

Laterally equivalent to the Appekunny Formation. Present only in the Coopers Lake area, southwest of Echo Mountain, at the very southern part of the map area. Consists of greenish-gray argillite with minor amounts of siltite and quartzite. A thin purplish-gray bed is in the lower exposures. Argillite is thick bedded to thinly laminated. Thickness of poorly exposed part of the formation not obtained

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BobMarshall_rect

Map Title

Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana

Map name: Bob Marshall and Great Bear Wildernesses

Map Unit Symbol: Yap

Unit Name: Appekunny Formation (Middle Proterozoic)

Map Unit Description

Northern equivalent of the Greyson Formation, present only in thrust fault plates in the area north of Baldhead Mountain, south of Marias Pass and Glacier National Park; mapped by Mudge and Earhart (1983) as Greyson. Described by Childers (1963) as mainly medium green to greenish gray interbedded argillites, quartzites, and some breccia; also contains thick units of light-gray, light-brown, and white sandstone. As thick as 305 m in the thrust fault plates

Map Citation

Mudge, M. R. and Earhart, R. L., 1991, Geologic map of the Bob Marshall and Great Bear Wildernesses and adjacent study areas, northwestern Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-2181, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: QTs

Unit Name: CLAY, SILT, SAND, AND GRAVEL, UNDIVIDED (QUATERNARY AND TERTIARY)

Map Unit Description

Includes alluvium, colluvium, glacial deposits, terrace deposits, and lake deposits.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Tb

Unit Name: Basalt lavas

Map Unit Description

Basalt lava flows, most probably Upper Miocene or Lower Pliocene, but could be as old as Oligocene (Klepper and others, 1971a).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Trv

Unit Name: Rhyolite lava and tuff of the Avon Volcanics

Map Unit Description

Rhyolite lava flows and tuffs of the Upper Eocene and Lower Oligocene (?) Avon Volcanics of the Helena Volcanic field.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Tri

Unit Name: Associated intrusive rocks of the Avon Volcanics

Map Unit Description

Rhyolite dikes and plugs, intrusive equivalents of the Avon Volcanics (Trv).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Tlv

Unit Name: Lowland Creek Volcanics

Map Unit Description

Quartz-latite tuff, welded tuff, and lava flows of the Middle Eocene Lowland Creek Volcanics.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Tli

Unit Name: Associated intrusive rocks of the Lowland Creek Volcanics, quartz latite

Map Unit Description

Quartz-latite intrusive rocks contemporaneous with the Lowland Creek Volcanics (Tlv). Shown separately only where not coincident with extrusive rocks and in the roof pendant near Wickes in the Jefferson City quadrangle.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: a

Unit Name: alaskite and/or aplite, Butte Quartz Monzonite

Map Unit Description

Aplite, alaskite, granite pegmatite, quartz-monzonite pegmatite, potassic leucogranite, quartz pegmatite, and quartz-tourmaline pegmatite, undivided; aplite and alaskite predominate. Generally small bodies of variable texture and structure, occurring as pods, dikes, sheets, and complexes, only few of which are entirely of a single rock type. Quartz, sodic plagioclase and alkali feldspar typically make up at least 98% of the rock, with biotite and lesser amounts of magnetite, sphene, apatite, zircon, and, occasionally, allanite constituting the remaining 2%. Bodies commonly are layered, either regularly or irregularly, and some are zoned. Textures commonly change along as well as across the layers. Miarolitic cavities are common in these rocks, containing well-formed crystals of quartz (clear, smoky, or amethyst), alkali-feldspar (microcline, orthoclase, perthite and microperthite), albite-oligoclase, tourmaline, and silvery green muscovite (?); locally, molybdenite, epidote, pyrite, magnetite, sphene, and allanite are conspicuous.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: gp

Unit Name: Granite porphyry

Map Unit Description

Granite porphyry, light to pinkish gray with phenocrysts of quartz and alkali feldspar, occurs as bodies large enough to show at the scale of this compilation only in the central part of the batholith. Compositionally similar to aplite-alaskite, but is distinctly more porphyritic and generally sheared and strongly altered. It shows both gradational and cross-cutting contact against Butte Quartz Monzonite (bqm); its relationship to the other silicic facies of the bqm is unknown. Because of their gradation into the bqm, these relatively rare rocks are believed to be nearly contemporaneous with the bqm. The granite porphyry almost certainly is not related to the quartz porphyry dikes that cut the bqm, but pre-date mineralization, in the Butte district. As described by Brimhall (1977), the quartz porphyry dikes always show sharp contacts with the bqm and are distinctly younger (<64 Ma; Meyer and others, 1968).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: h

Unit Name: Homestake quartz monzonite

Map Unit Description

Quartz monzonite of the Homestake pluton, well exposed in the Northern Pacific Railroad cut at Continental Divide (southeast of Butte). Field relations show that rocks of this pluton represent a continuous gradational series between the Butte Quartz Monzonite (bqm) and the alaskite-aplite (a); accordingly, the texture and mineralogy of these rocks may vary widely, ranging between those characteristic of the two end members. Most are light gray and some have pinkish cast, depending on the amount of alkali feldspar.

Contacts between the variants in the series can be gradational or sharp, in which case the more felsic of the two rocks in contact invariably is the younger. Many bodies of rock similar to those of the Homestake pluton occur throughout the Butte Quartz Monzonite but are too small to be shown at compilation scale.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: pr

Unit Name: Pulpit Rock quartz monzonite

Map Unit Description

Coarse-grained quartz monzonite of the Pulpit Rock pluton, located in the central part of the batholith (west of Boulder); overall light gray, but pinkish alkali feldspar is conspicuous. Mineralogically and texturally similar to the coarser grained varieties of the Butte Quartz Monzonite (bqm) but containing more quartz, plagioclase, and alkali feldspar and less ferromagnesian minerals. Can be highly porphyritic locally with large phenocrysts (or "megacrysts") of alkali feldspar, which commonly contain inclusions of earlier crystallized minerals aligned along crystal faces. Generally grades into but locally cuts bqm. In contrast to the Homestake-type rocks, the Pulpit Rock quartz monzonite rarely shows gradational contacts against aplite-alaskite bodies that intrude it.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: fqm

Unit Name: felsic quartz monzonite, compositionally similar to h and pr

Map Unit Description

Felsic quartz monzonites of unnamed plutons similar in color, texture, and composition to rocks of the Homestake and the Pulpit Rock plutons. Can range widely in grain size and texture. Commonly grades into the Butte Quartz Monzonite (bqm) but cross-cutting contacts, where observed, always show the bqm to be older. Some typical bodies of these rocks occur along the southern border of the Butte Quartz Monzonite (e.g., Spire Rock, west of Whitetail Basin).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: bqm

Unit Name: Butte Quartz Monzonite

Map Unit Description

Butte Quartz Monzonite (= Clancy Granodiorite of Knopf, 1957, 1963). Quartz Monzonite and subordinate granodiorite, mostly light gray to pinkish gray in color; locally, the marginal parts of the body appear darker gray because of greater abundance of ferromagnesian minerals. The rocks grade into and are cut by the silicic facies described above; locally and very rarely, thin dark dikes of undetermined composition (lamprophyre?), commonly highly altered, also cut the bqm. The general ranges in the principal constituent minerals (by volume) are: plagioclase 20 to 48%, alkali-feldspar 15 to 45%, quartz 15 to 40%, biotite < 1 to 12%, hornblende < 1 to 8%, pyroxene sparse but locally as much as 5%. These wide ranges reflect the gradation of bqm between its related silicic facies. Average grain size commonly varies from < 1 to 3 mm, and textures also vary widely, including xenomorphic, hypidiomorphic, equigranular, and seriate. Much of the bqm is distinctly porphyritic, with conspicuous subhedral to euhedral phenocrysts of poikilitic alkali feldspar, whose length can be as great as 5 cm or more.

Despite mappable textural, color, and compositional variants-of which more than a dozen have been mapped (for example, see Becraft and others, 1963; Ruppel, 1963; and Smedes, 1966)-all the rocks that constitute the Butte Quartz Monzonite (bqm) are considered to be parts of a single large pluton because of the predominance of gradational contacts between the bqm variants and of close chemical and isotopic similarity (Doe and others, 1968; Tilling, 1973). The textural and mineralogical differences are attributed to intermittent magma movement and mixing of magma fractions that reached different degrees of crystallization. These differences are best developed in parts of the pluton in proximity to country rock or older batholith rocks and are less common In the interior of the pluton.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: u

Unit Name: Unionville Granodiorite of Knoph (1963)

Map Unit Description

Unionville Granodiorite and granogabbro of Knopf (1963), undivided; mostly light- to medium-gray, seriate augite-hornblende-biotite granodiorite locally including dark-gray hypersthene granogabbro near contacts. Biotite commonly occurs as large bronze-colored, irregular poikilitic plates that continued to grow late in the crystallization history of the rock. The rocks typically are medium grained and equigranular, xenomorphic to hypidiomorphic, in texture.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: bp

Unit Name: granodiorite of Burton Park

Map Unit Description

Granodiorite of the Burton Park pluton; medium-grained, bluish-gray equigranular rock, containing poikilitic biotite, that forms a moderate-size pluton near southern end of the batholith. Several smaller satellitic bodies of granodiorite (sgd) cutting Proterozoic rocks in the area are similar in appearance to the Burton Park granodiorite and possibly correlative. Even though compositionally similar to the Unionville Granodiorite, the Burton Park rocks can only be assigned provisionally to the main magma series (Tilling, 1974). In contrast to the Butte Quartz Monzonite, both the Unionville Granodiorite and Burton Park plutons contain very few aplite-alaskite bodies.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: m

Unit Name: mafic rocks, mostly gabbroic

Map Unit Description

Mafic and ultramafic rocks, undivided; includes melanorite, hyperite, gabbro, syenogabbro, mafic monzonite, syenodiorite, augite quartz monzonite, and rare layers of peridotite in gabbro. These rocks, highly variable in composition and texture, may occur as a single rock type or, more commonly, form a complex of diverse rock types. Field relations and geochronometric data indicate the mafic and ultramafic rocks are the earliest products of the Boulder batholith, found almost exclusively along its margins. A representative suite of these complex rocks has been well characterized petrographically and chemically by Smedes (1966).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: cg

Unit Name: Climax Gulch pluton

Map Unit Description

Leucocratic quartz monzonite and granodiorite of the Climax Gulch pluton. Cuts the Butte Quartz Monzonite and the Burton Park granodiorite. This pluton varies widely in texture, mineralogy, and chemical composition, but the predominant rock type is a fine- to medium-grained, light gray to pinkish-gray, highly porphyritic quartz monzonite, which locally may contain as many as 300 phenocrysts (as large as 2 x 4 cm) of alkali feldspar per square meter. Compared to the Butte Quartz Monzonite, the Climax Gulch rocks tend to contain relatively more quartz and plagioclase, and fewer ferromagnesian minerals. Ranges in modal composition (by volume) are as follows: plagioclase 35 to 45%; alkali feldspar 20 to 35%; quartz 24 to 30%; hornblende 0 to 4%; biotite 4 to 8%; and accessory minerals < 1 to 2%. Locally, the rocks grade into, and are cut by, a more-felsic and finer-grained facies, which, where large enough, is shown as gr on the map. The youngest K-Ar age determinations for the Boulder batholith, 69.5 to 70.5 Ma, were obtained on biotite and hornblende, respectively, in the one sample of Climax Gulch pluton dated (see Tilling and others, 1968, Table 2).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: gr

Unit Name: Associated younger granitic bodies of Climax Gulch pluton

Map Unit Description

More-granitic, finer-grained, and slightly younger facies of the Climax Gulch pluton. Grades into and locally cuts the cg.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: hc

Unit Name: Hell Canyon pluton

Map Unit Description

Quartz monzonite of the Hell Canyon pluton, which forms the southern tip of the batholith. Although compositionally homogeneous, the pluton varies from medium-grained, light gray, slightly porphyritic rocks at its narrow southern end to coarse-grained, highly porphyritic varieties in the central and northern parts. Alkali-feldspar phenocrysts as large as 3 x 6 cm (Mathews and others, 1977), commonly contain inclusions of nearly all other minerals in discontinuous strings parallel to crystal faces. A distinctive feature of many of the Hell Canyon rocks is the presence of conspicuous, equant quartz "eyes," some of which may attain 1 cm in size. The Hell Canyon rocks are cut by rare, generally small, bodies of aplite (ap).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: ap

Unit Name: Associated aplite of Hell Canyon pluton

Map Unit Description

Rare aplite bodies that cut the Hell Canyon pluton; though virtually indistinguishable from the abundant aplites associated with the Butte Quartz Monzonite, these aplites are assumed to be related genetically to the Hell Canyon rocks because of spatial association.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: d

Unit Name: Donald Pluton

Map Unit Description

Leucocratic granodiorite of the Donald pluton; mineralogically similar to but slightly more felsic than rocks of the Hell Canyon pluton. Equigranular, medium-grained, light gray varieties predominate, but highly porphyritic rocks, with large pinkish alkali-feldspar phenocrysts also are common, locally forming spectacular castellated craggy exposures. This unit, like most other leucocratic rocks of the sodic magma series, is virtually devoid of aplitic or pegmatitic bodies.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: mc

Unit Name: Moose Creek pluton

Map Unit Description

Granodiorite and quartz monzonite of the Moose Creek pluton; consists of a probably early facies in the northern part of medium- to fine-grained, light gray granodiorite that contains abundant inclusions of diorite, and a main mass of medium- to coarse-grained, mostly porphyritic muscovite-biotite quartz monzonite with phenocrysts of alkali feldspar and quartz. Locally cut by small dikes and irregular bodies of quartz porphyry. Except for the presence of minor muscovite, the rocks are mineralogically and chemically similarly to those of the Donald pluton. Moreover, like the Donald rocks, the Moose Creek pluton locally is well exposed as high, spire-like outcrops (e.g. , the Humbug Spires, 8 km ENE of Divide; see Smedes and others, 1980).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: mt

Unit Name: Moosetown plutono

Map Unit Description

Leucocratic rocks of the poorly exposed Moosetown pluton. In color, mineralogy, texture, and grain size resemble those of the nearby Moose Creek pluton (mc).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: lg

Unit Name: unnamed plutons

Map Unit Description

Fine- to medium-grained, light gray, granodiorite and quartz monzonite, mostly equigranular; in place moderately to strongly altered. Lithologically similar to the finer-grained varieties of the Donald and Hell Canyon plutons. Several unnamed plutons in the central and northern part of the batholith represent the only bodies of lg rocks large enough to show at the scale of this compilation. The lg rocks satisfy the chemical criteria (see Tilling, 1973) used to define the sodic-series rocks in the southern end of the batholith. These rocks, none of which have been dated radiometrically, cut the Butte Quartz Monzonite; their specific relation to the other sodic-magma-series rocks is problematic.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: pg

Unit Name: porphyritic granodiorite of Knoph (1963)

Map Unit Description

Porphyritic granodiorite of Knopf (1957, 1963), typically light gray and coarse grained; a homogenous pluton characterized by phenocrysts of alkali feldspar (as large as 2 x 3 cm) uniformly distributed throughout. A representative mode (by volume) is: plagioclase 40%, alkali feldspar 24%, quartz 25%, biotite 7%, hornblende 3%, with magnetite, sphene, apatite, and zircon making up the remaining 1%.

This rock cuts the adjacent "granodiorite undivided" of Knopf (1963). Two K-Ar age determinations on biotite in the only sample of this pluton dated averaged 73.6 Ma, within the range of ages found for other leucocratic rocks of the batholith (Tilling and others, 1968, Fig. 2). The rocks are chemically similar to some of the rocks of the Climax Gulch pluton (cg), but available analytical data only permit provisional assignment to the sodic magma series (Tilling, 1974, Table 1).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: rc

Unit Name: granodiorite and quartz monzonite of the zoned Rader Creek pluton

Map Unit Description

Granodiorite and quartz monzonite of the zoned Rader Creek pluton, the largest of the plutons of the sodic magma series. The weathered surfaces of these rocks generally are darker (browner) than those of the adjacent Butte Quartz Monzonite and Donald pluton. In fresh exposures, however, most Rader Creek rocks are distinctly bluish gray. The southwestern part of the pluton is composed of medium-grained, equigranular granodiorite, which grades continuously and nearly imperceptibly into quartz monzonite in the northeastern part. Also, rocks in the northernmost end of the exposed pluton are conspicuously porphyritic rather than equigranular; these rocks are the only ones in the entire batholith to have the porphyritic texture expressed by plagioclase phenocrysts (dark gray and as long as 1 cm), rather than alkali-feldspar phenocrysts. Detailed descriptions of the mineralogical and chemical zonation of the Rader Creek pluton are given in Tilling (1964, 1968).

The Rader Creek pluton is cut by the Butte Quartz Monzonite. Its age relations to the granodiorites of the main magma series (the Unionville and Burton Park) are unknown because nowhere are these rocks in contact. However, K-Ar ages for the Rader Creek rocks (74.4-78.4 Ma) and the Unionville Granodiorite (74.0-79.5 Ma) largely overlap, but possibly the Unionville rocks are in part slightly older (Tilling and others, 1968, Table 3). Locally, the pluton is cut by rare aplite bodies (too small to show at compilation scale) and also by a number of mafic ("lamprophyric") intrusions (mb), which contain inclusions of the Rader Creek as well as aplitic rocks (see below).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: mb

Unit Name: mafic bodies that cut the Rader Creek pluton

Map Unit Description

Fine- to coarse-grained mafic bodies that intrude the Rader Creek pluton; occur as irregular plugs and ring dikes, and, much less commonly, as thin dikes (only the larger bodies could be shown on map). Some of the masses are uniform in lithology, but others are composed of several distinct lithologies. Compositionally, these rocks are heterogeneous and predominantly dioritic to gabbro, but granodioritic rocks may make up much of the ring-dike complexes, generally the interior portions. These mafic bodies probably were intruded before the emplacement of the Butte Quartz Monzonite. Detailed descriptions of several of the Rader Creek mafic bodies is given in Smedes and others (1968).

The relative proportion of late mafic intrusions in the Rader Creek pluton is much higher than that in the Butte Quartz Monzonite. The relationship among late mafic bodies associated with different plutons of the batholith is not known.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: sl

Unit Name: Leucocratic rocks

Map Unit Description

Leucocratic rocks, light gray granodiorite and quartz monzonite, undivided; variable in texture, fine- to medium-grained. These rocks are relatively sparse.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: si

Unit Name: intermediate rocks

Map Unit Description

Intermediate rocks, light- to medium-gray granodiorite to quartz monzonite, undivided; variable in texture and grain size, but coarse-grained varieties are rare.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: sgd

Unit Name: granodioritic rocks

Map Unit Description

Granodioritic rocks, undivided; mostly equigranular, medium-grained, and dark gray.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: sm

Unit Name: mafic rocks

Map Unit Description

Mafic and, less commonly, ultramafic brownish-weathering rocks, undivided; highly variable in texture and grain size. Includes some plutons that are composite bodies, composed of mafic rocks cut by more-felsic rocks.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Kb

Unit Name: Basalt flows and flow breccias

Map Unit Description

Basalt and olivine-basalt lava flows and flow breccias, commonly poorly exposed and/or altered. In the reconnaissance map of Prostka (1964), this unit was considered to be Tertiary, possibly post-Avon Volcanics (Trv). More recent studies (Derkey, 1986; Watson, 1986) consider these rocks, certainly where mapped in detail in the Emery mining district, to be "separate, but time equivalent" to the middle and upper members of the Elkhorn Mountains Volcanics (Key).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Kev

Unit Name: Elkhorn Mountain Volcanics

Map Unit Description

Elkhorn Mountains Volcanics and Slim Sam Formation, undivided. Tuffaceous sedimentary rocks of the Slim Sam Formation and basalt lavas; basalt and andesite tuff, breccia, and agglomerate; and rhyolite welded tuff of the Elkhorn Mountains Volcanics.

Field relations and radiometric age data demonstrate that the Kev and the earliest batholith rocks are nearly contemporaneous, but, where diagnostic cross-cutting relationships can be observed, the batholith rocks are invariably the younger (Becraft and others, 1963; Robinson and others, 1968; Tilling and others, 1968). For example, the middle member of the Kev near the northeastern end of the lie batholith is cut by mafic rocks (m) of the main magma series. In the central part of the batholith, the upper sedimentary member of the Kev is cut by the Butte Quartz Monzonite (bqm).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Ki

Unit Name: intrusive rocks associated with the Elkhorn Mountain Volcanics

Map Unit Description

Basaltic and andesitic hypabyssal intrusive rocks contemporaneous with the Elkhorn Mountains Volcanics (Kev).

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: MPz

Unit Name: MESOZOIC AND LATE PALEOZOIC SEDIMENTARY ROCKS, UNDIVIDED

Map Unit Description

Includes the Permian Phosphoria Fm., Jurassic Swift and Morrison Fm. and the Cretaceous Kootenai and Colorado Fms.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: Pz

Unit Name: PALEOZOIC SEDIMENTARY ROCKS, UNDIVIDED

Map Unit Description

Includes the Cambrian Flathead Quartzite, Wolsey Shale, Meagher Limestone, Park Shale, Pilgrim Fm, Hasmark Dolomite, and Red Lion Fm.; Devonian Maywood and Jefferson Dolomite; Devonian and Mississippian Three Forks Shale; Mississippian Lodgepole Limestone, Mission Canyon Limestone, and Amsden Fm.; and Pennsylvanian Quadrant Fm.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: pCs

Unit Name: SEDIMENTARY ROCKS OF THE BELT SUPERGROUP, UNDIVIDED (PROTEROZOIC)

Map Unit Description

(See original sources given in index for details concerning stratigraphic nomenclature of the rocks mapped). Includes formations and units mapped in the northern part as Empire Fm., Spokane Fm., Helena Dolomite; Marsh Fm., and Greenhorn Mountain Quartzite; in the eastern part as Empire Shale, Spokane Shale, and Greyson Shale; and in the southern part as LaHood Fm., Quartzite of Table Mountain, Greyson Shale, Argillite of Red Mountain, Empire Fm., Helena Dolomite, and Highland quartzite.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: pCi

Unit Name: GABBRO, DIABASE, AND BASALT INTRUSIVE ROCKS CONSIDERED TO BE BELT AGE (PROTEROZOIC)

Map Unit Description

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): BoulderBath_rect

Map Title

Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana

Map name: Boulder Batholith

Map Unit Symbol: pCm

Unit Name: METAMORPHIC ROCKS, UNDIVIDED (ARCHEAN)

Map Unit Description

Mostly gneiss and schist; lesser amounts of amphibolite and granite.

Map Citation

Smedes, H.W., Klepper, M.R., and Tilling, R.I., 1988, Preliminary map of plutonic units of the Boulder Batholith, southwestern Montana: U.S. Geological Survey Open-File Report 88-283, scale 1:200,000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: md

Unit Name: Placer and mill tailings, mine dumps, and slag piles (Holocene)

Map Unit Description

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Qs

Unit Name: Surficial deposits (Holocene and Pleistocene)

Map Unit Description

Alluvium, fan and terrace gravel, colluvium, gravel deposits on pediment surfaces, and landslide and travertine deposits (Holocene and Pleistocene); till, glacial lake, and outwash deposits (Pleistocene)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Ts

Unit Name: Sedimentary deposits and rocks (Tertiary)

Map Unit Description

Fan and gravel deposits (Pliocene) on pediment surfaces (Pliocene?) and conglomerate, sandstone, mudstone, and volcanic ash beds (Miocene, Oligocene, or Eocene?)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Trv

Unit Name: Rhyolitic volcanic rocks (Miocene, Oligocene, and Eocene)

Map Unit Description

In most of quadrangle, consists mainly of rhyolitic, quartz latitic, and latitic volcanic rocks (Oligocene and Miocene). Includes rhyolitic and dacitic plugs and dikes (lower Tertiary). In Bearmouth area, rhyolitic rocks interbedded with lesser amounts of basaltic, andesitic, and latitic volcanic rocks and dikes (Eocene). In southern Sapphire Mountains rocks are mainly rhyolitic and latitic volcanic rocks and lesser amounts of andesitic flows and dikes (Eocene?)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Tab

Unit Name: Andesitic and basaltic volcanic rocks (Oligocene and Eocene)

Map Unit Description

In most of quadrangle, consists of andesitic, basaltic, and latitic volcanic rocks (Eocene) and basaltic and andesitic volcanic rocks (Oligocene and Eocene). In eastern Garnet Range, consists of basaltic, andesitic, and latitic volcanic rocks and dikes (Oligocene? and Eocene)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Tlc

Unit Name: Lowland Creek Volcanics (Eocene)

Map Unit Description

Rhyolite and dacite flows, welded tuff, and air-fall tuff

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: TKab

Unit Name: Andesitic and basaltic volcanic rocks (Early Tertiary or Late Cretaceous)

Map Unit Description

Mainly basaltic and andesitic flows, flow breccia, and air-fall tuff east and northeast of Deer Lodge

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kem

Unit Name: Elkhorn Mountains Volcanics (Late Cretaceous)

Map Unit Description

Andesitic, quartz latitic, and basaltic air-fall tuff, breccia, welded tuff, and flows

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: KJs

Unit Name: Sedimentary rocks (Cretaceous and Jurassic)

Map Unit Description

In northeast corner of quadrangle, consists of Two Medicine Formation, Virgelle Sandstone, Telegraph Creek Formation, Marias River Shale (Upper Cretaceous), and Blackleaf Formation (Lower Cretaceous). In area west, northwest, and north of Deer Lodge, consists of Golden Spike Formation and Carten1 Creek, Jens, and Coberly Formations of Gwinn (1961) (Upper Cretaceous); Blackleaf and Kootenai Formations (Lower Cretaceous); Morrison Formation (Upper Jurassic); and Ellis Group (Upper and Middle Jurasic)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: PDs

Unit Name: Sedimentary rocks (Permian, Pennsylvanian, Mississippian, and Devonian)

Map Unit Description

Consists of Shedhorn Sandstone, Phosphoria and Park City Formations (Permian), Quadrant Quartzite (Middle Pennsylvanian), Snowcrest Range Group (Lower Pennsylvanian and Upper Mississippian), Madison Group and related rocks (Upper and Lower Mississippian), Three Forks Formation (Lower Mississippian and Upper Devonian), and Jefferson (Upper Devonian) and Maywood Formations (Upper and Middle Devonian). In the Butte quadrangle, the formations of the Snowcrest Range Group (Conover Ranch, Lombard, and Kibbey Formations) are too thin to map as separate formations (Wardlaw, oral commun., 1986). Three Forks Formation occurs only in northeastern part of quadrangle

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Cs

Unit Name: Sedimentary rocks (Cambrian)

Map Unit Description

Includes Red Lion Formation (Upper Cambrian) and Hasmark Formation (Upper and Middle Cambrian). Also includes the underlying Park Shale, Meagher Limestone, and Wolsey Shale (Middle Cambrian) in northeast part of quadrangle, all of which are laterally equivalent to the Silver Hill Formation (Middle Cambrian) in west, southwest, and northwest parts of quadrangle. Flathead Quartzite at base (Middle Cambrian) present in entire quadrangle

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: CYs

Unit Name: Sedimentary rocks (Cambrian and Middle Proterozoic)

Map Unit Description

Consists of lower Paleozoic and upper Middle Proterozoic rock units that are structurally superposed or are too thin to show at this scale. Red Lion (Upper Cambrian) and Hasmark (Upper and Middle Cambrian) Formations, Silver Hill Formation (Middle Cambrian), or Flathead Quartzite (Middle Cambrian) may be present overlying any of these Middle Proterozoic units: Pilcher Quartzite, Garnet Range, or McNamara Formations (Middle Proterozoic)

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Ymi

Unit Name: Missoula Group

Map Unit Description

Consists of Pilcher Quartzite; Garnet Range and McNamara Formations; Bonner Quartzite; and Mount Shields, Shepard, and Snowslip Formations

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Yc

Unit Name: Middle Belt carbonate rocks

Map Unit Description

Mainly consists of upper and middle members of the Wallace Formation west of long 113º 30’ W. and the laterally equivalent Helena Formation east of long 113º 30’ W.

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Yra

Unit Name: Ravalli Group

Map Unit Description

Consists of Empire, Spokane, and Greyson Formations

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Ymb

Unit Name: Metamorphosed rocks of the Belt Supergroup

Map Unit Description

Consists of quartzite, biotite-muscovite schist, quartzofeldspathic gneiss, calc-silicate gneiss, and migmatite. Metamorphosed during Late Cretaceous or early Tertiary time

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Tmg

Unit Name: Granitic rocks (Tertiary)

Map Unit Description

Mainly muscovite-biotite granite and monzogranite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Tgd

Unit Name: Granodioritic rocks (Tertiary)

Map Unit Description

Mainly quartz monzodiorite and granodiorite.

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: TKmg

Unit Name: Granitic rocks (Tertiary and Late Cretaceous)

Map Unit Description

Consists of foliated and nonfoliated biotite-muscovite monzogranite, leucomonzogranite, and grandiorite.

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: TKgd

Unit Name: Granodioritic rocks (Tertiary and Late Cretaceous)

Map Unit Description

Mainly foliated and nonfoliated biotite granodiorite, hornblende-biotite granodiorite, tonalite, and quartz diorite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name Butte-MF1925

Map Unit Symbol TKgb

Unit Name Gabbroic rocks (Tertiary and Late Cretaceous)

Map Unit Description

Consists of gabbro, microgabbro, and diorite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: TKa

Unit Name: Alkalic rocks (Tertiary or Late Cretaceous)

Map Unit Description

Pyroxenite, leucosyenite, and hornblende syenite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kmg

Unit Name: Granitic rocks (Late Cretaceous)

Map Unit Description

Mainly granite porphyry, biotite monzogranite porphyry, biotite monzogranite, biotite-muscovite monzogranite, biotite-muscovite granodiorite, quartz monzonite, microleucomonzogranite, leucomonzonite, aplite, alaskite, and pegmatite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kgd

Unit Name: Granodioritic rocks (Late Cretaceous)

Map Unit Description

Consists of foliated and nonfoliated biotite-hornblende granodiorite, biotite-hornblende granodiorite porphyry, biotite-hornblende monzogranite, and tonalite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kgb

Unit Name: Gabbroic rocks (Late Cretaceous)

Map Unit Description

Diorite, diorite porphyry, gabbro, microgabbro, and diabase

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kmd

Unit Name: Monzodioritic rocks (Late(?) Cretaceous)

Map Unit Description

Mainly hornblende quartz diorite, granodiorite, tonalite, quartz monzodiorite, diorite, quartz diorite, leucogranodiorite, and augite-hornblende monzonite

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name Butte-MF1925

Map Unit Symbol Kl

Unit Name Latite (Late Cretaceous)

Map Unit Description

Sill in northeastern corner of map

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: Kau

Unit Name: Augen gneiss (Late Cretaceous)

Map Unit Description

Part of the Idaho batholith in southwestern corner of map

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: ZYg

Unit Name: Gabbroic rocks (Late or Middle Proterozoic)

Map Unit Description

Gabbro, microgabbro, and diorite dikes and sills

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_MF1925_rect

Map Title

Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana

Map name: Butte-MF1925

Map Unit Symbol: mi

Unit Name: Diorite and diorite porphyry, diabase, gabbro, microgabbro, and diorite

Map Unit Description

Map Citation

Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° Quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, 1 sheet, scale 1:250000

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol md

Unit Name Placer tailings, will tailings, mine-dump material, and slag piles

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Qa

Unit Name Alluvium (Holocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qg

Unit Name: Fan, pediment, terrace, and colluvial gravel (Holocene and Pleistocene)

Map Unit Description

Locally contains mass-wasting and bog deposits in southeastern part of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ql

Unit Name: Landslide deposits (Holocene and Pleistocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qtr

Unit Name: Travertine deposits (Holocene and Pleistocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qo

Unit Name: Outwash deposits (Pleistocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qgl

Unit Name: Glacial lake deposits (Pleistocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qt

Unit Name: Till (Pleistocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Qty

Unit Name: Younger till

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Qto

Unit Name Older till

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tg

Unit Name: Fan deposits and gravel deposits on pediment surfaces (Pliocene?)

Map Unit Description

Locally contains mass-wasting deposits of Tertiary or Quaternary age

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ts

Unit Name: Stream and lake deposits, volcanogenic sandstone and mudstone, and volcanic ash beds (Miocene and Oligocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tsg

Unit Name: Stream and lake deposits, volcanogenic sandstone and mudstone, and volcanic ash beds mantled by fan deposits and gravel deposits on pediment surfaces (Pliocene, Miocene, and Oligocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tc

Unit Name: Conglomerate (Oligocene or Eocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tvs

Unit Name: Andesitic, latitic, and rhyolitic volcanic rocks (Eocene?)

Map Unit Description

Occurs in southern Sapphire Mountains

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Trs

Unit Name: Vitric rhyolite dikes (Eocene?)

Map Unit Description

Occurs in the southern Sapphire Mountains

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Trv

Unit Name: Rhyolitic volcanic rocks (Oligocene and Eocene)

Map Unit Description

Includes minor andesite and quartz latite flows and plugs. Occurs mainly east and northeast of Deer Lodge Valley

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Tav

Unit Name Andesitic volcanic rocks (Oligocene or Eocene?)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tabv

Unit Name: Andesitic and basaltic volcanic rocks (Oligocene or Eocene)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tvg

Unit Name: Basaltic, andesitic, and latitic volcanic rocks and dikes (Oligocene? and Eocene)

Map Unit Description

Occurs mainly in the eastern part of Garnet Range

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Tlav

Unit Name Latitic and andesitic volcanic rocks (Eocene?)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tvb

Unit Name: Basaltic, andesitic, and rhyolitic volcanic rocks and dikes (Eocene)

Map Unit Description

Occurs mainly in Bearmouth area

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tlv

Unit Name: Lowland Creek Volcanics (Eocene)

Map Unit Description

Quartz latite, rhyolite, and dacite flows, welded tuff, and tuff

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tbv

Unit Name: Basaltic volcanic rocks (Eocene?)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKbv

Unit Name: Basaltic and andesitic volcanic rocks

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ktm

Unit Name: Two Medicine Formation (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kvt

Unit Name: Virgelle Sandstone and Telegraph Creek Formations (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kcs

Unit Name: Colorado Group

Map Unit Description

Consists of Marias River Shale (Upper Cretaceous) and Blackleaf Formation (Lower Cretaceous)

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kev

Unit Name: Elkhorn Mountains Volcanics (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgs

Unit Name: Golden Spike Formation (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kcc

Unit Name: Carten Creek Formation of Gwinn (1961) (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kj

Unit Name: Jens Formation of Gwinn (1961) (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kc

Unit Name: Coberly Formation of Gwinn (1961) (Upper Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kb

Unit Name: Blackleaf Formation (Lower Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbv

Unit Name: Vaughn Member

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbvu

Unit Name: Upper part of Vaughn Member

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbvl

Unit Name: Lower part of Vaughn Member

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbtf

Unit Name: Taft Hill and Flood Members

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbvf

Unit Name: Lower part of the Vaughn Member and Taft Hill and Flood Members

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Kbk

Unit Name Blackleaf and Kootenai Formations (Lower Cretaceous)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ks

Unit Name: Golden Spike Formation and Carten Creek, Jens, and Coberly Formations of Gwinn (1961) (Upper Cretaceous), and Blackleaf and Kootenai Formations (Lower Cretaceous)

Map Unit Description

All formations not present everywhere unit occurs

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Js

Unit Name: Morrison Formation (Upper Jurassic) and Ellis Group (Swift, Rierdon, and Sawtooth Formations) (Upper and Middle Jurassic)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: KJs

Unit Name: Kootenai Formation (Lower Cretaceous) and Jurassic formations (Upper and Middle Jurassic)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: PPs

Unit Name: Shedhorn Sandstone and Phosphoria and Park City Formations (Permian), and Quadrant Quartzite (Upper Pennsylvanian)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Pq

Unit Name: Quadrant Quartzite (Upper Pennsylvanian)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: PMs

Unit Name: Shedhorn Sandstone and Phosphoria and Park City Formations (Permian), Quadrant Quartzite (Upper Pennsylvanian), and Snowcrest Range Group (Lower Pennsylvanian(?) and Upper Mississippian)

Map Unit Description

All formations not present everywhere unit occurs

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: JMs

Unit Name: Morrison Formation (Upper Jurassic), Ellis Group (Upper and Middle Jurassic), Shedhorn Sandstone and Phosphoria and Park City Formations (Permian), Quadrant Quartzite (Upper Pennsylvanian), and Snowcrest Range Group (Lower Pennsylvanian(?) and Upper Missi

Map Unit Description

All formations not present everywhere unit occurs

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: KMs

Unit Name: Golden Spike Formation and Carten Creek, Jens, and Coberly Formations of Gwinn (1961) (Upper Cretaceous), Blackleaf and Kootenai Formations (Lower Cretaceous), Morrison Formation (Upper Jurassic), Ellis Group (Upper and Middle Jurassic), Shedhorn Sandston

Map Unit Description

All formations not present everywhere unit occurs

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Mm

Unit Name: Madison Group and related rocks (Upper and Lower Mississippian)-

Map Unit Description

Consists of Mission Canyon Limestone at top and Lodgepole Limestone at bottom in most of quadrangle. In western part of Garnet Range, includes Mission Canyon Limestone at top and Middle Canyon Formation and Paine Limestone below (W.J. Sando, U.S.G.S. oral commun., 1986)

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: MDmt

Unit Name: Madison Group (Upper and Lower Mississippian) and Three Forks Formation (Lower Mississippian and Upper Devonian)

Map Unit Description

Occurs in northeastern part of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: MDs

Unit Name: Madison Group and related rocks (Upper and Lower Mississippian) and Jefferson Formation (Upper Devonian)

Map Unit Description

Occurs west, southwest, and northwest of Deer Lodge Valley

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Djm

Unit Name: Jefferson and Maywood Formations (Upper Devonian)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: DCs

Unit Name: Devonian and Cambrian formations

Map Unit Description

Includes Jefferson and Maywood Formations (Upper Devonian) and the Red Lion and Hasmark Formations (Upper Cambrian)

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Crh

Unit Name: Red Lion and Hasmark Formations (Upper Cambrian)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Cmw

Unit Name: Western lithofacies: Silver Hill Formation and Flathead Quartzite (Middle Cambrian)

Map Unit Description

Occurs west of longitude 112° 25' W.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Cme

Unit Name: Eastern lithofacies: Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Quartzite (Middle Cambrian)

Map Unit Description

Occurs east of longitude 112° 25' W.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ces

Unit Name: Cambrian formations, eastern lithofacies

Map Unit Description

Includes some or all of the following formations: Red Lion and Hasmark Formations (Upper Cambrian), and Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Quartzite (Middle Cambrian). Occurs east of longitude 112° 25 W.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Cws

Unit Name: Cambrian formations, western lithofacies

Map Unit Description

Includes some or all of the following formations: Red Lion and Hasmark Formations (Upper Cambrian) and Silver Hill Formation and Flathead Quartzite (Middle Cambrian). Occurs west of longitude 112° 25' W.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: CYsg

Unit Name: Silver Hill Formation and Flathead Quartzite (Middle Cambrian), and Pilcher Quartzite and Garnet Range Formation of Missoula Group (Middle Proterozoic)

Map Unit Description

Pilcher Quartzite absent south of latitude 46° 35'N.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ypi

Unit Name: Pilcher Quartzite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ygr

Unit Name: Garnet Range Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Yin

Unit Name: McNamara Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ybo

Unit Name: Bonner Quartzite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Yms

Unit Name Mount Shields Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Yms3

Unit Name: Member Three

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Yms2

Unit Name: Member Two

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Yms1

Unit Name Member One

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ymsc

Unit Name: Carbonate lithofacies in upper part of Member One

Map Unit Description

Occurs west of longitude 1130 00' W.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ysh

Unit Name: Shepard Formation

Map Unit Description

Absent south of latitude 46° 30' N.

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ysn

Unit Name: Snowslip Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ymg

Unit Name: Missoula Group

Map Unit Description

Includes Pilcher Quartzite, Garnet Range and McNamara Formations, Bonner Quartzite, Mount Shields, Shepard, or Snowslip Formations; all formations not present at any locality

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Yh

Unit Name: Helena Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Yhl

Unit Name: Helena Formation Lower Member

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ywu

Unit Name: Wallace Formation Upper Member

Map Unit Description

Occurs in northeastern part of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ywm

Unit Name: Wallace Formation Middle Member

Map Unit Description

Occurs in western and southwestern parts of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Yws

Unit Name Wallace and Snowslip Formations

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Ye

Unit Name Empire Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ys

Unit Name: Spokane Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Yg

Unit Name Greyson Formation

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ybsh

Unit Name: Biotite-muscovite schist and interbedded quartzite and lesser amounts of quartzofeldspathic gneiss

Map Unit Description

High-grade metamorphic rocks of uncertain Belt Supergroup protolith metamorphosed during Late Cretaceous or Tertiary time

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ybqg

Unit Name: Quartzofeldspathic gneiss and migmatite, and lesser amounts of biotite-muscovite schist

Map Unit Description

High-grade metamorphic rocks of uncertain Belt Supergroup protolith metamorphosed during Late Cretaceous or Tertiary time

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ybcg

Unit Name: Calc-silicate gneiss and migmatite, and lesser amounts of quartzofeldspathic and biotite-muscovite schist

Map Unit Description

High-grade metamorphic rocks of uncertain Belt Supergroup protolith metamorphosed during Late Cretaceous or Tertiary time

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tbmi

Unit Name: Muscovite-biotite granodiorite, biotite granodiorite, and monzogranite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol TKbi

Unit Name Biotite-muscovite monzogranite and muscovite-biotite granodiorite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol TKhd

Unit Name Hornblende-biotite granodiorite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdi

Unit Name: Biotite granodiorite and hornblende-biotite granodiorite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgti

Unit Name: Foliated biotite granodiorite and hornblende-biotite tonalite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbgi

Unit Name: Foliated biotite granodiorite

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kaui

Unit Name: Augen gneiss

Map Unit Description

Rocks of the Idaho batholith, Bitterroot lobe

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kmlm

Unit Name: Leucomicromonzogranite porphyry in sills, dikes, and pods

Map Unit Description

Rocks of the Sapphire batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgds

Unit Name: Porphyritic and equigranular hornblende-biotite granodiorite of outer zone

Map Unit Description

Rocks of the Sapphire batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kmgs

Unit Name: Porphyritic and equigranular muscovite-biotite monzogranite of inner zone

Map Unit Description

Rocks of the Sapphire batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tgds

Unit Name: Biotite granodiorite of the Seymour Creek stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tgda

Unit Name: Granodiorite and dacite dikes

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tmgh

Unit Name: Biotite-muscovite monzogranite of Hearst Lake stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tmgp

Unit Name: Equigranular to porphyritic muscovite-biotite granodiorite of Pintlar Creek batholith

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol TKp

Unit Name Pegmatite

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKgm

Unit Name: Hornblende-biotite granodiorite of Maloney Basin stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKbb

Unit Name: Biotite granodiorite of Beaverhead Mountain stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKmpm

Unit Name: Biotite monzogranite porphyry of La Marche Creek stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbmm

Unit Name: Biotite monzogranite of Mill Creek stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqds

Unit Name: Hornblende quartz diorite, granodiorite, tonalite, quartz monzodiorite, and diorite of Storm Lake stock

Map Unit Description

Rocks of Anaconda batholithic suite. Also forms dikes, sills, and pods

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgs

Unit Name: Biotite-hornblende granodiorite of Short Peak stock

Map Unit Description

Rocks of Anaconda batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kbmp

Unit Name: Porphyritic muscovite-biotite monzogranite of Mt. Powell batholith

Map Unit Description

Rocks of the Flint Creek batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdr

Unit Name: Locally foliated hornblende-biotite granodiorite of Royal stock

Map Unit Description

Rocks of the Flint Creek batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Kgdp

Unit Name Hornblende-biotite granodiorite of Philipsburg batholith

Map Unit Description

Rocks of the Flint Creek batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdc

Unit Name: Hornblende-biotite granodiorite of Cable stock

Map Unit Description

Rocks of the Flint Creek batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqdr

Unit Name: Quartz diorite, diorite, leucogranodiorite, and metasedimentary rocks of Racetrack Creek intrusive and metamorphic complex

Map Unit Description

Rocks of the Flint Creek batholithic suite

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgp

Unit Name: Medium-grained granite porphyry

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kpl

Unit Name: Leucomonzonite of Knopf (1963) at Priest Pass

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgra

Unit Name: Graphophyre of Knopf (1963)

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgmw

Unit Name: Porphyritic and equigranular quartz monzonite of Wilson Park stock

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Ka

Unit Name: Aplite, alaskite, and pegmatite dikes, sills, and pods

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kmgd

Unit Name: Porphyritic biotite-hornblende monzogranite and granodiorite of Boulder batholith

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdu

Unit Name: Unionville granodiorite of Knopf (1963)

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kd

Unit Name: Diorite of Swedes (1968)

Map Unit Description

Rocks of the Boulder batholith

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tqmd

Unit Name: Quartz monzodiorite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tgb

Unit Name: Gabbro, microgabbro, and diorite plugs, dikes, and sills

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tgd

Unit Name: Granodiorite stocks and dacite dikes and flows

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Td

Unit Name: Dacite of Knopf (1963)

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tqmm

Unit Name: Hornblende-biotite granodiorite of Marysville stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Tgl

Unit Name: Biotite monzogranite stock of Lost Creek

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKmg

Unit Name: Biotite monzogranite, biotite-muscovite monzogranite, leucomonzogranite, and granodiorite plugs, stocks, dikes, and sills

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKgd

Unit Name: Biotite and hornblende-biotite granodiorite stocks, sills, and dikes

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: TKgb

Unit Name: Gabbro, microgabbro, and diorite plugs, sills, and dikes

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol TKgp

Unit Name Tonalite, quartz diorite, and granodiorite of Gird Point stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol TKmw

Unit Name Biotite monzogranite of Welcome Creek stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdb

Unit Name: Porphyritic hornblende-biotite granodiorite and muscovite-biotite monzogranite of Big Spring Creek stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kmgb

Unit Name: Biotite monzogranite of Broadwater stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdw

Unit Name: Porphyritic hornblende-biotite granodiorite of Wallace Creek stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Kl

Unit Name Latite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqmd

Unit Name: Hornblende-biotite granodiorite of Dalton Mountain stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqmb

Unit Name: Hornblende-biotite granodiorite of Blackfoot City stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdh

Unit Name: Hornblende-biotite granodiorite of Henderson Creek stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqmo

Unit Name: Hornblende-biotite granodiorite of Ogden Mountain stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdg

Unit Name: Porphyritic hornblende-biotite granodiorite of Garnet stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgdm

Unit Name: Hornblende-biotite granodiorite of Miners Gulch stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqmh

Unit Name: Hornblende-biotite granodiorite of Mineral Hill stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kmg

Unit Name: Monzogranite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgd

Unit Name: Granodiorite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kgb

Unit Name: Microgabbro, gabbro, and diabase plugs, sills, and dikes

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kdi

Unit Name: Diabase sills and dikes

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kdp

Unit Name: Diorite porphyry and equigranular diorite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kps

Unit Name: Pyroxenite, leucosyenite, and hornblende syenite of Skalkaho Mountain stocks

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqms

Unit Name: Augite-hornblende monzonite of Scratch Gravel Hills stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: Kqmg

Unit Name: Hornblende-clinopyroxene-biotite granodiorite of Granite Butte stock

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name Butte-OF86-292

Map Unit Symbol Zd

Unit Name Gabbro, microgabbro, and diorite dikes and sills

Map Unit Description

Occur mainly in the northeastern part of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: ZYd

Unit Name: Gabbro, microgabbro, and diorite dikes and sills

Map Unit Description

Occur mainly in northwestern part of quadrangle

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: dp

Unit Name: Diorite porphyry

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: di

Unit Name: Diabase

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Butte_OF86_292_rect

Map Title

Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana

Map name: Butte-OF86-292

Map Unit Symbol: gb

Unit Name: Gabbro, microgabbro, and diorite

Map Unit Description

Map Citation

Wallace, C.A., Schmidt, D.J., Lindke, D.J., Waters, M.R., Elliott, J.E., French, A.B., Whipple, J.W., Zarske, S.E., Blaskowski, M.J., Heise, B.A., Yeoman, R.A., O'Neill, J.M., Lopez, D.A., Robinson, G.D., and Klepper, M.R., 1986, Preliminary geologic map of the Butte 1°x2° quadrangle, western Montana: U.S. Geological Survey Open-File Report 86-292, 14 p.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Qd

Unit Name: Quaternary deposits, undivided (Holocene and Pleistocene)

Map Unit Description

Includes modern stream alluvium, terrace gravel, talus and related slope material, landslide debris, and unconsolidated glacial moraines and outwash gravel.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Qa

Unit Name: Alluvium, undivided (Holocene)

Map Unit Description

Floodplain, terrace, and alluvial-fan deposits that include stream-deposited gravel, sand, and silt. Gravel and peat are in filled ponds and lakes.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Qf

Unit Name: Alluvial-fan deposits (Holocene)

Map Unit Description

Shown separately only in area near Challis and Antelope Flat (44°18’ N., 114°04’ W.), 30 km north of southeast corner of quadrangle.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ql

Unit Name: Landslide and related deposits (Holocene)

Map Unit Description

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Qm

Unit Name: Glacial deposits, undivided (Pleistocene)

Map Unit Description

Unsorted boulders, cobbles, pebbles, sand, silt, and clay in moraines and in glaciofluvial outwash. Belt of coalescent moraines along eastern front of Sawtooth Range has been attributed to two major late Pleistocene glaciations, the Bull Lake and the Pinedale (Williams, 1961).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Qtr

Unit Name: Travertine (Pleistocene)

Map Unit Description

Yellowish-white to cream-colored, irregularly thin- to medium-bedded, locally finely banded deposits of travertine showing varying degrees of irregular cellular and concentric texture with local cavities and encrustations. Layering in most of the deposit is nearly horizontal. Many exposures at eastern margin have steeply inclined layering; some of these clearly are of slumped blocks; others could be of undisturbed travertine deposited on steep slopes. Thought to once have covered about 2.5 km2 on southwest side of Bradbury Flat (44°26’ N., 114°10’ W.). Probably related to presently extinct hot springs that issued from faults in underlying Paleozoic carbonate strata. Estimated thickness 100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcb

Unit Name: Columbia River Basalt Group (Miocene)

Map Unit Description

Dark-gray to black, fine-grained ophitic basalt; consists chiefly of plagioclase laths embedded in augite, and scattered crystals of magnetite. Exposures include small cap on ridge immediately west of Grimes Pass (44°01’ N., 115°49.8’ W.) and small outcrops west of Paddy Flat (44°45’ N., 115°59’ W.), near northwest corner of quadrangle.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tpa

Unit Name: Payette Formation (Miocene)

Map Unit Description

Stratified, tan to gray, loosely consolidated arkosic sandstone and siltstone and interstratified conglomerate and thin-bedded, dark-gray to black shale in which are abundant impressions of upper middle to lower upper Miocene leaves (W. C. Rember, written commun., 1983). Formation also contains seams of low-rank coal as much as 30 cm thick, bedded intervals several meters thick of light-gray to white diatomaceous earth, and beds of gray volcanic ash as much as 30 cm thick. Formation crops out along west side of Middle Fork of Payette River northwest of Crouch (44°07’ N., 115°58’ W.). It was deposited in an intermontane basin and is now part of a west-tilted, down-faulted block. Minimum thickness 1,680 m; base not exposed.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trd

Unit Name: Rhyolite dikes

Map Unit Description

Thunder Mountain cauldron complex and environs:
These small rhyolite intrusions have potassium-argon ages of 39.8±0.9, 41.1+-0.9, 42.4±1.5, and 45.2±1.5 m.y. (see table 1). Additional description see below.

Western and south-central parts of quadrangle:
Rocks are light colored and generally porphyritic, containing rounded and embayed quartz phenocrysts. Potassium feldspar phenocrysts are more plentiful than plagioclase. Matrices are pinkish gray and aphanitic. Modal compositions include rhyolite, quartz-latite, and rhyodacite. The rocks are altered: sericite is developed from feldspars and iron oxides from pyrite. Dikes range from a few meters to more than 30 m wide and are as much as several hundred meters long. Rhyolite dikes are more numerous near bodies of granite (Tg), to which they probably are related, and, like that rock, are more radioactive than other plutonic rocks or dikes. Granophyric matrices common in dikes cutting Idaho batholith rocks north of Stanley. Some dikes in that area also are composite, having marginal zones more mafic than rhyolite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tr

Unit Name: Rhyolite intrusions

Map Unit Description

Thunder Mountain cauldron complex and environs:
Sanidine from a sample taken from Monumental Creek (44°56’ N., 115°12’ W.) was dated by potassium-argon methods at 44.6±1.5. For additional description, see below.

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Dikes and plugs of mostly light-gray, dense, phenocryst-poor rhyolite; locally contains conspicuous phenocrysts of sanidine as long as 8 mm and sparse phenocrysts of quartz, as at Red Rock Peak, along northern border of Challis quadrangle at long 114°25’30" W. Rock at Red Rock Peak grades into, and forms composite bodies with, quartz porphyry intrusions (Tqp). Sanidine from Red Rock Peak yielded potassium-argon age of 44.6±1.5 m.y. (see table 1).

Custer graben area:
Gray, white, and pink dikes, plugs, and domes that contain phenocrysts of alkali feldspar and quartz, and minor amounts of biotite and plagioclase.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tgp

Unit Name: Gray porphyry

Map Unit Description

Thunder Mountain cauldron complex and environs:
Gray dacite porphyry and minor diorite porphyry. Consists of both extrusive and intrusive rock. These rocks mostly have a dense or cryptocrystalline groundmass but, locally, have a holocrystalline, fine-grained groundmass (diorite porphyry). Phenocrysts of plagioclase generally are conspicuous and, in Indian Creek area (44°48’ N., 115°13’ W.), commonly are 2-3 mm long. Quartz is sparse. Mafic minerals consist of varying proportions of biotite, hornblende, and pyroxene. Phenocryst content varies from about 20 to 50 percent. In places, dacitic rocks clearly intrude lapilli tuff (Tdq) and possibly younger tuff units as well. In other places, rocks appear to be stratiform, having flow layering that defines gentle dips and containing interlayered zones of flow breccia characteristic of contact zones between lava flows. As mapped, therefore, this unit in some places includes dacite lava that is correlative with the lower latite lava (Tll) and in other places includes dikes and irregularly shaped intrusives that probably are younger than lapilli tuff (Tdq). Also correlates in part with dacite and diorite porphyry (Tdc) mapped in western part of quadrangle (see p. 20).

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
A mixed sequence of gray and green-gray extrusive and intrusive rocks of intermediate composition; most are dacite porphyry that locally displays flow layering, flow brecciation, and dense to glassy groundmass indicating they are lavas. In places, porphyry is massive, has crystalline groundmass, and locally exhibits intrusive contacts with country rock as young as basal part of tuffs of Camas Creek-Black Mountain (Tc, see p. 7). Therefore, this unit, as mapped, probably includes intermediate lava as old as 51 m.y. and younger dikes and irregularly shaped intrusive masses 48 m.y. old or younger. Phenocrysts (30-45): q, 0 (in most rocks) to 5; af, 0; pf, 60-75; b, 1-12; hb, trace-25; px (mostly altered but in places includes both fresh opx and cpx), trace-20. Contacts are gradational over short distances from hornblende- and biotite-rich varieties to pyroxene-rich varieties. Thickness 0 to more than 500 m.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Biotite from sample collected near Casto (44°34’ N., 114°50’ W.) gave potassium-argon age of 48.6±1.4 m.y. (see table 1). Sample collected from probable extrusive rock 8 km north of Casto yielded hornblende age of 46.9±2.8 m.y. and biotite age of 49.5±1.4 m.y. (see table 1).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tla

Unit Name: Latite of Lookout Mountain

Map Unit Description

Black, nearly aphyric, vesicular lava interbedded with cinders and bombs. Rock locally contains sparse small (0.5 mm long) phenocrysts of plagioclase and small prisms (as long as 1.0 mm) of hypersthene set in groundmass of randomly oriented plagioclase microlites and glass. Leonard and Marvin (1982) report whole-rock potassium-argon ages of 41.0±1.4 m.y. and 43.4±1.4 m.y. for two samples collected just north of Challis quadrangle. Thickness 0-50 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tds

Unit Name: Beds of Dewey mine

Map Unit Description

Cauldron-filling sedimentary rocks and bedded, reworked ash-fall tuff. Includes siltstone in varved lake beds and coarse volcaniclastic conglomerate containing intercalated landslide debris and talus; carbonaceous in part. Thickness 0-50 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tss

Unit Name: Sunnyside tuff of Shannon and Reynolds (1975)

Map Unit Description

An informal term used by Shannon and Reynolds (1975) in the Thunder Mountain mining district and now used throughout the Thunder Mountain cauldron complex. Potassium-argon ages of biotite from one sample and sanidine from two samples are 47.7±1.6, 46.3±1.1, and 46.3±1.0 m.y.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsu

Unit Name: Upper tuff

Map Unit Description

Red- and red-brown-weathering, densely welded, devitrified rhyolite tuff, multiple-flow compound cooling unit that contains numerous small volcanic rock fragments and well-flattened pumice lapilli throughout. Base is marked by a black vitrophyre 3-10 m thick that is rich in lithic fragments. Extremely sparse biotite flakes are only visible mafic minerals in devitrified rock; pyroxene and hornblende are only visible mafic minerals in vitrophyre. Phenocrysts (12-31): q, 20-60; af, 40-80; b, 0-1; hb, trace (as many as four grains per thin section in basal vitrophyre only); cpx, trace (as many as eight grains pigeonite per thin section in basal vitrophyre only). Allanite is common accessory in basal vitrophyre only. Thickness 0-300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tmx

Unit Name: Megabreccia

Map Unit Description

Varicolored breccia consisting of fragments of lower tuff (Tsl, see below), a few centimeters to several meters in diameter, in a matrix of upper tuff (Tsu). The fragments probably slid into caldera from outer rims during initial eruptions of upper tuff. Possibly, rock is a coarse-fragment, lithic-rich, early cooling unit of upper tuff. Thickness 0-100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tlsu

Unit Name: Uppermost tuff that has mineralogy of lower tuff

Map Unit Description

Reddish-gray, simple cooling unit of densely welded rhyolite tuff. Distinguished from upper tuff (Tsu) by more abundant plagioclase and biotite; separated from upper tuff by few meters of bedded tuff (not shown on map). These rocks are mineralogically similar to lower tuff (Tsl) but are separated from it by rhyolitic lava (Tsrl). Phenocrysts (26): q, 40; af, 44; pf, 12; b, 3; altered mafic, 1. Thickness 0-40 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsrl

Unit Name: Rhyolite lava or tuff

Map Unit Description

Red flow-layered lava or extremely hot ash-flow tuff; presence of several zones of black vitrophyre within rhyolite suggests presence of two or more cooling units; east of Marble Creek (44°50’ N., 114°59’ W.) a thin flow of black vesicular latite is intercalated within unit. Although rock in all places looks very similar, containing 5-10 percent phenocrysts (0.5-5 mm, in length), rock east of Marble Creek contains more plagioclase than alkali feldspar, and rock exposed north of Dynamite Creek (44°53’ N., 114°05’ W) contains more alkali feldspar than plagioclase. Thickness 0 to more than 100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsl

Unit Name: Lower tuff

Map Unit Description

At least three cooling units, each of which grades upward from white to pink, nonwelded to slightly welded rhyolite at base to gray, densely welded quartz latite at top. Upper and middle cooling units commonly display vertical sheeting or jointing and contain very little recognizable pumice, whereas lower unit contains abundant pumice. Upper unit along Marble Creek (44°50’ N., 114°59- W.) contains 28-49 percent phenocrysts: q, 9-45; af, 32-51; pf, 16-33; b, 2-11; hb, 0-3; zircon, trace. Middle unit along Little Cottonwood Creek (44°55’ N., 115°03’ W.) contains 15-34 percent phenocrysts: q, 26-51; af, 23-39; pf, 2-26; b, 4-13; hb, trace. Quartz latite upper part of this cooling unit contains sanidine phenocrysts as long as 8 mm. Lower cooling unit, same location, contains 18-28 percent phenocrysts: q, 6-51; af, 11-38; pf, 12-62; b, 9-21 (in books); zircon, trace. Phenocrysts in lower parts of all three cooling units rarely exceed 2 mm in length. Cauldron-wide hydrothermal alteration (mostly propylitization) has led to albitic replacement of sanidine. Thickness 0-500 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tbr

Unit Name: Buff rhyolite

Map Unit Description

Buff rhyolite, in contrast to lapilli tuff (Tdq, see below), is nearly aphyric, containing only about 1 percent phenocrysts consisting of plagioclase (0.5-1.5 mm in length), traces of biotite, and an altered prismatic mafic mineral. Rhyolite is flow laminated and layered; either it is an unusually widespread lava or it originated as an extremely hot ash-flow tuff that has not retained any identifiable fragmental or pyroclastic textures. Mapped in northwestern part of cauldron complex, where it presumably occupies same stratigraphic position as lapilli tuff. Thickness 0 to more than 300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tpl

Unit Name: Perlitic rhyolite

Map Unit Description

Three rhyolite cooling units separated by green epiclastic sediments. All units have black vitrophyre at base and grade upward to devitrified, lavender to salmon, flow-layered lava or high-temperature, densely welded tuff. Upper cooling unit is ash-flow tuff having nonwelded top. Upper unit vitrophyre in headwaters of Rush Creek (44°56.5’ N., 115°00’ W.) contains 14 percent phenocrysts: pf, 82; af, 11; hb, 7; cpx, trace. Lower unit, same location, contains 3-5 percent phenocrysts: pf, 31-76; af, 24-69; hb, 0-2; cpx, trace. Phenocrysts rarely exceed 2 mm in length. Thickness 0 to more than 300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdq

Unit Name: Dime- and quarter-size lapilli tuff

Map Unit Description

A complex sequence of ash-flow tuff, commonly separated by beds of tuffaceous sandstone and siltstone, and locally by thin black latite lava. Eruption of these tuff units caused initial collapse of Thunder Mountain cauldron complex. They are Thunder Mountain analog of tuffs of Camas Creek-Black Mountain (Tc, see p. 6) in Van Horn Peak cauldron complex. Most are densely welded and contain collapsed pumice lapilli that in plan view are about the size of dimes and quarters; locally larger. Lapilli are mostly dark green or brownish green and contrast with lighter colored green-gray or buff matrix. Tuffs are pervasively propylitized and mafic minerals are altered to chlorite, calcite, and iron oxide. In contrast to overlying tuff (Tsl), lapilli tuff (Tdq) is chiefly pyroxene-bearing. In a specimen from Indian Creek (44°50' N., 115°15' W.), pyroxene is principally clinopyroxene. Phenocrysts generally less abundant and smaller than those in lower tuff of Sunnyside (Tsl), and most tuffs are quartz poor. Phenocrysts (9-16): q, trace-5; af, 2-8; pf, 70-83; b, trace-2; hb, 0-4; cpx (mostly altered), trace-16. Some crystal-poor, quartz-free, flow-layered tuffs near head of Prospect Creek (44°48' N., 114°55' W.), east of Marble Creek, contain more alkali feldspar than plagioclase. Similar tuffs occur west of Shellrock Peak (44°57' N., 114°57' W.) just below perlitic rhyolite (Tpl). Thickness 0 to more than 500 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdql

Unit Name: Lower densely welded tuff

Map Unit Description

Quartz-rich, gray tuff within lower latite lava (Tll, see below)-that closely resembles lower tuff of Sunnyside (Tsl). Phenocrysts (23-30): q, 27-35; af, 20-26; pf, 34-38; b, 1-3; hb, trace-1; altered mafic mineral, 2-11. Thickness 0 to more than 30 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tll

Unit Name: Lower latite lava

Map Unit Description

Mostly dark-gray and dark-purplish-gray, flow-layered lava consisting both of crystal-poor flows that probably are about same composition as much younger latite of Lookout Mountain (Tla) and conspicuously porphyritic flows that probably are dacite or rhyodacite in composition. Porphyritic flows contain 30-40 percent phenocrysts of plagioclase as long as 6 mm and abundant mafic minerals, consisting of varying proportions of biotite, hornblende, and pyroxene. Potassium-argon ages reported by Leonard and Marvin (1982) suggest an age range of 48-50 m.y. for this sequence-virtually the same as reported for older intermediate lava (Tdf) exposed farther east and southeast (McIntyre and others, 1982). Sanidine yielded an age of 50.8±1.7 m.y. (see table 1). Thickness 0 to more than 500 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcv

Unit Name: Challis Volcanic Group, undivided

Map Unit Description

Thunder Mountain cauldron complex and environ:
Thickness 0 to more than 50 m.

Western and south-central parts of quadrangle:
Includes three small ridge caps of rhyolite and discordant rhyolitic tuff near headwaters of North Fork of Boise River (44°05’ N., 115°11’ W.) and, in northern part of area, exposures on headwaters of Rapid River (44º40’ N., 115º02’ W.) and on headwaters of Riordan Creek (44°49’ N., 115°24’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tqp

Unit Name: Quartz porphyry intrusions

Map Unit Description

Dikes and plugs of pink porphyry that varies greatly in size of phenocrysts and texture of groundmass; typically contains smoky quartz phenocrysts as much as 3-4 mm long, tabular alkali feldspar and sparse plagioclase phenocrysts as much as 6-8 mm long, and sparse flakes and books of biotite as much as 3 mm long, in dense micrographic groundmass of quartz and alkali feldspar; commonly, however, has microgranular or cryptocrystalline groundmass. Locally contains extremely large phenocrysts of resorbed quartz in bipyramids as much as 1 cm long and alkali feldspar and plagioclase phenocrysts as much as 3 cm. long in graphic groundmass. Single large sanidine crystal 3 cm long from dike east of Yellowjacket Creek (44°59’ N., 114°24’ W.) yielded a potassium-argon age of 44.4±1.0 m.y. (see table 1). The quartz porphyry is described as pink granophyre by Ross (1934). Some dikes contain rhyolite without quartz phenocrysts; in places these quartz-poor dikes were included with lapilli tuff (Tdq), in other places with rhyolite intrusions Tr, see below). Phenocrysts (19-35): q, 15-58; af, 37-83; pf, 0-12; b, trace-4.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tmi

Unit Name: Mafic intrusions

Map Unit Description

Dikes and plugs of basaltic composition similar to or same as basaltic lava (Tb, see below). Includes mafic to intermediate rocks, near Van Horn Peak and elsewhere, that are conspicuously porphyritic, containing phenocrysts of pyroxene (hypersthene, pigeonite, or both) and plagioclase as long as 5 mm; locally contains sparse biotite and hornblende.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tvp

Unit Name: Tuff of Van Horn Peak

Map Unit Description

Vent-filling tuff exposed about 10 km south of Black Mountain consisting of a discontinuous outer rim as much as 50 m wide of light-gray tuff that is virtually identical to basal part of tuffs of Camas Creek-Black Mountain (Tc), and a core, 1 km or more in diameter, of tuff that appears identical to tuff of Table Mountain (Ttm).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tg

Unit Name: Granite

Map Unit Description

Thunder Mountain cauldron complex and environs, Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Corresponds to "Casto pluton" of Ross (1934) and of Cater and others (1973). Mostly equigranular pink granite: q, 22-34 (0.2-5 mm long); af (perthitic cloudy orthoclase and microcline), 31-57 (0.5-10.0 mm. long); pf, 18-33; b, 20-37; hb, 0-3.5; trace amounts of sphene and allanite. These rocks plot in granite field of both Johannsen (1948) and Streckeisen (1973). Also includes light-gray rocks that are distinctly richer in plagioclase and fall in quartz monzonite field of Johannsen (1948). Armstrong (1975) reports potassium-argon age on biotite of 43.9±1.3; Leonard and Marvin (1982) report potassium-argon age from the same locality, also on biotite, of 47.8±1.9 m.y. (see table 1). On Loon Creek (44°43' N., 114°48' W.), biotite from the granite has a potassium-argon age of 45.1±1.6 m.y. (see table 1). Biotite from fine-grained, light-gray rock exposed near Grouse Lake (44°50' N., 114°41' W.) has a potassium-argon age of 46.6±1.6 m.y.

Western and south-central part of quadrangle:
Pink to gray, medium- to coarse-grained granite characterized by pink perthitic feldspar. Relative proportion of salic minerals (calculated from the CIPW norm): q, 39; af, 34; pf, 27. Rock contains miarolitic cavities, locally lined with smoky quartz crystals, and is more radioactive than granodiorite of Idaho batholith. Hornblende from one sample was dated by potassium-argon methods at 44.3±1.3 m.y. (see table 1). Granite includes part of Sawtooth batholith (Reid, 1963).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Thg

Unit Name: Hornblende granite

Map Unit Description

Corresponds to hornblende granite of Ross (1934). Mostly buff to pink, medium-grained hornblende granite (Johannsen, 1948); however, one sample from Marble Creek (44°48’ N., 114°58’ W.) and one from Loon Creek (44°44’ N., 114°49’ W.) are quartz syenite (Streckeisen, 1973). A sample from just south of Woodtick Summit (44°47’ N., 114°41’ W.) contained less quartz and alkali feldspar and is quartz monzonite according to both classifications. Rock in all three places tends to weather rusty. Composition of samples from Woodtick Summit area, Loon Creek, and Marble Creek, respectively: q, 8.3, 9.3, 13.4; af (mostly cloudy orthoclase), 39.7, 54.9, 57.4; pf, 36.7, 20.1, 12.1; b, 2.2, 0.6, 1.3; hb, 13.1, 12.5, 15.1. Loon Creek and Marble Creek samples each contained several grains of allanite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Toc

Unit Name: Colluvium of Panther Creek

Map Unit Description

Poorly consolidated sandstone, mudstone, boulder conglomerate, and tephra; locally carbonaceous; includes large landslide masses of diverse volcanic rocks. Deposited during subsidence of Panther Creek graben after extrusion of younger part of monolith-forming tuff (Tmt). Some subsidence of graben may have been due to magma withdrawal, but most was probably due to regional rifting concurrent with volcanism. This incompetent sequence of rocks is easily eroded, and landslides are common.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tmt

Unit Name: Monolith-forming tuff

Map Unit Description

Varicolored, nonwelded to partly welded ash-flow and ash-fall rhyolite tuff. Sequence overlies and underlies a single genetically related, densely welded cooling unit of tuff of Castle Rock (Tck) having identical phenocryst mineralogy. Lower part of monolith-forming tuff locally includes unrelated soft, bedded tuff containing abundant biotite; includes several zones rich in small, variegated volcanic lithic fragments. Rock above and below tuff of Castle Rock (Tck) weathers to tepee-shaped hoodoos and other variously shaped monoliths. Unit typically contains vitric, silky pumice lapilli and fresh black glass shards, but zeolitized and otherwise altered in many places. Phenocrysts, (15-25): q, 33-50; af, 50-60; pf, 0-3. b, 0-1; hb, 0-trace; px (mostly pseudomorphs), 0-3; commonly contains smoky quartz and chatoyant alkali feldspar. Thickness 0-300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tck

Unit Name: Tuff of Castle Rock

Map Unit Description

Within cauldron includes five cooling units of reddish ash-flow tuff and thin interbeds of ash-fall tuff. Upper cooling unit is densely welded and about 228 m thick. Beneath upper unit are, successively, two thin, partly welded, lithic-rich cooling units, each about 30 m thick; a cliff-forming, moderately welded cooling unit about 150 m thick; and a lowermost slope-forming, partly welded cooling unit rich in lithic fragments, about 190 m thick. Densely welded upper unit is inferred to correlate with densely welded part of outflow unit (Tmt). If this is the case, soft tuff preserved above densely welded unit in Panther Creek graben has been stripped away at Castle Rock (44°49’ N., 114°25’ W.). Phenocrysts, upper cliff-former (28): q, 47; af, 50; pf, 0.7; b, 0.3-0.7; altered cpx, 0.7; (base) to 2.9 (top). Phenocrysts in lower cliff former show considerable variation from base to top: q, 15 (base) to 45 (top); af, 78 (base) to 49 (top); pf, 3.8 (base) to 4.1 (top); b, trace (base) to 1.0 (top); hb, trace; cpx, 3.1 (base) to 1.4 (top). Same minerals are present in thin cooling units between cliff-formers and in thick, moderately welded lower unit. Quartz is slightly smoky throughout sequence, and all units contain zones of chatoyant alkali feldspar. Total thickness 620 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tfl

Unit Name: Flow-layered rhyolite

Map Unit Description

Probably at least two cooling units of reddish flow-laminated and layered rhyolite lava or remobilized tuff; had a source outside Castle Rock cauldron but is intercalated with tuff of Castle Rock (Tck) within Panther Creek graben. Phenocrysts (8-11): q, 0-3; af, 80-95; pf, 0-5; b, 0-trace; altered px, 2-12.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tb

Unit Name: Basaltic lava

Map Unit Description

Black and brownish-gray lava that probably ranges in composition from potassium-rich basalt to trachyandesite or latite; vesicular to dense; contains scattered small (0.5-2 mm long) phenocrysts of pyroxene and plagioclase in pilotaxitic groundmass composed of plagioclase laths, pyroxene, and glass; locally contains small altered olivine phenocrysts and commonly contains xenocrysts of quartz that have reaction rims composed of tiny pyroxene prisms and glass. Unit is intercalated with rocks as young as basal tuff of Castle Rock (Tck) and with rocks as old as tuff of Ellis Creek (Te, see p. 8). Thickness 0-50 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tqb

Unit Name: Quartz-biotite tuff

Map Unit Description

Light-green-gray and reddish-gray, locally flow-layered, densely welded ash-flow tuff erupted during collapse of Castle Rock cauldron segment (see table 4). Consists of at least two cooling units. Locally, unit in Panther Creek graben is flow laminated and layered from base to top; these characteristics indicate that hot ash flows there coalesced to liquids before coming to rest. Elsewhere, especially on slopes south of West Fork of Camas Creek (44°47’ N., 114°35’ W.), rock is only locally flow layered and displays zones containing abundant brown-green pumice lapilli that are darker than light-gray or light-greenish-gray enclosing matrix. Abundance and relative proportions of phenocrysts vary greatly. Phenocrysts (20-35): q, 19-50; af, 25-45; pf, 15-40; b, 2-20; hb, trace-5; px, trace. Some quartz phenocrysts in this unit show a peculiar tendency to be biaxial, even where they are not obviously strained. They tend to be smoky and nearly everywhere are incipiently to strongly resorbed. Allanite is a common accessory mineral. Thickness 0-300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tap

Unit Name: Alkali feldspar-plagioclase tuff

Map Unit Description

Light-greenish gray and reddish-gray tuff, commonly altered to yellow and various pastel shades; flow-layered and laminated, densely welded, locally containing recognizable well-flattened pumice lapilli. Ash flows in this unit coalesced to liquids before they stopped flowing. Named for sparse, but conspicuous, euhedral phenocrysts of water-clear, "plate glass" tabular alkali feldspar crystals as long as 5-6 mm and altered and inconspicuous euhedral plagioclase crystals as long as 5-6 mm. Spherulitic in several localities; unit has an altered perlitic basal vitrophyre. Phenocrysts (6-10): af, 30-40 (locally as much as 50); pf, 45-66; altered mafic mineral (probably pyroxene), 2-8. Unit is intruded by dense rhyolite at Singheiser (44°51’ N., 114°24’ W.) and Rabbit Foot (44°53’ N., 114°20’ W.) mines and is weakly mineralized. Thickness 0-300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdt

Unit Name: Dirty tuff

Map Unit Description

Three thin, vitric cooling units of densely welded ash-flow tuff rich in lithic fragments. Recognized only in Panther Creek graben. Locally flow laminated and devitrified; typically having vitric gray matrices and well-flattened black, glassy pumice fragments as long as 15 cm; locally called "tiger rock." These units are crystal-poor, plagioclase-bearing tuff that most closely resembles some of the crystal-poor plagioclase tuff in dime- and quarter-size lapilli tuff (Tdq) exposed near Shellrock Peak (44°57.5’ N., 114°56’ W.). Thus, these three units presumably are distal ends of very hot ash flows erupted from Thunder Mountain cauldron complex to west, although their counterparts there have not been positively correlated. Phenocrysts (2-9): af, 0-6; pf, 75-98 (0.4-2 mm long, extensively resorbed); b, 0-trace; hb, 0-trace; opx, trace-19. Thickness 0-150 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tc

Unit Name: Tuffs of Camas Creek-Black Mountain

Map Unit Description

A cauldron-filling sequence of mostly very densely welded ash-flow tuff consisting of 10 or more separate cooling units that all are characterized by small phenocrysts (about 2 mm long) that in upper part of sequence consist of plagioclase and fairly abundant mafic minerals, in middle part consist of plagioclase and sparse to moderate amounts of alkali feldspar, and in lower part consist of plagioclase and sparse alkali feldspar and quartz. Entire sequence contains abundant mafic minerals consisting mostly of altered pyroxene, and includes variable amounts of biotite and sparse hornblende. Lower part of sequence has more biotite and hornblende than pyroxene. Assemblage is similar to tuff of Eightmile Creek (Tem, see below) although phenocrysts make up a greater proportion of tuff of Eightmile Creek. Phenocrysts in upper cooling unit (11-40): q, 0-trace; af, 0-trace; pf, 67-75; b, trace-13; altered hb, 0-trace; altered pyroxene, 10-20. Phenocrysts in middle cooling unit (5-25): q, 0-trace; af, trace-20; pf, 65-77; altered b, trace-9; altered hb, trace-3; altered px, 3-10. Phenocrysts in lower cooling unit (3-15): q, 2-12; af, 2-8; pf, 60-75; altered b, 2-10; altered hb, trace-3; altered px, trace-10. Sequence appears to have been almost entirely confined to cauldron complex formed principally as result of eruption of tuff of Ellis Creek (Te, see below). Only thin, partly welded ash-flow tuff and minor ash-fall tuff appear outside the complex. Outflow units are mapped with tuff of Pennal Gulch (Tp, see below). Thickness 0-3,000 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ttm

Unit Name: Tuff of Table Mountain

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Outflow equivalent of tuff of Van Horn Peak. See below for additional description.

Corral Creek cauldron segment and area north and east of Challis:
Pale-grayish-red to yellowish-brown, densely welded rhyolite or quartz latite ash-flow tuff, probably a simple cooling unit. Phenocrysts (10-13): pf, 82-90; b, 7-13; altered px, 2-5. Black basal vitrophyre a few meters thick contains abundant small volcanic lithic fragments a few millimeters to a few centimeters in diameter. Biotite from vitrophyre has a potassium-argon age of 47.8±1.7 m.y. (see table 1). Unit has reversed magnetic polarity. Source for this unit is a vent at Van Horn Peak (44°46.5’ N., 114°19.5’ W.)-(Ekren, 1981). Thickness 0 to more than 100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcs

Unit Name: Tuffs of Camas Creek-Black Mountain and bedded strata, undivided

Map Unit Description

Thin ash-flow tuff cooling unit of Camas Creek-Black Mountain lithology interbedded with thin-bedded ash-fall tuff of similar lithology and lacustrine tuffaceous siltstone, sandstone, and conglomerate. Thickness 0-100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tpq

Unit Name: Quartz-phenocryst perlite

Map Unit Description

Pink and orange-gray, flow-laminated, hydrated rhyolite glass that has retained its perlitic texture despite deep weathering and alteration; mapped in all localities to include subjacent and superjacent horizontal beds of tuff and tuffaceous sandstone. Quartz is amethystine to smoky and as much as 4 mm long. Phenocrysts (21-33): q, 27-35; af, 9-31; pf, 19-47; b, 6-12; hb, 4-6.5; altered px, 2. Thickness 0-35 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tem

Unit Name: Tuff of Eightmile Creek

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Two or more cooling units of green-gray quartz latitic and rhyodacitic ash-flow tuff that together are more than 300 m thick near Sleeping Deer Mountain (44°46' N., 114°41' W.) within cauldron complex, but rarely exceed a few tens of meters each outside cauldron complex or Custer graben. Unit overlies tuff of Ellis Creek (Te), underlies the tuffs of Camas Creek-Black Mountain (Tc), and locally shares some characteristics of each unit. Included in tuff of Pennal Gulch (Tp) south of Table Mountain. Where densely welded and rich in phenocrysts, it is not easily distinguished from tuff of Ellis Creek; it differs only in containing significant amounts of alkali feldspar and fewer mafic minerals. Phenocrysts (14 (weakly welded) to 46 (densely welded within the cauldron complex)): q, 10-22; af, 6-16; pf, 44-63; b, 6-16; hb, 1-5; px, trace-2. Unit contains abundant apatite, modest amounts of zircon, and sparse allanite as accessories. Most quartz phenocrysts are slightly embayed. Large grains that are extensively embayed are common. Biotite from exposures of this unit near West Fork of Morgan Creek (44°43' N., 114°15' W.) has potassium-argon age of 48.4±1.7 m.y. (see table 1), which agrees with stratigraphic position of this tuff, below 47.8-m.y.-old tuff of Table Mountain (Ttm). Thickness 0 to more than 300 m.

Corral Creek cauldron segment and area north and east of Challis:
Light-gray and green-gray, massive-weathering, partly welded and densely welded quartz latite or rhyodacite ash-flow tuff; appears to be simple cooling unit in Corral Creek area (44°45' N., 114°14' W.), where it is poorly exposed and, in most areas, was not mapped separately at base of tuff of Pennal Gulch (Tp). Phenocrysts (25-35): q, 13-19; af, 12-18; pf, 47-57; b, 9-14; hb, trace-2; cpx, trace. Thickness 0-50 m.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Erosional remnant of this tuff on lower Mill Creek (44°32' N., 114°17' W.) overlies thin-bedded tuffaceous sandstone, siltstone, and reworked pumice beds that in turn overlie aphanitic intermediate lava (TI, see p. 12). Tuff is light greenish gray to brownish gray, nonwelded, and only slightly devitrified; it contains pale-green to white pumice lapilli. Phenocrysts (approximately 26): af, 15; q, 22; pf (strong oscillatory zoning), 33; b, 23; hb (green), 7. On southwest side of Corkscrew Mountain (44°32' N., 114°23' W.), erosional remnants of tuff of Eightmile Creek are light gray to greenish gray, nonwelded, and pumiceous, containing medium-brownish-gray pumice lapilli that are darker than matrix. Crystals, as much as 2 mm long, commonly are broken. Phenocrysts (42): af, 15; q, 8; pf (strong oscillatory zoning), 64; b, 12; hb, 1. At Red Butte (44°39' N., 114°20.5' W.) about 60 m of this tuff underlies rhyolite of Red Butte (Trb). Tuff is nonwelded to partly welded, very pale gray, and rich in pumice. Phenocrysts (as much as 2.5 mm long) (27-33): af, 11-12; q, 17-22; pf (strong oscillatory zoning), 52-55; b, 13-15; hb, 0-2. From upper Spider Creek to upper Parker Creek (44° 38' N., 114° 33' W.), unit is greenish-gray, densely welded, and pumiceous; contains whitish-green pumice lapilli that generally are lighter than matrix. The tuff is altered to calcite and chlorite; sericite, clay minerals, and epidote locally are present. Biotite from sample from West Fork of Morgan Creek (44° 42' N., 114° 18' W.) has potassium-argon age of 48.4±1.7 (see table 1). Phenocrysts (25-35): af, 12-17; q, 9-27; pf, 43-

Geologic map unit descriptions

66; b, 7-18; hb, 2-4.

Custer graben area:
Gray, greenish-gray, pale-brown, and grayish-pink, bluff-forming, pumice-rich, crystal-rich, densely welded, quartz latitic ash-flow tuff characterized by phenocrysts, as much as 4 mm long, of plagioclase, quartz, sanidine, biotite, amphibole, clinopyroxene, orthopyroxene, zircon, apatite, and allanite. Biotite from vitrophyre exposed west of mouth of Tenmile Creek (44°28’ N., 114°35’ W.) has potassium-argon age of 47.5±1.3 m.y. (see table 1); this age supersedes previously published age of 46.9±1.6 m.y. (McIntyre and others, 1982). Unit has reversed magnetic polarity. On west side of Eightmile Creek about 4 km above its mouth (44º27’ N., 114º39’ W.), four cooling units having total thickness of more than 215 m are exposed.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Te

Unit Name: Tuff of Ellis Creek

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Rhyodacitic, crystal-rich ash-flow tuff characterized by phenocrysts of plagioclase, strongly resorbed quartz, and abundant biotite and hornblende, all of which are present in subequal amounts. Rocks exposed within cauldron complex commonly are partly altered to chlorite, epidote, and associated minerals. Locally, as along West Fork of Camas Creek (44°49' N., 114°18' W.), abundant very fine-grained magnetite darkens rock. Sample from northeast of Duck Peak (44°55' N., 114°29' W.), in Panther Creek graben, has potassium-argon age on biotite of 48.4±1.6 m.y. (see table 1). Thickness 0 to more than 2,000 m.

Corral Creek cauldron segment and area north and east of Challis:
Light-green-gray, massive-weathering, densely welded rhyodacite ash-flow tuff that is outflow from Van Horn Peak cauldron complex. A multiple-flow compound cooling unit or, possibly, two cooling units; everywhere contains conspicuous pumice; contains zones within which pumice lapilli are lighter than matrix and zones within which lapilli are darker than matrix. Phenocrysts (36-50): q, 4-15 (commonly "worm-eaten" and as long as 4 mm); pf, 60-75 (as long as 6 mm); b, 12-20; hb, 8-16; cpx, trace. Thickness 0-300 m.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Along lower Eddy Creek this unit consists of two outflow cooling units, each about 60 m thick, separated by 1-2 m of thin-bedded tuff and reworked, cross-bedded, fluvial tuffaceous sandstone containing abundant biotite. Ash-flow tuff in both cooling units is gray green and moderately welded; contains pale-green pumice lapilli as much as 3 cm long. Phenocrysts (28-34): q, 3-6; pf, 66-67; b, 22-24; hb, 5-6.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdf

Unit Name: Dacitic and rhyodacitic lava

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Principally cliff forming, dark-gray, conspicuously porphyritic lava of dacitic composition; blocky weathering; inconspicuous flow layering; unit locally includes phenocryst-poor, dark purplish-gray latite or andesite. Phenocrysts, dacitic lava (25-40): q, 0-trace; pf, 60-70 (as long as 6 mm); b, 0-4; hb, 15-23; cpx, trace-15; opx, trace. In some areas mafic minerals are oxidized to black opaque iron oxides or replaced by chlorite and iron oxide. Latite or andesite lava contains 5-15 percent phenocrysts (0.5-2 mm long) of plagioclase and clinopyroxene, and traces of orthopyroxene and oxidized hornblende; locally, pyroxene and hornblende phenocrysts are as long as 1 cm. Biotite from sample collected near Red Rock Peak (45°00' N., 114°25' W.), in Panther Creek graben, gave potassium-argon age of 48.6±1.7 m.y. (see table 1). Sample from Little West Fork of Morgan Creek (44°42' N., 114°19' W.) has potassium-argon age on biotite of 51.1±1.8 m.y. (see table 1). Thickness 0 to more than 1,000 m.

Corral Creek cauldron segment and area north and east of Challis:
Thickness 0-900 m.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex::
Rhyodacite lava and agglomerate exposed southeast of Challis Creek near Corkscrew Mountain (44°32' N., 114°23' W.) and north of Challis Creek (44°36' N., 114°20' W.) between Pats Creek and Eddy Creek. Dark-brown-weathering, brown to gray, porphyritic, locally vitrophyric, massive rhyodacite lava and coarse agglomeratic breccias containing 0.2-3 m blocks of monolithologic rhyodacite porphyry in matrix of glassy to devitrified rhyodacite. Phenocrysts (28-44): pf (as much as 5 mm long), 60-75; b, 1-14; px (both opx and cpx), 7-35; hb, 0-13. Contacts between massive and agglomeratic phases of unit are irregular and commonly steep. Cavities filled with chalcedonic silica locally abundant. Biotite from sample collected from southwest side of Corkscrew Mountain (44°32' N., 114°23 ' W.) has potassium-argon age of 50.4±1.8 m.y. (see table 1).

Custer graben area:
In Custer graben consists chiefly of crystal-poor, potassium-rich andesite that contains phenocrysts, generally smaller than 2 mm long, of plagioclase and clinopyroxene. Characterized by propylitic alteration in Sunbeam mine-Estes Mountain area (44º27' N., 114º44' W.) and in area surrounding Custer (44º23.5' N., 114º41' W.).

Southeastern part of quadrangle:
Contains heterogeneous group of rocks erupted from numerous vents scattered over area from Challis to south edge of quadrangle. Individual, local units generally can be consistently distinguished during mapping at large scales (see, for example, Hobbs and others, 1975). Compositions mainly dacite and rhyodacite; contain as phenocrysts various combinations of the minerals plagioclase, biotite, amphibole, clinopyroxene, orthopyroxene, and, uncommonly, olivine or quartz. Includes minor amounts of potassium-rich andesite characterized by phenocrysts of pyroxene and(or) olivine. Has normal and reversed magnetic polarity. Ranges in age from about 49 m.y. to about 51 m.y. Potassium-

argon ages on biotite are 49.2±1.2 m.y. and 51.1±1.7 m.y.; plagioclase is dated at 49.3±1.4 m.y. (see table 1).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tmz

Unit Name: Intermediate lava and breccia of mixed zone

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
This lava crops out east of Morgan Creek Summit (44°47’ N., 114°15’ W.). Same description as below.

Corral Creek cauldron segment and area north and east of Challis:
A heterogeneous mixture of mafic and dacitic lava and flow breccia interbedded with tuff breccia, mud flows, and debris flows; locally includes well-stratified boulder and cobble conglomerate containing petrified tree stumps and logs; entire sequence principally forms slopes, but in and adjacent to canyons weathers to hoodoos and monoliths. Matrix of breccia and mud flows is rich in montmorillonite and weathers to spongy texture; slimy when wet. Individual tabular lava flows are mostly latite or andesite that appears to be same composition as lava in younger map unit Tl. Tabular lava flows are dark purplish gray and brownish gray; vesicular. Phenocrysts (5-30): pf, 55-70 (0.5-2 mm long); cpx, 10-20 (mostly less than 3 mm long); opx, 10-20 (mostly less than 2 mm long); hb, trace-5. In hand specimens of some of these mafic lavas, only clinopyroxene (as long as 1 cm) as phenocrysts is visible, whereas in others hornblende (as long as 3 cm) is only apparent phenocryst. Groundmasses are principally pilotaxitic. Dacitic lava and breccia are identical in composition to cliff-forming, conspicuously porphyritic lava (Tdf), but in this unit they consist mostly of slope-forming flow breccia. A porphyritic rhyodacite lava near base contains same phenocryst assemblage as tuff of Ellis Creek (Te). Thickness 0-900 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tinm

Unit Name: Intermediate and mafic intrusions

Map Unit Description

Corral Creek cauldron segment and area north and east of Challis:
Similar to intermediate and mafic lavas (Tl), listed on p. 17.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Includes dark-gray to bluish-black, dark-brown-weathering, aphanitic, porphyritic, intermediate intrusive rocks containing 3-5 percent euhedral plagioclase phenocrysts as much as 6 mm long and 1-2 percent altered euhedral pyroxene phenocrysts. Exposed on Challis Creek at mouth of Eddy Creek (44°35’ N. 114°19’ W.) and on Moose Creek (45°48.5’ N., 114°10’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tl

Unit Name: Potassium-rich andesite, latite, and basalt lava

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben, southeastern part of quadrangle, and Twin Peaks caldera and southern part of Van Horn Peak cauldron complex: Predominantly aphyric, reddish-brown-weathering, gray, purple, and greenish-gray, blocky to platy lava, locally containing interbedded oxidized breccia. Olivine and pyroxene occur as phenocrysts in some samples. Plagioclase not commonly found as phenocrysts. Microphenocrysts include olivine, clinopyroxene, orthopyroxene, and sieve-textured plagioclase. Quartz xenocrysts commonly present. Plagioclase-rich groundmass commonly is trachytic or pilotaxitic and may contain apatite and reddish-brown, strongly pleochroic mica. In region surrounding Challis, rock compositions range from potassium-rich andesite to potassium-rich basalt, andesite probably predominating. Farther south, in area between East Fork of Salmon River and Jerry Peak (44°03.5' N., 114°06.5' W.), compositions range from potassium-rich andesite to latite. Latite is more common toward top of section. Magnetic polarity indeterminate in area near Challis; lava toward south has reversed magnetic polarity. Near Challis, the lava overlies tuff of Ellis Creek (Te, 48.4±1.6 m.y.) and is overlain by tuff of Eightmile Creek (Tem, 48.4±1.6 m.y. and 47.5±1.3 m.y.) and tuff of Table Mountain (Ttm, 47.8±1.7 m.y.). Toward south, lava overlies tuff dated at 49.0±2.9 m.y. (Tvs) and is overlain by tuff of Herd Lake (Th, 48.1±1.7 m.y.).

Corral Creek cauldron segment and area north and east of Challis:
In Corral Creek area (44°45' N., 114°14' W.), thickness is 0-700 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdm

Unit Name: Tuff of Degan Mountain

Map Unit Description

Pink and reddish-gray, densely welded rhyodacite ash-flow tuff, uncommonly rich in mafic minerals; appears to have erupted from west flank of Degan Mountain (44°57' N., 114°06.5' W.) where composite vent also contains mafic, nonfragmental intrusive rock (Tinm). Contains numerous small quartz phenocrysts about 1 mm long and a few slightly larger quartz xenocrysts that have reaction rims of tiny pyroxene microlites and glass. Phenocrysts (20-32): q (includes xenocrysts), 5-15; af, 4-18; pf, 29-58; b, 2-8; hb, 14-36; cpx, 6-26; opx, trace. Thickness 0-50 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tlt

Unit Name: Lithic tuff of Corral Creek

Map Unit Description

Reddish-gray, greenish-gray, and yellowish-gray, densely welded, cliff-forming dacite or rhyodacite ash-flow tuff rich in lithic fragments; possibly comprising two separate multiple-flow cooling units. Phenocrysts (13-38): q, 0-1; pf, 72-85; b, 0-4; hb, 3-5; opx, 7.5-22. Extrusion of this tuff apparently triggered subsidence of Corral Creek segment of Van Horn Peak cauldron complex (see table 4). In places, tuff grades upward into debris flow containing abundant latite and dacite clasts. Thickness 0-200 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tfr

Unit Name: Flow-laminated rhyolite or quartz latite lava

Map Unit Description

Yellowish-brown, slope-forming, massive-weathering, aphyric rock; in most exposures this rock more closely resembles massive siltstone than volcanic rock. Thin sections contain a crystal or two of albite (2 mm long) and a single flake of biotite in groundmass of dense felt of alkali feldspar microlites.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trf

Unit Name: Rhyolite dikes, plugs, and flows

Map Unit Description

Light-gray, tan, and pinkish-red, generally crystal-poor or only moderately crystal-rich, porphyritic intrusive rocks and minor flows. Rock typically contains phenocrysts of quartz and sanidine in variable amounts; plagioclase locally present in minor amounts. Locally contains minor biotite and, rarely, trace amounts of pyroxene. These rocks display fabrics ranging from massive to flow laminated to autobrecciated. In thin section, textures vary from glassy to devitrified to fine grained, allotriomorphic, and granular. In ridges between East Fork of Mayfield Creek and Yankee Fork (44°30’ N., 114°40’ W.) at least two generations of rhyolite are present. Older rhyolite is glassy to devitrified and is intruded by dikes and pluglike masses of more massive rhyolite. Narrow rhyolite dikes and irregularly shaped intrusive masses pervade west and north margins of Twin Peaks caldera and crosscut lower part of tuff of Challis Creek (Tcrl, see p. 12) and the caldera-wall slump debris (Tsd, see p. 11). Potassium-argon age of sanidine is 46.5±1.7 (see table 1).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tfd

Unit Name: Felsic dike rocks

Map Unit Description

Light-gray to brown-gray, light-brown-weathering dikes of porphyritic trachyte and(or) rhyolite that contain phenocrysts of sanidine, as long as 5 mm, and locally contain minor amounts of pyroxene and biotite. Plagioclase crystals, where present, generally are small, resorbed, and mantled by alkali feldspar. These dike rocks occur principally within Twin Peaks caldera, where they intrude tuff of Challis Creek (Tcrl, see p. 12) and caldera-wall slump debris (Tsd, see p. 11).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tpe

Unit Name: Intrusive rocks of Pats Creek-Upper Eddy Creek

Map Unit Description

Light-gray to pinkish-red or lavender, red- to lavender-weathering, fissile to flaggy, flow-laminated, and locally autobrecciated intrusive rock along north and east margins of Twin Peaks caldera. Phenocrysts (9-21): af, 0-25; pf (strong oscillatory zoning), 53-69; b, 17-34; hb, 0-5. Locally, near contacts, rock is black and vitrophyric or perlitic, devitrified, and gray-green weathering. Rock has steep to vertical flow foliation and locally has isoclinal flow folds with steep to vertical axial planes of variable strike. Locally, this rock contains cavities lined with chalcedonic quartz. In hand specimen, rock resembles rhyolite of Red Butte (Trb, see p. 13), except that, unlike rhyolite of Red Butte, it generally contains scattered sanidine phenocrysts. Unit is in intrusive contact with tuff of Challis Creek (Tcr) in upper Pats Creek area (44°36’ N., 114°21’ W.) and in upper Eddy Creek above Eddy Basin (44°40’ N., 114°27.5’ W.). A pluglike mass (not shown on map) containing plagioclase, biotite, sanidine, and hornblende phenocrysts is on Spider Creek (44°40.5’ N., 114°26.5’ W.). This rock is light greenish-gray, medium-brown weathering, and steeply flow foliated; it contains abundant gas cavities lined with rosettes of gypsum and minor calcite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tii

Unit Name: Intermediate dikes or flows

Map Unit Description

Dark-brown to purple-brown, dark-brown-weathering, porphyritic dikes or flows containing abundant phenocrysts as much as 3 mm in length of plagioclase and pyroxene, less abundant hornblende, and minor biotite. On lower Bear Creek (44°34.5’ N., 114°24’ W.) a probable dike of this unit, which appears to occupy ring-fracture fault of Twin Peaks caldera, contains phenocrysts of sanidine in addition to above minerals. Contacts of this unit near Mosquito Flat Reservoir (44° 31’ N., 114°26’ W.) are not exposed, and relations with tuff of Challis Creek (Tcr) are uncertain.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdi

Unit Name: Dikes and plugs of intermediate composition

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben:
Not shown separately in this area. Massive to faintly flow-laminated and locally vitrophyric at intrusive margins. Present in area of East Fork of Mayfield Creek (44°29' N., 114°37' W.) and in Custer graben. In upper Tenmile Creek area (44°28' N., 114°37' W.), reddish-brown to lavender, porphyritic rhyodacite intrudes tuff of Eightmile Creek (Tem) and is intruded by porphyritic rhyolite (Trf). Phenocrysts (22-25): pf, 54-58; b, 10-15; hb, 23-26; op, 5-7. Potassium argon age of intrusive mass on upper Tenmile Creek is 46.0±1.7 m.y. (biotite); 48.9±2.9 m.y. (hornblende).

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Massive to faintly flow-laminated and locally vitrophyric at intrusive margins. Present in area of East Fork of Mayfield Creek (44°29' N., 114°37' W.) and in Custer graben. In upper Tenmile Creek area (44°28' N., 114°37' W.), reddish-brown to lavender, porphyritic rhyodacite intrudes tuff of Eightmile Creek (Tem) and is intruded by porphyritic rhyolite (Trf). Phenocrysts (22-25): pf, 54-58; b, 10-15; hb, 23-26; op, 5-7. Potassium-argon age of intrusive mass on upper Tenmile Creek is 46.0±1.7 m.y. (biotite); 48.9±2.9 m.y. (hornblende) (see table 1).

Custer graben area:
Brown- and reddish-brown-weathering, crystal-poor rocks that contain phenocrysts less than 2 mm in length of plagioclase, amphibole or pyroxene, and minor biotite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tip

Unit Name: Intermediate intrusive rocks of Spider Creek-Parker Creek

Map Unit Description

Medium- to dark-gray, brownish-gray, gray- to brown-weathering, porphyritic intrusive rock containing abundant phenocrysts of plagioclase as long as 7 mm and less abundant hornblende, pyroxene, and minor biotite in pilotaxitic microcrystalline to devitrified, blotchy matrix. Where fine-grained, rock has steep flow foliation of variable strike and in places flow folds have steep axial planes. This rock intrudes tuffs of Camas Creek-Black Mountain (Tc) at head of Parker Creek (44°37' N., 114°32' W.). Unit is intruded by rhyolite (Trf).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsd

Unit Name: Caldera-wall slump debris (megabreccia)

Map Unit Description

Heterogeneous deposit of coarse talus and megabreccia (following usage of Lipman, 1976) interfingering and admixed with ash-flow tuff. Deposits of this material are localized along ring-fracture system on southeast margin of Twin Peaks caldera (44°34’ N., 114°23’ W.) and in northern part of caldera, where they extend into caldera from its north and west margins. In lower part of unit are bedded, indurated, coarse conglomeratic sandstone and angular talus deposits, resembling concrete on fresh fracture; these deposits also form thin, lens-like layers and pods throughout the map unit. Megabreccia consists of tuffaceous matrix-supported to block-supported deposits of angular, unsorted pebble- to boulder-size clasts and house-size blocks of ash-flow tuff, intermediate and siliceous lava, epiclastic rock, and abundant fragments of tuff of Challis Creek. Ash-flow tuff matrix of megabreccia is nonwelded and crystal poor; it resembles tuff of Challis Creek except for higher plagioclase content. Phenocrysts (4-20): af, 40-47; q, 37-57; pf, 3-17; b, trace. Thickness more than 400 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcru

Unit Name: Tuff of Challis Creek, upper unit

Map Unit Description

Multiple flow, compound cooling unit of crystal-rich rhyolite ash-flow tuff. Phenocrysts (22-26 in basal nonwelded tuff, 36-44 in remainder of unit): af, 54-69; q, 25-45; pf, 0-3; b, trace; hb, rare; px, 0-4.5. Accessory minerals are zircon, allanite, and trace amounts of apatite. Sanidine phenocrysts, as long as 5 mm, are chatoyant. Quartz phenocrysts commonly are slightly resorbed, bipyramidal, and smoky. Phenocrysts are somewhat smaller and less abundant in basal part of unit than in densely welded tuff. This unit, like middle and lower cooling units (Tcrm and Tcrl), has little or no plagioclase or ferromagnesian minerals. Plagioclase does not generally exceed 0.5 percent of total phenocrysts, biotite is uncommon, and minor pyroxene grains are preserved only in most densely welded tuff. Except locally near base, this unit is medium-gray to brownish-gray, brown-weathering, densely welded, devitrified ash-flow tuff containing pumice lapilli as much as 12 cm long and 3 cm thick (uncommonly as much as 26 cm long and 2 cm thick) and scattered pebble- to cobble-size fragments of gray to lavender, aphyric intermediate to rhyolitic lava. Pumice lapilli are in places medium to rusty brown and darker than matrix or light gray and lighter than matrix. Sanidine has been dated by 40Ar-39Ar methods at 45.5±0.3 m.y. (see table 3). At base, this tuff is light gray to light brown, nonwelded to moderately welded, and glassy and contains more abundant lithic fragments than do rocks exposed above; lithic fragments less than about 8 cm in diameter constitute 4-6 percent of rock and include porphyritic intermediate lava, light-gray, flow-banded rhyolite (in places as much as 1 m long at base of unit), and fragments of ash-flow tuff that has mineralogy of tuff of Challis Creek. The most pumiceous nonwelded to moderately welded basal part of tuff is as much as 60 m thick and is overlain by densely welded tuff at the base of which is a laterally discontinuous vitrophyre as much as 6 m thick. Original top of unit is not exposed. Thickness is more than 700 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcrm

Unit Name: Tuff of Challis Creek, middle unit

Map Unit Description

Two, or possibly three, cooling units of light-gray to greenish-gray or brownish-gray, partly to densely welded, pumiceous rhyolite ash-flow tuff that weathers gray, light brown, or lavender. Phenocrysts (as much as 2 mm long) (15-26): af, 43-59; q, 38-57; pf, 0-trace; b, 0-1.5; px, 0-2. Pumice lapilli in upper cooling unit are greenish brown, darker than matrix, and as much as 6 cm, but generally less than 1 cm, long. In lower cooling unit, pumice lapilli are pale greenish gray and lighter than matrix. Sanidine from zeolitized middle unit gives an 40Ar-39Ar age of 45.9±0.2 m.y. (see table 3). Middle unit (Tcrm) typically is in sharp contact with overlying upper unit (Tcru). There are concentrations of lithic fragments near contact. Middle unit locally overlies thin tuffaceous sediments at contact with underlying lower unit (Tcrl). Thickness 22-48 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcrl

Unit Name: Tuff of Challis Creek, lower unit

Map Unit Description

Light- to dark-brownish-gray, brownish-gray-weathering, moderately to densely welded, crystal-rich, pumiceous rhyolite ash-flow tuff. Phenocrysts (2-4 mm long) (15-48): af, 50-71; q, 26-47; pf, 0-3 (generally less than 0.5); b, rare; px (preserved only in vitrophyre), 0-2. Variable amounts of pumice and vertical variation in compaction (welding zonation) within this unit, especially in upper part, suggest compound cooling. Unit shows similar alternating variations in crystal and lithic fragment content. Lithic fragments generally are small and scattered but locally are as much as 0.3 m in diameter and constitute as much as 10 percent of rock. They consist principally of flow-banded, aphyric, felsic lava and moderately crystal-rich, quartz- and sanidine-bearing ash-flow tuff that resembles tuff of Challis Creek. Pumice is lighter or darker than matrix depending on degree of welding, and lapilli commonly range from 1 to 6 cm in diameter but can be as much as 15 cm. Vitrophyric zones of this unit locally are as much as 22 m thick. Tuff forms distinct buff to pale-green, treeless or sparsely tree-covered outcrops where altered to zeolites north and west of Twin Peaks (44°36' N., 114°28' W.). Sanidine crystals from this unit were dated at 45.8±0.2 m.y. and 46.5±0.1 m.y. (see table 3). Thickness more than 610 m (base not exposed).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcr

Unit Name: Tuff of Challis Creek, outflow unit

Map Unit Description

Corral Creek cauldron segment and area north and east of Challis: See both descriptions below.

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
Reddish- to gray-brown, partly to densely welded rhyolite ash-flow tuff containing 13-45 percent phenocrysts (as much as 4 mm long): af, 38-70; q, 27-60; pf, 0-3; b, trace; px, 0-3. Comprises rocks outside Twin Peaks caldera that cannot be correlated with certainty with units within caldera. Outflow tuff of Challis Creek, where it caps high mountain peaks north and west of Twin Peaks caldera, consists of single cooling unit at least 200 m thick. Locally, as exposed on uppermost Tenmile Creek (44°29' N., 114°39' W.), outflow tuff of Challis Creek grades upward from crystal-rich, moderately welded tuff to very fine grained, crystal-poor ash-fall tuff. Tuff there and in nearby exposures on upper East Fork of Mayfield Creek (44°30' N., 114°39' W.) is interpreted to be associated with an early collapse segment of Twin Peaks caldera that is west of west margin of Twin Peaks caldera proper. This early collapse segment is obscured by a mass of intrusive rhyolite (Trf). Sanidine from this unit was dated by 40Ar-39Ar methods at 46.3±0.2 m.y,

Southeastern part of quadrangle:
Red, reddish-purple, yellowish-brown, or gray, densely welded, devitrified ash-flow tuff containing 5-20 percent crystals as long as 3 mm of chatoyant alkali feldspar and smoky quartz in matrix of fine shards. Locally contains abundant pumice. Also contains sparse zircon, allanite, biotite, and a few crystals of plagioclase. Near Challis, single cooling unit overlies an irregular erosion surface carved on underlying tuff of Pennal Gulch (Tp). Two, or possibly three, densely welded cooling units present in Spar Canyon-Sand Hollow area. One of these units may be younger than tuff of Red Ridge (Trr). Unit has normal magnetic polarity. Potassium-argon age of sanidine is 45.0±1.3 m.y.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tmb

Unit Name: Megabreccia of Ibex Creek

Map Unit Description

Heterogeneous deposit of cobble- to house-size blocks of volcanic rock. Blocks include highly fractured pyroclastic rocks that resemble tuffs of Camas Creek-Black Mountain (Tc), rocks that may be tuff of Ellis Creek (Te) and tuff of Eightmile Creek (Tem), intermediate porphyritic lava, and blocks of coarse-grained volcaniclastic rock. Indurated matrix consists of smaller fragments of same materials that make up the blocks. Exposed in slope west of lower Ibex Creek (44°34.5’ N., 114°43.5’ W.). Megabreccia is intruded on all sides by rhyolite (Trf) and gray porphyry (Tgp). Megabreccia is interpreted to represent caldera-wall slump debris shed from west margin of Van Horn Peak cauldron complex after eruption of tuffs of Camas Creek-Black Mountain (Tc). Thickness more than 150 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tp

Unit Name: Tuff of Pennal Gulch

Map Unit Description

Northern part of Van Horn Peak cauldron complex and Panther Creek graben, Corral Creek cauldron segment and area north and east of Challis - both descriptions below apply to these two areas:

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex:
In Darling Creek area (44°38’ N., 114°17’ W.), unit consists of gray-brown to buff to pale-green or red bedded tuff, tuffaceous sediment, nonwelded ash-flow tuff, and pumice flows. Typical pumice-rich ash-flow tuff or pumice flows contain phenocrysts (2 mm in length) (9-14): af, 0-15; q, 0-7; pf, 62-83; b, 12-26; hb, trace. Ash-flow tuff ranges in thickness from 1 to 52 m and is rich in pumice. Noncollapsed pumice fragments in these tuff beds generally are 1-2 cm. in maximum diameter and constitute 30-70 percent of rock, so many of these units are pumice flows. Lithic fragments in these tuff beds typically are pebble-size clasts of aphyric felsic lava and intermediate porphyritic lava containing feldspar and biotite phenocrysts. Interbedded with pumice-flow tuff beds are buff to green and lavender, thin-bedded, fine- to medium-grained fluvial tuffaceous sandstone, siltstone, reworked pumice beds, and coarse conglomerate beds that contain debris-flow lenses and siltstone and range from 1 to 35 m thick. Map unit is at least 355 m thick and is unconformably overlain by tuff of Challis Creek (Tcr).

Southeastern part of quadrangle:
Gray, pale pink, or pale green, silicic, crystal-poor pyroclastic flows and air-fall, both subaqueous and subaerial. Chiefly massive to crudely bedded, pumice-rich, coarse tuff and pumice-lapilli tuff, but also includes beds of sorted, thin-bedded volcanic sandstone and mudstone. Commonly contains crystals as much as 2 mm long of plagioclase, sanidine, and biotite, and subordinate or very minor quartz, amphibole, allanite, zircon, and apatite. Sparse carbonized or silicified plant fragments are present in some pyroclastic flows. Locally in exposures east and north of Round Valley (44°30’ N., 114°11’ W.) and northwest of Ellis (44°41.5’ N., 114°03’ W.), a ledge-forming vitrophyre as much as 15 m thick consists of black, crystal-poor, perlitic, rhyodacitic glass containing crystals of plagioclase, sanidine, clinopyroxene, and zircon. Some samples contain abundant lithic inclusions. Unit has reversed magnetic polarity. Tuff of Eightmile Creek (Tem) included within basal part of map unit south of Table Mountain (44°44’ N., 114°12’ W.). Thickness 0 to more than 370 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trb

Unit Name: Rhyolite of Red Butte

Map Unit Description

Red, reddish-gray, lavender, pale-brown, or buff, pinkish-tan to reddish-brown-weathering, flow-laminated and layered rhyolite that forms a cap rock on Red Butte (44°39’ N., 114°20.5’ W.), east of Twin Peaks caldera. On ridge between mouth of Pats Creek and Eddy Creek, just north of Challis Creek (44°35’ N., 114°20’ W.), this unit contains basal flow-banded vitrophyre 10 m thick that grades upward into flow-banded rock that displays crude columnar jointing and contains abundant flattened gas cavities (as much as 8 cm long). Vitrophyre locally flow brecciated with blocks up to 0.3 m. To north, in Morgan Creek area (44°40’ N., 114°17’ W.), rhyolite locally displays pyroclastic characteristics and may represent a pyroclastic deposit that flowed after coalescing to liquid. Phenocrysts (2-5 mm in length) (5-16): pf, 76-81; b, 15-17; hb, 0-11; af (with reaction rims of pf), rare. Abundant accessory apatite and zircon. Allanite uncommon. Biotite from a sample collected on east side of Red Butte (44°37’ N., 114°18’ W.) has a potassium-argon age of 46.9±1.6 m.y. (see table 1). Thickness 0-250 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsb

Unit Name: Sedimentary breccia

Map Unit Description

A heterogeneous unit consisting primarily of poorly sorted, poorly bedded, coarse sedimentary breccia that contains angular to rounded, pebble- to boulder-size clasts of aphyric and porphyritic intermediate lava and fragments of siltstone and claystone in a matrix of coarse sand to clay. Also contains discontinuous beds of tan-gray to light-brown, light-brown-weathering, coarse conglomerate and thin interbeds of coarse-grained tuffaceous sandstone containing abundant grains of feldspar, altered ferromagnesian minerals, and minor quartz. Locally present are mudflow breccia deposits containing intermediate lava clasts in biotite-bearing epiclastic matrix and log-size and smaller fragments of petrified wood. Unit underlies potassium-rich andesite, latite, and basalt lava (Tl) exposed along lower Challis Creek (44° 34.5’ N., 114° 18’ W.). May be correlative with intermediate lava and breccia of mixed zone (Tmz) exposed in Corral Creek cauldron segment. Thickness 0-130 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Td

Unit Name: Dikes

Map Unit Description

Custer Graben area:
Gray, brownish-gray and greenish-gray, holocrystalline, medium- to fine-grained dike rocks, primarily gabbro and diabase, made up chiefly of plagioclase and clinopyroxene; pyroxene commonly partly or wholly altered to chlorite. Have reversed magnetic polarity.

Western and southcentral part of quadrangle:
Rocks are dark green to gray and commonly porphyritic, containing phenocrysts of zoned plagioclase as long as 2 cm; compositions are primarily andesite, dacite, and latite. Phenocrysts of hornblende, somewhat altered to chlorite, and euhedral biotite also commonly present. Quartz phenocrysts are sparse. Phenocrysts are set in groundmass of andesine-oligoclase, minor potassium feldspar, hornblende, and magnetite. Sphene and allanite are common accessories. Dikes range from a few meters to more than 30 m wide and are as much as several hundred meters long. They are more numerous near exposures of Tertiary diorite complex (Tdc), to which they probably are related.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tgi

Unit Name: Intrusive rocks east of Bonanza

Map Unit Description

Porphyritic to equigranular rocks that range in composition from granodiorite to quartz monzonite. Major element analysis of quartz monzonite resembles analysis of tuff of Eightmile Creek (Tem). Rocks exposed are in roof zone of pluton intruding intermediate lava (Tdf, see below); blocks of lava are common as inclusions, and in some exposures intrusion more closely resembles swarm of closely spaced dikes cutting lava, as first described by Anderson (1949). Aeromagnetic data and distribution of thin dikes indicate buried extension of intrusion for at least 3 km west of principal outcrop area. Intrusion and country rock both are propylitized; minor hydrothermal biotite locally developed in intrusion.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trl

Unit Name: Rhyolite lava

Map Unit Description

Gray and grayish-red, chiefly crystal-poor rhyolite containing phenocrysts of alkali feldspar and quartz. On ridgecrest east of upper Basin Creek (44°22’ N., 114°53’ W.) it is unaffected by faults that offset underlying volcaniclastic rocks (Tps) and intermediate lava (Tdf).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tpc

Unit Name: Tuffs of Pennal Gulch and Camas Creek-Black Mountain, undivided

Map Unit Description

Nonwelded tuff sequence that overlies tuff of Eightmile Creek (Tem, see below) in Custer graben, chiefly east of Jordan Creek. Locally includes tuff of Ninemile Creek (McIntyre and others, 1982), a densely welded unit not shown separately on this map, and debris possibly derived from rhyolite domes in upper Jordan Creek area (44°26’ N., 114° 44’ W.) (Foster, 1982). Thickness more than 600 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tvc

Unit Name: Volcaniclastic rocks

Map Unit Description

Custer Graben area:
Ash-flow and ash-fall tuff that overlies tuff of Eightmile Creek west of Bonanza (44°23’ N., 114°43.5’ W.). Coarser grained rocks in this unit are characterized by crystals of plagioclase, sanidine, and quartz (quartz more abundant than sanidine in most places); biotite is only mafic mineral present. On ridge west of Lightning Creek (44°25.5’ N., 114°49’ W.), thin flow of intermediate lava occurs within the unit.

Southeastern part of quadrangle:
Ash-flow tuff, thin-bedded volcanic sandstone, siltstone, and mudstone, containing local zones of impure lignite; unit exposed from Little Antelope Flat (44°23’ N., 114°04’ W.) southwestward to Spar Canyon area (44°14’ N., 114°13’ W.). Coarsest grained rocks in this unit are characterized by crystals of plagioclase, sanidine, and quartz (quartz commonly more abundant than sanidine); biotite is only mafic mineral present. West of mouth of Spar Canyon nonwelded and densely welded ash-flow tuff related to the tuff of Challis Creek are locally present but have not been mapped separately. Subaqueous pyroclastic flow that is probable equivalent of tuff of Eightmile Creek (Tem) crops out in Spar Canyon and in Sand Hollow. Conglomerate containing clasts of quartzite, slate, and granitic rock, in addition to volcanic clasts, caps sequence south of Spar Canyon and is exposed in hills east of Tub Spring (44°15.5’ N., 114°11’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tvs

Unit Name: Volcaniclastic and sedimentary rocks

Map Unit Description

Twin Peaks caldera and southern part of Van Horn Peak cauldron complex: See both descriptions below.

Custer graben area:
Volcanic sandstone, conglomerate, siltstone, and mudstone exposed northeast of Basin Creek. The coarsest grained rocks in lower part of unit, which include volcanic sandstone, conglomerate, and massive, pumice-rich pyroclastic flow more than 15 m thick, contain crystals of plagioclase, sanidine, quartz, and biotite. Rocks higher in unit lack sanidine and contain plagioclase, quartz, biotite, and hornblende. Beds of nonvolcaniclastic arkosic sandstone locally present in upper part of unit.

Southeastern part of quadrangle:
Includes subaqueously deposited pyroclastic flows, mudflow breccia and conglomerate, volcanic sandstone, and mudstone exposed along the Salmon River west and south of Challis, near Centennial Flat, along East Fork Salmon River, along Road Creek, and along Herd Creek. Also includes subaerial ash-fall and ash-flow deposits intercalated with and overlying intermediate lava in and north of Squaw Creek drainage basin (44°22’ N., 114°28’ W.). Volcanic components of all these rocks contain plagioclase, biotite, and amphibole. Quartz is minor and variable in amount. Some samples contain a few grains of pyroxene. Coeval with parts of intermediate lava sequence (Tdf); ranges in age from about 50 m.y. to about 48 m.y. Potassium-argon dating on sample from southeast of Jerry Peak yielded ages of 49.0±1.8 m.y. on biotite and 49.0±2.9 m.y. on hornblende (see table 1). A subaqueous pyroclastic flow, about 12 m thick, that is probable equivalent of tuff of Ellis Creek (Te, 48.4±1.6 m.y.) occurs within this unit in area south of Centennial Flat. Arbitrarily included in this unit are outcrops of pyroclastic flow exposed south of mouth of Squaw Creek that contains significant alkali feldspar, in addition to plagioclase and quartz, and biotite as sole mafic mineral.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tar

Unit Name: Arkosic sandstone and conglomerate

Map Unit Description

Gray arkosic sandstone and local beds of conglomerate that contains pebbles and cobbles of gray quartzite. Occurs as discontinuous lenses at base of sequence east of Basin Creek (44º18’ N., 114º51’ W.). Many occurrences too small to be shown at this map scale.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdbi

Unit Name: Rhyodacite plugs

Map Unit Description

Rhyodacite plugs at Bradbury Flat-Black, columnar-jointed, glassy rhyodacite and gray, grayish-brown, or red-purple devitrified rhyodacite containing as much as 30 percent phenocrysts as much as 4 mm long of plagioclase, orthopyroxene, clinopyroxene, biotite, apatite, and opaque oxides.

Cross-cutting plugs of rhyodacite in bluff exposures along Salmon River west of Bradbury Flat (44°26’ N., 114°10’ W.) and in hills north and east of Bradbury Flat. Have normal magnetic polarity. Northeast-dipping slab of similar rock at southwest margin of Bradbury Flat has reversed magnetic polarity.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdb

Unit Name: Rhyodacite domes

Map Unit Description

Rhyodacite domes at Bradbury Flat-Black, columnar-jointed, glassy rhyodacite and gray, grayish-brown, or red-purple devitrified rhyodacite containing as much as 30 percent phenocrysts as much as 4 mm long of plagioclase, orthopyroxene, clinopyroxene, biotite, apatite, and opaque oxides.

Irregularly shaped domelike masses of rhyodacite in hills northwest of Bradbury Flat. Potassium-argon age for columnar-jointed rhyodacite exposed at northwest margin of Bradbury Flat is 39.7±1.2 m.y. (see table 1).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tib

Unit Name: Mafic intrusive rocks

Map Unit Description

Olivine-bearing intrusive rocks that have been mapped separately only along Road Creek (44°10’ N., 114°10.5’ W.), and Horse Basin Creek.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdl

Unit Name: Diabase and lamprophyre dikes

Map Unit Description

Southeastern part of quadrangle:
Trends are primarily northeast.

Western and south-central parts of quadrangle:
Diabase dikes are the more common. Rock is dark and fine- to medium-grained; consists chiefly of lath-like crystals of plagioclase enclosed in matrix of pyroxene crystals. Diabase dikes are youngest dikes and crosscut all others. They are the most continuous and commonly trend northwest. Lamprophyric dikes are dark gray to black, fine grained, and somewhat porphyritic; commonly range from a few centimeters to a meter or so in width and are only a few meters in strike length. Augite, brown hornblende, biotite, and plagioclase are principal minerals of this rock, which is a young rock but its relation to the diabase is unknown.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Til

Unit Name: Potassium-rich andesite, latite, and basalt intrusions

Map Unit Description

Dikes, sills, and plugs that commonly consist of brown- or reddish-brown-weathering, dark-gray, greenish-gray, or black, crystal-poor rocks containing variable proportions of phenocryst minerals clinopyroxene, orthopyroxene, olivine, and plagioclase. Exposed as dikes, sills, and plugs along Salmon River near Centennial Flat (44°22' N., 114°16.5' W.), in region between Summit Rock and Bald Mountain, and as altered, irregularly shaped intrusive masses north of Little Antelope Flat. Near Centennial Flat, intrusive rocks were altered by reaction with wet, semiconsolidated sediments they intruded to produce chlorite-, clay-, and carbonate-rich, light-greenish-gray rocks. Whole-rock potassium-argon age for the unaltered part of one intrusive mass is 48.2±1.4 m.y. (see table 1). Magnetic polarities are normal and reversed.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsy

Unit Name: Syenite intrusion

Map Unit Description

Irregularly shaped, sill-like mass of medium- to coarse-grained syenite that crops out east of Tub Spring, in upper Spar Canyon (44°15.5’ N., 114°11’ W.). Rock contains potassium feldspar, clinopyroxene, biotite, apatite, and magnetite. Clinopyroxene commonly altered to carbonate; both clinopyroxene and biotite commonly altered to chlorite. Carbonate also occurs as veins. Some, if not most, carbonate may be primary. Marginal facies of intrusion are dark, basalt-like rocks containing altered olivine phenocrysts; thin sections show that these rocks have holocrystalline matrices made up chiefly of alkali feldspar and biotite. Emplacement of intrusion probably penecontemporaneous with eruption of nearby latite lava (Tl, see p. 17).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tbau

Unit Name: Mafic lava

Map Unit Description

Olivine-bearing basaltic lava and associated volcaniclastic rocks that crop out south of Road Creek (44º10’ N., 114º10.5’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trr

Unit Name: Tuff of Red Ridge

Map Unit Description

Red- and reddish-brown weathering, grayish-purple or reddish-purple, blocky to platy, crystal-poor ash-flow tuff containing phenocrysts less than 1 mm long of alkali feldspar (chiefly anorthoclase). Vitrophyre at east end of Red Ridge (44° 06’ N., 114°29.5’ W.) contains a few crystals of green pyroxene and amphibole. This unit found only along east flank of White Cloud Peaks (44°11’ N., 114°27’ W.) and in Spar Canyon-Sand Hollow (44°13’ N., 114°12.5’ W.) area. Thickness 0 to more than 140 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Th

Unit Name: Tuff of Herd Lake

Map Unit Description

Red-purple or red-brown, devitrified, flow-laminated, locally lithophysal, crystal-poor rhyolitic rock that contains phenocrysts of plagioclase, biotite, and clinopyroxene 1 mm long. Two cooling units, separated by breccia zone, present north of Herd Lake (44°05' N., 114°10' W.). In most places these rocks resemble rhyolite lavas; however, exposure on ridge about 3 km south of Jerry Peak reveals marginal vitrophyre rich in shards. This exposure and sheetlike aspect of deposit indicate that unit was emplaced as very hot ash flow that coalesced and moved like lava prior to final chilling. Biotite from vitrophyre has potassium-argon age of 48.1±1.7 m.y. (see table 1). Map unit has reversed magnetic polarity. Overlies unit Tl. Thickness 0-150 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Trm

Unit Name: Rhyolite of Mill Creek Summit

Map Unit Description

Black, gray, and greenish-gray vitrophyric rhyolite lava and gray to pink, banded, devitrified rhyolite lava containing 1-5 percent phenocrysts, as much as 2 mm in length, of plagioclase and biotite. Also contains hornblende, allanite, zircon, apatite, and opaque oxides. Some flows also contain alkali feldspar and quartz. Four flows that have aggregate thickness of about 235 m are present in butte east of Mill Creek Summit (44°28’ N., 114°29’ W.). Potassium-argon age on biotite is 48.5±1.2 m.y. (see table 1). All flows have reversed magnetic polarity.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tbam

Unit Name: Mafic lava

Map Unit Description

Dark, sparsely porphyritic basaltic and andesitic lava, exposed along Salmon River near Centennial Flat (44°22’ N., 114°17’ W.) that contains variable proportions of olivine, pyroxene, or plagioclase phenocrysts. Probably related to mafic intrusive rocks (Til) that crop out nearby.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tbal

Unit Name: Mafic lava

Map Unit Description

Dark, sparsely porphyritic basaltic and andesitic lava that crops out below, and is interbedded with, flows of intermediate composition lava (Tdf) in hills southwest of Challis. Mafic lava contains variable proportions of olivine, pyroxene, and plagioclase phenocrysts. Sample from Garden Creek (44°29.5' N., 114°19' W.), west of Challis, has whole-rock potassium-argon age of 50.3±1.5 m.y. (see table 1).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tgc

Unit Name: Tuff of Germania Creek

Map Unit Description

Densely welded, vitrophyric ash-flow tuff and associated volcanic sediments exposed in ridges northwest and southeast of Germania Creek (44°01’ N., 114°32’ W.). Includes "ignimbrite of Germania Creek" of Motzer (1978). Ash-flow tuff contains as much as 40 percent phenocrysts, as long as 1 mm, of plagioclase, amphibole, clinopyroxene, orthopyroxene, and biotite. Mafic phenocrysts make up more than 40 percent of total phenocrysts. Ash-flow tuff resembles tuff of Burnt Creek (Tbc, below) except for preponderance of amphibole. More thorough sampling may show that this characteristic is not consistent. Has reversed magnetic polarity.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tbc

Unit Name: Lava and ash-flow tuff of Burnt Creek

Map Unit Description

Dacitic lava and ash-flow tuff, locally vitrophyric, but commonly rusty brown and devitrified, containing phenocrysts of plagioclase, orthopyroxene, clinopyroxene, amphibole, and biotite. More than 40 percent of total phenocrysts in ash-flow tuff commonly are mafic minerals. Presence of one thin ash-flow tuff cooling unit that has these mineralogic features within tuff of Sage Creek (Tsc) in Sage Creek drainage basin (44°05’ N., 114°05’ W.) shows that the two units are contemporaneous, despite large contrast in composition. Probably has normal magnetic polarity.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tsc

Unit Name: Tuff of Sage Creek

Map Unit Description

Ash-flow and ash-fall tuff and associated sedimentary rocks characterized by phenocrysts of plagioclase and sanidine, together with minor biotite, amphibole, and rare pyroxene. Quartz not present. Exposed chiefly near southeast corner of quadrangle in the drainage basin of Sage Creek, and on ridge south of Sheep Mountain. There are isolated outcrops of this rock type, too small to show on map, opposite mouth of Spar Canyon, east of lower Herd Creek, and along East Fork of Salmon River northwest of mouth of McDonald Creek (44°08.5' N., 114°19' W.). At all these localities, these rocks crop out beneath volcaniclastic rocks mapped as Tvs. Near Sheep Mountain, tuff of Sage Creek is mixed with breccia and intermediate lava (Tdf); contact between the two units is arbitrary. In some samples of breccia containing blocks with phenocrysts of plagioclase, quartz, biotite, and amphibole, dominance of matrix by crystals of plagioclase and sanidine demonstrates intermingling of material from two sources. Has normal magnetic polarity.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tcg

Unit Name: Conglomerate and fanglomerate

Map Unit Description

Chiefly cobble and boulder (as large as 2 m in diameter) conglomerate; black, pink, gray, or white quartzite clasts predominate near base, and volcanic clasts predominate near top. Matrix of conglomerate contains volcanic component throughout. Locally includes pyroclastic flow that contains lava blocks containing plagioclase, biotite, amphibole, and quartz phenocrysts. Present only near southeast corner of quadrangle. Also included in this unit is prevolcanic fanglomerate exposed southeast of Lone Pine Peak (44°21’ N., 114°10’ W.). Clasts in fanglomerate were derived from nearby exposures of Paleozoic rocks, which formed topographically high ridges prior to volcanism.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tri

Unit Name: Rhyolite stock

Map Unit Description

Red-weathering, yellowish-gray, aphanitic rhyolite that contains sparse phenocrysts of quartz as long as 1mm and pyrite or pyrite casts. Forms massive outcrops. Rhyolite is well exposed on ridge southeast of Cape Horn Creek (44°21.5’ N., 115°11.5’ W.), where stock contains roof pendants of granodiorite (Kgd, see p. 21) and metasedimentary rocks (rp, see p. 26).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdu

Unit Name: Tertiary dikes, undivided

Map Unit Description

Rhyolite to diabase dikes.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tdc

Unit Name: Diorite complex

Map Unit Description

Complex suite of rocks ranging from nonporphyritic diorite to porphyritic granodiorite, which is prevalent. Rock is characterized by abundance of hornblende, euhedral biotite, and magnetite, which together make up as much as 35 percent of it. Phenocrysts in porphyritic rocks are chiefly zoned plagioclase and pale-red perthitic microcline, which may be as long as 1 cm; phenocrysts are set in fine-grained, pale-red matrix. Quartz phenocrysts are rare. Relative proportion of salic minerals (calculated from CIPW norm): q, 19; af (microcline), 21; pf, 60. Rocks weather to chocolate-brown soil, darker than soil formed from granitic rocks of area. Diorite and dark-greenish-gray aphanitic andesitic phases are generally peripheral to porphyritic rock. Biotite, hornblende, and whole-rock potassium-argon ages for three samples collected in Jackson Peak (44º05’ N., 115º25’ W.) and Monumental Peak areas are 46.2±0.9 m.y., 46.6±0.5 m.y., 47.7±1.1 m.y., 48.2±3.0 m.y., and 46.0±1.7 m.y. (see table 1). In some areas this unit is mapped to include large numbers of andesite, dacite, and latite dikes (Td).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Twt

Unit Name: Welded tuff of Obsidian

Map Unit Description

Light-gray welded lithic tuff exposed north of Obsidian, near south edge of quadrangle. Weathers reddish-purple, brownish gray, and brown. Rock is light-gray ash-flow tuff that contains phenocrysts of sanidine and quartz in a fine, light-gray matrix.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tva

Unit Name: Andesite

Map Unit Description

Dark-gray to black, thinly layered, flow-banded, aphanitic lava that has pilotaxitic texture. Contains olivine phenocrysts, rimmed by iddingsite, set in groundmass of andesine microlites and interstitial pyroxene and magnetite. Overlies rhyolitic flows where exposed on ridge top between Knapp and Beaver Creeks (44°25' N., 115°05' W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Tvr

Unit Name: Rhyolite flows

Map Unit Description

Yellowish-gray to pale-red to purple, aphanitic lava that commonly shows flow-banding and flattened quartz-lined vugs along flow laminae. Contains phenocrysts of platy sanidine and rounded, embayed quartz. Rock erodes to conspicuous massive knobs on ridge line and to reddish, slabby scree. Includes minor amounts of rhyolitic tuff. Sanidine has a potassium-argon age of 37.6±2.1 m.y. (see table 1). Geologic relations suggest that this age is too young. Preserved in a graben between Knapp and Beaver Creeks (44°23’ N.,115°08’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ki

Unit Name: Granitic rocks of Idaho batholith, undivided

Map Unit Description

Rocks in the northern part of the Sawtooth Range, west of Stanley, were mapped in 1967-68 and not restudied and are shown on the geologic map (Fisher and others, 1992, in pocket) as Idaho Batholith (Ki), but probably are chiefly biotite granodiorite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Klg

Unit Name: Leucocratic granite

Map Unit Description

Light-gray to white, fine to medium-grained granite having distinctive anhedral texture. Principal minerals are quartz (33 percent), potassium feldspar (29 percent), and plagioclase (An26-30, 33 percent). Biotite may constitute as much as 2 percent of rock, garnet is common, and feldspars are altered to sericite and small irregular flakes of muscovite. This rock, described as leucocratic quartz monzonite by Reid (1963) and by Kiilsgaard and others (1970), as aplite by Cater and others (1973), and as aplitic quartz monzonite by Anderson (1947), occurs as dikes and irregularly shaped stocks that are resistant to erosion and tend to form high points on ridges. Rubbly, weathered scree from these high points may be extensive on lower hillsides and may give the impression of being eroded from larger masses than actually exist. Intrudes biotite granodiorite (Kgd, see below) and is itself intruded by Tertiary granite (Tg) and stocks of Tertiary diorite complex (Tdc). It also occurs as small dikes and plugs intrusive into biotite granodiorite and granite (Kgd, see below) in exposures along east side of Stanley Basin. Potassium-argon ages of biotite from five samples range from 63.6±1.4 to 72.6±2.5 m.y. (see table 2).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kg

Unit Name: Muscovite-biotite granodiorite and granite

Map Unit Description

Gray to light-gray, medium- to coarse-grained, equigranular to porphyritic granodiorite; contains books of muscovite that are visible in hand specimen and make up as much as 5 percent of rock. Except for visible muscovite, rock is similar to biotite granodiorite (Kgd), with which it is transitional through zone about 2 km or more wide. It is exposed in western part of quadrangle and comprises what is considered to be core of Atlanta lobe of Idaho batholith. Includes quartz monzonite of Warm Lake of Schmidt (1964). Potassium-argon ages of nine samples range from 65.3 to 73.9±2.7 m.y. for biotite and from 68.8±0.2 to 74.7±2.7 for muscovite (see table 2).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kgd

Unit Name: Biotite granodiorite

Map Unit Description

Gray to light-gray, medium- to coarse-grained, and equigranular to porphyritic rock. Plagioclase (An22-30) is chief component of rock, which has lesser quantities of quartz and potassium feldspar. Biotite is principal mafic mineral, constituting as much as 5 percent of rock in most places; however, east of Stanley Basin it makes up 25 percent of rock. Hornblende is rare. Biotite granodiorite is most common granitic rock of Idaho batholith and is exposed over vast areas. In western part of quadrangle rock was identified by Schmidt (1964) as granodiorite of Gold Fork. Biotite granodiorite is intruded into older tonalite (Kt, see below) and in the 60- to 90-m-wide contact zone it exhibits intensive primary foliation as well as xenoliths of tonalite. Includes foliated diorite in Loon Creek (44°35’ N., 114°51’ W.) and at mouth of Camas Creek (44°53’ N., 114°44’ W.). Potassium-argon ages of biotite range from 61.5 to 98.1±3.3 m.y. (see table 2).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kgds

Unit Name: Sphene-enriched biotite granodiorite

Map Unit Description

Mapped by Schmidt (1964) as leucocratic quartz diorite of Little Valley.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kgdp

Unit Name: Porphyritic biotite granodiorite and granite

Map Unit Description

Coarsely porphyritic granitoid rock containing metacrysts of pink potassium feldspar (microcline) from 3 to 10 cm long in medium- to coarse-grained matrix that contains roughly equal amounts of microcline, plagioclase, and quartz; generally 5-15 percent biotite and variable amounts of hornblende. Foliation commonly present and locally strongly developed in area west and north of Stanley Basin. Also included in this unit are rocks that form cores of stock at White Cloud Peaks and large pluton east of Stanley Basin. In those areas rocks are unfoliated porphyritic biotite granite and biotite granodiorite that contain metacrysts of microcline 1-3 cm long in medium-grained granitoid matrix containing predominantly 5-10 percent, and rarely as much as 20-25 percent, biotite and approximately equal amounts of quartz, potassium feldspar, and plagioclase. Equigranular margins of two bodies are separated from porphyritic granite cores by potassic metasomatized transition zone as much as 1.5 km wide that contains abundant veins and pods of potassium feldspar and locally abundant secondary muscovite that coats joints. Potassium-argon ages of biotite from four samples range from 62.6 to 84±2 m.y. (see table 2).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name Challis 250K

Map Unit Symbol Kgdh

Unit Name Hornblende-biotite granodiorite

Map Unit Description

Gray, medium- to coarse-grained, equigranular to porphyritic, commonly foliated granodiorite; biotite and hornblende are aligned in plane of foliation. Rock commonly is associated with xenoliths and pendants on high ridges in western part of quadrangle. It is intermixed with tonalite (Kt); the two rock types form border zone of Atlanta lobe of Idaho batholith.

For additional information see Kiilsgaard and Lewis (1985).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kt

Unit Name: Tonalite and granodiorite

Map Unit Description

Gray to dark-gray, medium- to coarse-grained, equigranular to porphyritic rock. Plagioclase (andesine) is dominant mineral of rock, some of which contains biotite or hornblende and which ranges from massive to highly foliated. It is exposed in western part of quadrangle, where it includes quartz dioritic gneiss of Donnelly (Schmidt, 1964), and in west-central part of quadrangle in Loon Creek drainage basin (44°32’ N., 114°51’ W.). East of Stanley and southwest of mouth of Warm Spring Creek (44°08’ N., 115°58’ W.) this unit is equigranular, medium-grained, granitoid rock containing 30-35 percent amphibole laths, 40-50 percent plagioclase, and about 20 percent quartz. Amphibole is partly altered to brown, highly pleochroic biotite and to epidote. Sphene is principal accessory mineral. Potassium-argon ages of biotite from three samples range from 71.9±2.5 to 81.6±2.9 m.y. (see table 2).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Kim

Unit Name: Mixed rock units

Map Unit Description

Mainly alaskite that encloses Precambrian metamorphic xenoliths.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Jg

Unit Name: Gabbro

Map Unit Description

Dark-grayish-green, medium- to coarse-grained rock containing primary mineral assemblage of calcic plagioclase, clinopyroxene, and magnetite, whose texture is overprinted by alteration assemblage of chlorite, pale-green acicular amphibole, albite, sphene, and small amounts of apatite, prehnite(?), pumpellyite(?), carbonate and(or) secondary quartz. Occurs as numerous small, irregular dikes, small plugs, and sill-like tabular masses scattered over area east and northeast of Clayton. Most commonly found intruded along or near thrust fault at base of Clayton Mine Quartzite (OCq). Fission-track age of 140.1±17.4 m.y. was obtained from zircon in quartzite immediately adjacent to contact with gabbro at mouth of Bayhorse Creek (44°22.5’ N., 114°15’ W.) (R. A. Zimmermann, written commun., 1983). This age for the zircon indicates time of track annealing caused by heat from gabbro intrusion. It also serves as limiting age for thrust fault beneath Clayton Mine Quartzite, already in existence prior to intrusion of gabbro.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Pg

Unit Name: Grand Prize Formation (Lower Permian)

Map Unit Description

Well-exposed sequence of fine-grained, dark-gray, carbonaceous argillite, siltite, limy siltite, and silty limestone. Weathers dark brown, reddish-brown, or dark gray. Much of sequence is graded and has abundant cross-bedding, convolute structures, and prominent banded appearance. Measured section on north side of Pole Creek at confluence with Grand Prize Creek (43°56’ N., 114°41’ W.) at type locality in Hailey 1°x2° quadrangle is about 2,000 m thick, but neither top nor bottom is exposed. Conodonts collected by C. M. Tschanz from low in section at Pole Creek are reported to be Leonardian-Roadian (upper Lower Permian) by Bruce Wardlaw (written commun., 1979). On Pungo Mountain a sequence about 100 m thick of thin-bedded limestone and calcareous argillite that have been extensively metamorphosed to tremolite-actinolite is questionably assigned to this unit. Sequence forms black soil. Mapped to include clean, well-sorted quartzite on east side of Pungo Mountain.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: P[Pw

Unit Name: Wood River Formation, Upper part (Lower Permian to Upper Pennsylvanian)

Map Unit Description

Includes units 5 and 6 of Hall and others (1974). Thick sequence of gray and light-brown, fine-grained, calcareous sandstone that weathers dark brown and dark reddish brown. Interbedded in calcareous sandstone are fine-grained sandy limestone, fine- to medium-grained bioclastic limestone, and brown, thick-bedded, fine-grained quartzite. Cross-bedding and convolute structures are common. Unit is dated on basis of abundant fusulinids. Minimum thickness 3,400 m at type locality (Hall and others, 1974).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: [Pwl

Unit Name: Wood River Formation Lower part (Upper to Middle Pennsylvanian)

Map Unit Description

Includes units 1, 2, 3, and 4 of Hall and others (1974). Lower part of Wood River Formation is present only from Railroad Ridge (44°08.5' N., 114°35.5' W.) at Little Livingston and Hermit mines south to Livingston mine. Unit 1 is chert and quartzite conglomerate present as thin fault slivers at Little Livingston and Hermit mines. It is overlain by succession about 150 m thick of fine-grained limy sandstone, silty limestone, and limy siltstone that includes units 2, 3, and 4.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Pzsr

Unit Name: Salmon River assemblage (Paleozoic)

Map Unit Description

Medium- to dark-gray, thin- to thick-bedded, well-laminated argillite, siltstone, calcareous siltstone, and fine-grained calcareous sandstone; some local grit and nearly pure, medium-gray limestone. Weathers tan, medium brown to dark brown, and, locally, light gray, blue gray, and pink. Sandstone is predominantly very fine to fine grained; some medium sand and grit layers; localized thin beds of chert-like, very siliceous argillite. Rock composed of variable proportions of quartz (predominant), clay minerals, carbonaceous material, sericite, mica, feldspar (usually only few percent), lithic fragments (argillite, shale, chert, fine-grained quartzite), various accessory minerals, and carbonate. Faint to prominent lamination in most places; cross lamination, current bedding, and sole structures in many fine-grained, thin sandstone beds and laminae. Dark colors related to amount of carbonaceous material, which ranges from nil to nearly 100 percent in few impure, coaly seams. Age of this assemblage is poorly known. Megafossils recovered from blocks of float found near mouth of Mill Creek (44°15’ N., 114°33’ W.) were assigned a Mississippian age (Hobbs and others, 1975). Conodonts collected from lower Thompson Creek (44°16.5’ N., 114°31’ W.) and from Slate Creek (44°12’ N., 114°36’ W.) have Late Cambrian and Devonian ages (J. Repetski, written commun., 1984). Base of sequence as exposed in quadrangle is thrust fault; overthrust by Grand Prize Formation (Pg) between Warm Springs and Slate Creeks (44°13’ N., 114°38’ W.) and by Wood River Formation (P[Pw and [Pwl) near Washington Peak (44°01’ N., 114°00’ W.). Thickness and sequence of units indeterminate in most places because of isoclinal folding and thrust faulting. About 1,400 m is present along Last Chance Creek (44°11.5’ N., 114°37’ W.), but neither base nor top is exposed.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Msuc

Unit Name: Surrett Canyon and South Creek Formations, undivided (Upper Mississippian)

Map Unit Description

Gray, fossiliferous, pure, thick-bedded, cliff-forming limestone and grayish-red-purple, impure, thin-bedded, slope-forming limestone. Top not exposed in quadrangle. Thickness about 400 m in area to east (Mapel and others, 1965).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Msp

Unit Name: Scott Peak Formation (Upper Mississippian)

Map Unit Description

Medium-dark-gray, chert-bearing bioclastic limestone; weathers medium dark to medium light gray; chert medium dark to medium gray, weathers brownish-tan, forms discontinuous thin layers and nodules scattered along bedding. Medium to thick bedded. Forms ledges. Contains much crinoidal debris, many corals, and brachiopods. Locally contains jasperoid (black silica as replacement of carbonate rocks). Evidence obtained elsewhere in region indicates that this material was formed during or after Eocene volcanism (B. A. Skipp, oral commun., 1983). Fragments of what appears to be this material within conglomerate at base of volcanic sequence (Tcg) suggest that jasperoid in this area may be both older than and penecontemporaneous with the volcanic rocks. Present only in southeast corner of quadrangle. Thickness about 750 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Mmc

Unit Name: Middle Canyon Formation (Upper and Lower Mississippian)

Map Unit Description

Succession of medium-bedded cherty limestone and impure limestone exposed as smooth, float-covered slopes in southeast corner of quadrangle. Upper half is impure, medium-dark-gray to medium-gray, cherty, microgranular limestone. Black chert abundant in layers and nodules. Weathers to medium- or light-gray, small, irregularly shaped blocks that have slight yellow or pink mottling. Lower half is very fine-grained sandy limestone, silicified in part. Float in lower half is more brightly colored and more angular than that of upper part. Locally, limestone is replaced by jasperoid; see discussion under Scott Peak Formation (Msp), above. Thickness about 200 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Mw

Unit Name: White Knob Limestone (Upper Mississippian)

Map Unit Description

Chiefly gray, ledge-forming, thick- to thin-bedded fossiliferous limestone; locally sandy, variably cherty, but in middle part also includes gray to yellowish-brown chert and quartzite granule to cobble conglomerate, sandstone, siltstone, and mudstone. Locally, limestone is replaced by jasperoid; see discussion under Scott Peak Formation (Msp), above. Thickness about 1,150 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Mmg

Unit Name: McGowan Creek Formation (Lower Mississippian)

Map Unit Description

Poorly exposed unit of mudstone (or argillite), subordinate siltstone, partly calcareous claystone, sandstone, and minor pebble conglomerate. Extensively sheared; formation sustains steep slopes covered by slabby or platy, locally finely blocky or pencil-like fragments; weathers medium light gray, yellowish-gray, or light olive gray. Measured thickness 1,100 m in Lost River Range, east of quadrangle (Mapel and others, 1965; Sandberg, 1975).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Mcb

Unit Name: Copper Basin Formation, lower part (Lower Mississippian)

Map Unit Description

Light-gray to black, medium- to thick-bedded conglomerate, sandstone, siltstone, and mudstone. Conglomerate contains clasts as much as 20 cm in diameter of chert, quartzite, quartz, and argillite in sandstone matrix. Unit is series of proximal to distal turbidites (Nilsen, 1977). Crops out chiefly near southeast corner of quadrangle. An isolated outcrop at confluence of Herd Creek and Lake Creek (44°07’ N., 114°14.5’ W.) is questionably assigned to this formation. Thickness more than 3000 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Dgj

Unit Name: Grand View and Jefferson Dolomites, undivided

Map Unit Description

Grand View Dolomite - Includes microgranular, medium-dark- to medium-light-gray dolomite that weathers medium light gray and lighter and much recrystallized medium-light-gray to very light gray, fine- to coarse-grained dolomite that weathers grayish-orange or pale yellowish-brown. Scattered sandy intervals; a few shaly beds. Beds thick, commonly laminated. Formation moderately to highly resistant; forms blocky ledges and, locally, cliffs. At south end of, and southwest of, Grand View Canyon (44°21.5' N., 114°3.5' W.) map unit includes small patches of calcareous shale and dolomite elsewhere assigned to overlying Three Forks Formation (Hays and others, 1978). Thickness about 365 m.

Jefferson Dolomite - Resistant, well-exposed unit of medium-dark-gray to medium-gray and subordinate dark-gray dolomite, Weathers to similar dark colors, partly mottled, commonly having brown cast; a few beds weather medium light gray. Grain size ranges from microgranular to fine; little silt or sand; commonly fetid. Beds thick to very thick (0.3-1.5 m); some thin, regular lamination. Highly resistant, forms ledges and cliffs. Thickness about 300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Dg

Unit Name: Grand View Dolomite (Upper Devonian)

Map Unit Description

Includes microgranular, medium-dark- to medium-light-gray dolomite that weathers medium light gray and lighter and much recrystallized medium-light-gray to very light gray, fine- to coarse-grained dolomite that weathers grayish-orange or pale yellowish-brown. Scattered sandy intervals; a few shaly beds. Beds thick, commonly laminated. Formation moderately to highly resistant; forms blocky ledges and, locally, cliffs. At south end of, and southwest of, Grand View Canyon (44°21.5’ N., 114°3.5’ W.) map unit includes small patches of calcareous shale and dolomite elsewhere assigned to overlying Three Forks Formation (Hays and others, 1978). Thickness about 365 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Dj

Unit Name: Jefferson Dolomite (Upper and Middle Devonian)

Map Unit Description

Resistant, well-exposed unit of medium-dark-gray to medium-gray and subordinate dark-gray dolomite, Weathers to similar dark colors, partly mottled, commonly having brown cast; a few beds weather medium light gray. Grain size ranges from microgranular to fine; little silt or sand; commonly fetid. Beds thick to very thick (0.3-1.5 m); some thin, regular lamination. Highly resistant, forms ledges and cliffs. Thickness about 300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Dab

Unit Name: Informal units B (Middle? and Lower Devonian) and A (Lower Devonian) of Hays and others (1978, 1980) and Beartooth Butte Formation (Lower Devonian), undivided

Map Unit Description

Unit B contains dark-gray to olive-gray, medium-bedded to very thick-bedded dolomite and minor dolomitic sandstone; unit A contains dark- to light-gray, medium- to thick-bedded, moderately silty dolomite; Beartooth Butte Formation contains gray and brownish-gray, medium- to thick-bedded, very fine grained quartzite, sandstone, and siltstone.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Sl

Unit Name: Laketown Dolomite (Silurian)

Map Unit Description

Strikingly light colored dolomite that commonly forms ridges and peaks. Dolomite is predominantly medium light to light gray, mostly very fine to fine grained, and almost pure. Few scattered sandy intervals. Beds medium to very thick, mainly 0.3-1 m; locally, rock is massive and bedding is obscure. Joints common. Resistance to erosion high; forms rounded, light-gray to very light gray ledges and cliffs. Thickness 215-395 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Srm

Unit Name: Roberts Mountains Formation (Silurian)

Map Unit Description

Medium-dark- to medium-gray, carbonate-bearing, fine-grained detrital rocks and impure carbonate rocks. Most are mudstone, siltstone, and very fine silty sandstone, mainly dolomitic, partly calcareous; less abundant and irregularly distributed are muddy, silty, or finely sandy microgranular to very fine grained limestone and dolomite; small amount of siltite and quartzite. Beds medium to very thick. Regular lamination, 3 mm or less thick, and cleavage that may be parallel or oblique to bedding common. Resistance to erosion moderate to weak. Upper part contains fossils of late Wenlock and probable Ludlow age. Thickness about 800 m in Lone Pine Peak quadrangle (Hays and others, 1978).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Op

Unit Name: Black, carbonaceous, graptolite-bearing shale and argillite (Ordovician)

Map Unit Description

Black, fissile, carbonaceous shale; bedding obscured by cleavage. Exposures totaling less than 1 km2 along lower reaches of Big Lake Creek and Pine Creek (44°09’ N., 114°23’ W.), tributaries to East Fork of Salmon River. Generally deformed, especially in highest exposures beneath thrust contact with Salmon River assemblage (Pzsr). Tentatively correlated with Ordovician Phi Kappa Formation to south, as suggested by Dover and others (1980). Maximum of 35 m of unit exposed, total thickness unknown.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ose

Unit Name: Saturday Mountain Formation, Kinnikinic Quartzite, and Ella Dolomite, undivided (Ordovician)

Map Unit Description

Upper and Middle Ordovician Saturday Mountain Formation is predominantly medium-dark- to medium-gray, microgranular to very fine grained, fairly pure dolomite that contains abundant (as much as 50 percent), irregular layers of medium-dark-gray chert in uppermost part of exposed section; some chert color laminated. Weathered surfaces medium light gray with yellowish cast. Forms blocky outcrops strongly ribbed by brownish-weathering chert. Contains considerable limestone, siltstone, and black shale in Squaw Creek area (44°18' N., 114°29' W.). Uppermost part of Saturday Mountain Formation may be Silurian. Middle Ordovician Kinnikinic Quartzite is fine-grained quartzite that is mainly light to very light gray with yellowish or brownish cast; locally as dark as medium gray or mottled medium dark and lighter gray; very fine to fine grained, contains some medium-size rounded grains; clean. Medium to thick bedded (maximum 1 m), bedding commonly obscured by shearing and partial recrystallization; local faint lamination. Middle Ordovician Ella Dolomite is medium- to dark-gray or brownish-gray, medium- to thick-bedded dolomite that contains thin laminae of silt and sand. Sequence in extreme northeastern part of quadrangle at Rattlesnake Creek (44°58' N., 114°0.5' W.) includes quartzite that possibly is older than Ella Dolomite. Upper 30 m or so consists of medium-gray, fine-grained, mostly foliated dolomite, locally massive. Lower 10 m includes foliated dolomitic quartzite, which grades downward to massive, cliff-forming, white to light-gray quartzite about 200 m thick consisting of virtually pure quartz in two size fractions, a framework fraction 0.4-0.6 mm in diameter and a matrix fraction 0.1-0.2 mm in diameter. Landreth (1964) noted a few pale-red-purple beds near lower part of unit and considered entire sequence to be Kinnikinic Quartzite. Dolomite sampled by P. J. Modreski from upper 30 m contains conodonts of Middle or Late Ordovician age (J. Repetski, written commun., 1983) and an orthoid brachiopod identified by J. T. Dutro, Jr., (written commun., 1983) as probably genus Valcourea. Dutro further suggests that the collection might well represent Ella Dolomite. This allows possibility that quartzite is older than Kinnikinic and equivalent to Lower Ordovician Summerhouse Formation (Ruppel and others, 1975; McCandless, 1982). Total thickness about 1,450 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Oc

Unit Name: Upper carbonate unit (Ordovician)

Map Unit Description

Heterogeneous sequence of dolomite, silty dolomite, and dolomitic sandstone that crops out in Squaw Creek drainage basin, northwest of Clayton. Estimated thickness about 150 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: OCrr

Unit Name: Siltstone, sandy siltstone, and quartzite of Rob Roy mine area (Ordovician? or Cambrian?)

Map Unit Description

Thickness of at least 600 m exposed only near Kinnikinic Creek north of Clayton. Top eroded; thrust fault at base.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: OCq

Unit Name: Quartzite (Lower Ordovician or older)

Map Unit Description

Divided into five map units by Hobbs and others (1975). Over most of its outcrop area, consists mostly of Clayton Mine Quartzite (Middle Ordovician or older), which is poorly sorted, coarse- to medium-grained, feldspathic quartzite that, in upper two-thirds of section, includes conglomerate layers, pebbly quartzite, and scattered pebbles. Very thin shale partings throughout. More than 1,000 m thick.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Or

Unit Name: Ramshorn Slate (Ordovician?)

Map Unit Description

Gray, greenish-gray, purple, thin-bedded, well-laminated slate, locally phyllitic. Commonly shows well-developed cleavage at angle to bedding. Includes thin beds of sandstone toward top. Thick lens of conglomerate at base in outcrops west of Challis. Thickness about 800 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: OCb

Unit Name: Bayhorse Dolomite (Lower Ordovician and Upper Cambrian)

Map Unit Description

Light-gray to yellowish-gray, medium-bedded to very thick bedded dolomite in upper part and medium- to dark-gray, thin-bedded, fine-grained limestone in lower part. Dolomite contains dark-gray, silicified oval structures resembling pisolites in several layers as much as 9 m thick. Both upper and lower parts locally contain thin interbeds of siltstone, argillite, or fine-grained sandstone. Top of unit is erosional disconformity characterized by zone of probable paleokarst topography. Minimum thickness about 400 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Cg

Unit Name: Garden Creek Phyllite (Cambrian(?))

Map Unit Description

Dark-gray to black, slightly calcareous phyllite. As shown, includes small area of dolomite beneath phyllite, which is exposed in bed of Bayhorse Creek west of Bayhorse. Estimated thickness is 150-300 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ccqs

Unit Name: Quartzite, shale, and carbonate rocks of Squaw Creek area (Cambrian)

Map Unit Description

Includes fossiliferous upper Middle Cambrian shale and underlying sequence of quartzite and carbonate rocks of Cambrian or older age.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: OCZl

Unit Name: Interbedded quartzite, dolomite, and argillite of Leaton Gulch and Pennal Gulch areas (Ordovician?, Cambrian?, Late Proterozoic?)

Map Unit Description

Sequence of predominantly quartzitic strata containing subordinate dolomite interbeds and some thin argillitic interbeds and locally thicker argillite intervals. Quartzite generally deep red to dark purplish gray to medium gray; some thick zones of light pinkish or tannish gray and very light gray to white; medium grays and purplish grays predominate. Thin to medium bedded, platy, laminated; some massive units are thick bedded and structureless; mostly medium to fine grained, locally coarse grained and pebbly; lamination prominent in some thick layers; includes several zones of very coarse conglomerate or intraformational breccia. Much of thin-bedded platy quartzite shows ripple marks, flute casts, worm trails; abundant magnetite in parts of section. Dolomite very fine grained to dense, light to medium tan on fresh surface, weathers rich reddish tan to brown; beds dispersed in quartzite and range from 0.2 m to several meters in thickness; restricted to area within 1 km east from Beardsley Hot Springs (44°31’ N., 114°10’ W.). Argillite occurs as laminae or thin interbeds in much of quartzite sequence and locally forms continuous sequence as much as 100 m thick; generally thin bedded, fissile; dark gray or purplish gray, in places altered to deep gray green. Many argillaceous layers metamorphosed to phyllite close to thrust faults. Sequence of rock types is indeterminate because of complex structure and discontinuity of exposures. General characteristics of strata and structural relations to Swauger Formation suggest possible correlation with Late Proterozoic Wilbert and (or) Lower Ordovician Summerhouse Formations (Ruppel, 1975) or with formation of Tyler Peak of Early Cambrian age (McCandless, 1982).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: rp

Unit Name: Roof pendants and xenoliths of metamorphic rock in Idaho batholith, undivided (Paleozoic? or Proterozoic?)

Map Unit Description

Includes schist, quartzite, and calc-silicate rocks. At some places graphite is common constituent of rocks. Includes Thompson Peak Formation of Reid (1963).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: rps

Unit Name: Schist roof pendant

Map Unit Description

Exposures of these rocks east of Big Baldy Lookout (44°47’ N., 114°13’ W.) are principally staurolite-muscovite-biotite-quartz schist and locally, according to B. F. Leonard (written commun., 1983), contain garnet and andalusite.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: rpq

Unit Name: Quartzite roof pendant

Map Unit Description

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: rpc

Unit Name: Calc-silicate rock roof pendant

Map Unit Description

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yl

Unit Name: Lawson Creek Formation

Map Unit Description

Thin- to medium-bedded and interbedded fine-grained, platy, pink to greenish-gray quartzite and dark purplish-gray quartzitic phyllite containing some zones of laminated purple, sandy argillite. Quartzite is feldspathic, locally containing much coarser mica on bedding planes, and has conspicuous ripple marks and other sedimentary structures. Some thicker quartzite beds similar to Swauger Formation in general characteristics. Base of sequence is gradational through distance of a few meters with the Swauger Formation on which it lies; top not known; minimum thickness about 1,300 m (Hobbs, 1980).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ys

Unit Name: Swauger Formation

Map Unit Description

Light-pink, pinkish-tan, purplish-gray to locally red, medium- to coarse-grained, fairly pure, well-sorted quartzite; commonly contains several percent feldspar; medium to thick bedded, locally prominent cross-lamination; few very thin shaly partings. Base not exposed; top seems to grade over several meters into Lawson Creek Formation (Yl). Minimum thickness about 3,000 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yg

Unit Name: Gunsight Formation

Map Unit Description

Light-brownish-gray, fine- to medium-grained (0.3-0.6 mm diameter), thin- -to thick-bedded, sericitic quartzite; typically contains about 60-65 percent quartz, 30 percent sericite, 2-4 percent orthoclase and perthite, 3-6 percent microcline, 0.4-0.6 percent plagioclase. Rock is not well sorted; mostly well rounded quartz "berries" as large as 0.7 mm commonly occur in matrix of grains averaging about 0.3 mm diameter. Some exposures contain only trace amounts of alkali feldspar and plagioclase and considerably less than 15 percent sericite, and appear to be gradational with overlying Swauger Formation. Thickness 400 m (incomplete).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ya

Unit Name: Apple Creek Formation

Map Unit Description

Mainly siltstone and fine-grained sandstone; medium-greenish-gray to grayish-red-purple to dark-gray, thin-bedded, laminated siltstone containing irregular streaks and lenses of light-gray, pinkish to pale-brown sandstone cemented by ferrodolomite. Sandstone lenticles are typically a few millimeters to several centimeters thick and 1 m, more or less, long, although much longer lenses are known. Medium-gray to brownish-gray to light-gray or pale-red, feldspathic, fine-grained quartzite beds several centimeters in thickness occur in what appear to be stratigraphically higher parts of unit. Ripple marks and other sedimentary structures are abundant, and many bedding surfaces are coated with detrital mica; lamination and cross-lamination in fine-grained sandstone common. Disconnected exposures and complex structure prevent accurate correlation of beds and determination of thickness. No base or top exposed in quadrangle. It is possible that upper part of section mapped as Yellowjacket Formation (Yy) east and north of Iron Lake (44°54.5’ N., 114°11.5’ W.) and north of Iron Creek (44°56’ N., 114°04’ W.) actually is Apple Creek Formation.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yb

Unit Name: Big Creek Formation

Map Unit Description

Light-greenish-gray, thin- and thick-bedded, fine- to medium-grained, micaceous and feldspathic quartzite; thicker beds are conspicuously cross bedded; magnetite grains are abundant in some laminae and scattered through rock. In some exposures greenish-gray quartzite grades upward to reddish-gray feldspathic quartzite that weathers brown and brownish gray. Some thinner bedded exposures contain more siltite and show rather pronounced slaty cleavage, obscure current ripple marks, and some load casts. Typical rocks contain 45-57 percent quartz (0.1-0.3 mm long), 10-20 percent orthoclase and microcline, 10-20 percent plagioclase, and 7-20 percent sericite, biotite, and iron oxide. Abundance of plagioclase is distinctive. Thickness 600 m (incomplete).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yy

Unit Name: Yellowjacket Formation

Map Unit Description

Mostly medium-gray and light-bluish-gray to greenish-gray, thin- and thick-bedded, argillaceous quartzite and siltite grading downward to thin- and thick-bedded, light-gray quartzite that is indistinguishable from underlying Hoodoo Quartzite (Yh, see below). Upper sequence of Yellowjacket Formation (above Hoodoo) along north border of quadrangle at long 114°27’ W. is of uncertain thickness but probably has preserved thickness of several hundred meters. Overall, it is cleaner and lighter colored than Yellowjacket that underlies Hoodoo. Incomplete sequence below Hoodoo in Yellowjacket area (44°59’ N., 114°30’ W.) consists of 2,340 m of dark-gray, argillaceous, thin- -and thick-bedded quartzite and siltite that tend to weather to hackly chips. Ross (1934) and our work show that quartzite beds are composed of 55-70 percent quartz grains having average diameter of 0.1 mm, about 30 percent biotite, chlorite, sericite (formed from originally argillaceous material), and magnetite. Some beds are sufficiently rich in magnetite to strongly attract pencil magnet. Argillaceous quartzite grades downward locally to varicolored calcareous rocks. According to Carter (1981), calcareous rocks occur as discrete lenses in argillaceous quartzite. Thin quartzite beds throughout Yellowjacket display fine-scale, cross-laminated layers, oscillatory ripple marks, and current ripple marks. Excellent mud cracks were found in siltite or very thin quartzite layers just east of Yellowjacket Creek, along Hoodoo Creek (44°57.5’ N., 114°35’ W.), and at mouth of Musgrove Creek (45°01’ N., 114°19’ W.) in Elk City 1°x2° quadrangle. These occurrences confirm conclusion of Ross (1934) that Yellowjacket was deposited under shallow marine conditions, at least in area near Yellowjacket mining district (44°59’ N., 114°30’ W.). Base of formation has not been identified in Challis quadrangle. Lower sequence of Yellowjacket in Iron Creek area (44°55’ N., 114°06’ W.) is more than 3,500 m thick; thickness of entire Yellowjacket at principal reference section (Ekren, 1988) is greater than 4,000 m (including Hoodoo Quartzite).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yh

Unit Name: Hoodoo Quartzite

Map Unit Description

White, off-white, and light-brownish-gray, massive-weathering, thin- and thick-bedded, clean quartzite. Except for outcrops at top and base, bedding is obscure; crossbedded in beds 0.5-1.0 m thick; contact at base and top transitional with subjacent and superjacent Yellowjacket. Intensely fractured and sheared in most places. Quartz averages about 85 percent; feldspar averages 5-15 percent and consists of microcline, non-perthitic orthoclase, and sparse albite. Rocks near base and top contain as much as 10 percent biotite, sericite, and iron oxide formed from original clay-rich cement. Thickness 0-1,100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Dr

Unit Name: Diorite, quartz diorite, and syenite

Map Unit Description

In Yellowjacket area corresponds to "hornblende quartz diorite" of Ross (1934), who considered rock to be Tertiary in age. This unit is mixed sequence of mostly gray, melanocratic rock ranging in composition from reconstituted gabbro to mafic-rich quartz monzonite. Composition of gabbro from near Middle Fork Peak (44°58’ N., 114°39’ W.): pf (1-10 mm long), 34.4; b, 2.8; hb (mostly after px), 18.4; fibrous actinolite-tremolite, 5.2; nonfibrous actinolite-tremolite, 15.1; chlorite, 7.6; black opaque oxides, 10.8; apatite, 5.7. According to Ross (1934, p. 58), typical hornblende quartz diorite is nearly white and contains the following minerals: q, trace-5 (locally as much as 20); af, trace-10; pf, 60; hb and b (mostly intergrown), 20-40 (locally hb, 43; b, 38). Rock commonly is altered to epidote, chlorite, sericite, and calcite. Cater and others (1973) considered these rocks to be Precambrian in age, and Peale (1982, p. 58) considered them to be Cambrian(?)-to Ordovician(?). Diorite and quartz diorite are part of composite mass that includes syenite (sr, see below). Gabbro and diabase may be as old as Precambrian, but ages of other rocks of this unit clearly are uncertain. Karl Evans (written commun., 1984) obtained an Ordovician age on zircons from syenite in this map unit from a locality a few kilometers east of Middle Fork Peak (44°58’ N., 114°39’ W.).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: sr

Unit Name: Quartz syenite, syenite, and granite

Map Unit Description

A composite mass, considered by Ross (1934) to be Tertiary in age. According to Peale (1982, p. 61-62), rocks all contain quartz except for syenite, which is rare. Mode: q, 5-32; af (mostly microcline-microperthite), 37-85; pf, 1-28; b, 0-5; ferrohastingsite, 0-15. Much of rock in this unit is remarkably fresh and postorogenic; it intrudes highly deformed Precambrian rocks. Rock resembles syenite of known Tertiary age elsewhere in quadrangle; in particular, it resembles syenite that is part of intrusive mass at Jackson Peak (Tdc), which intrudes Idaho batholith and has an Eocene potassium-argon age (see page 20). It also closely resembles "hornblende granite" of Ross (1934), which intrudes Challis Volcanics. These rocks presumably are same age as syenite mapped within unit dr (see p. 27).

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Ose?

Unit Name: Saturday Mountain Formation, Kinnikinic Quartzite, and Ella Dolomite, undivided (Ordovician)

Map Unit Description

Upper and Middle Ordovician Saturday Mountain Formation is predominantly medium-dark- to medium-gray, microgranular to very fine grained, fairly pure dolomite that contains abundant (as much as 50 percent), irregular layers of medium-dark-gray chert in uppermost part of exposed section; some chert color laminated. Weathered surfaces medium light gray with yellowish cast. Forms blocky outcrops strongly ribbed by brownish-weathering chert. Contains considerable limestone, siltstone, and black shale in Squaw Creek area (44°18’ N., 114°29’ W.). Uppermost part of Saturday Mountain Formation may be Silurian. Middle Ordovician Kinnikinic Quartzite is fine-grained quartzite that is mainly light to very light gray with yellowish or brownish cast; locally as dark as medium gray or mottled medium dark and lighter gray; very fine to fine grained, contains some medium-size rounded grains; clean. Medium to thick bedded (maximum 1 m), bedding commonly obscured by shearing and partial recrystallization; local faint lamination. Middle Ordovician Ella Dolomite is medium- to dark-gray or brownish-gray, medium- to thick-bedded dolomite that contains thin laminae of silt and sand. Sequence in extreme northeastern part of quadrangle at Rattlesnake Creek (44°58’ N., 114°0.5’ W.) includes quartzite that possibly is older than Ella Dolomite. Upper 30 m or so consists of medium-gray, fine-grained, mostly foliated dolomite, locally massive. Lower 10 m includes foliated dolomitic quartzite, which grades downward to massive, cliff-forming, white to light-gray quartzite about 200 m thick consisting of virtually pure quartz in two size fractions, a framework fraction 0.4-0.6 mm in diameter and a matrix fraction 0.1-0.2 mm in diameter. Landreth (1964) noted a few pale-red-purple beds near lower part of unit and considered entire sequence to be Kinnikinic Quartzite. Dolomite sampled by P. J. Modreski from upper 30 m contains conodonts of Middle or Late Ordovician age (J. Repetski, written commun., 1983) and an orthoid brachiopod identified by J. T. Dutro, Jr., (written commun., 1983) as probably genus Valcourea. Dutro further suggests that the collection might well represent Ella Dolomite. This allows possibility that quartzite is older than Kinnikinic and equivalent to Lower Ordovician Summerhouse Formation (Ruppel and others, 1975; McCandless, 1982). Total thickness about 1,450 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Yh?

Unit Name: Hoodoo Quartzite

Map Unit Description

White, off-white, and light-brownish-gray, massive-weathering, thin- and thick-bedded, clean quartzite. Except for outcrops at top and base, bedding is obscure; crossbedded in beds 0.5-1.0 m thick; contact at base and top transitional with subjacent and superjacent Yellowjacket. Intensely fractured and sheared in most places. Quartz averages about 85 percent; feldspar averages 5-15 percent and consists of microcline, non-perthitic orthoclase, and sparse albite. Rocks near base and top contain as much as 10 percent biotite, sericite, and iron oxide formed from original clay-rich cement. Thickness 0-1,100 m.

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Challis_rect

Map Title

Geologic map of the Challis 1° x 2° quadrangle, Idaho

Map name: Challis 250K

Map Unit Symbol: Klg

Unit Name: Leucocratic granite

Map Unit Description

Map Citation

Fisher, F.S., McIntyre, D.H., and Johnson, K.M., 1992, Geologic map of the Challis 1° x 2° quadrangle, Idaho: U.S. Geological Survey Miscellaneous Investigations Series Map I-1819, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Qs

Unit Name Surficial deposits (Quaternary)

Map Unit Description

Alluvium; alluvial fans; landslide and related deposits; talus; avalanche deposits; flood, stream terrace, pediment, or alluvial gravel; rock streams; colluvium; protalus ramparts; creep and solifluction deposits; glacial deposits; travertine; and locally, basalt. Includes slide blocks of Pennsylvanian to Mississippian carbonate rocks in the Methodist Creek area, southern Lost River Range.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Qb

Unit Name: Basalt (Quaternary)

Map Unit Description

Basalt flows of the Snake River Group. Includes a Quaternary to Tertiary late Cenozoic cinder cone in the central Lost River Range.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: QTs

Unit Name: Surficial deposits (Quaternary and Tertiary)

Map Unit Description

Gravel and older alluvium, undifferentiated.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Ts

Unit Name: Sedimentary rocks and tuff (Tertiary)

Map Unit Description

Clastic rocks, sandstone, conglomerate, tuff and tuffaceous conglomerate, gravel, fanglomerate, brecciated limestone; generally younger than extrusive rocks (Te).

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Te

Unit Name Extrusive rocks (Tertiary)

Map Unit Description

Mostly Challis Volcanic Group. Includes rocks of the Idavada Volcanics and the Heise volcanic field. Contains volcaniclastic rocks, rhyolite, dacite, latite, trachyte, andesite, shoshonite, and basalt lava flows, tuff breccia, crystal-lithic tuff, rhyolite to dacite ash-flow tuff, and air-fall tuff.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Ti

Unit Name: Intrusive rocks (Tertiary)

Map Unit Description

Plutons, dikes, and sills primarily of Challis Volcanic Group. Includes rhyodacite porphyry, granodiorite (described as quartz monzonite by Dover; 1969, 1981) plutonic rocks; rhyolite, basalt and andesite dikes.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Tj

Unit Name: Jasperoid (Tertiary)

Map Unit Description

Jasperoid, diffuse jasperoid, and silicified sedimentary rocks.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Tc

Unit Name Conglomerate (Tertiary)

Map Unit Description

Conglomerate, breccia, and sandstone at or near the base of the Challis Volcanic Group.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: PIPw

Unit Name: Wood River Formation of the Sun Valley Group (Lower Permian to Middle Pennsylvanian)

Map Unit Description

Silty and sandy limestone, calcareous sandstone and siltstone, quartzite, limestone, and conglomerate.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: PMc

Unit Name: Mixed carbonate and siliciclastic rocks (Lower Permian to Upper Mississippian)

Map Unit Description

Includes Snaky Canyon (Wolfcampian to Chesterian), Bluebird Mountain (Morrowan and Chesterian), and Arco Hills (Chesterian) Formations. Locally, may include unit Mcb (below). Primarily limestone, sandy limestone, dolostone, and sandstone .

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Mc

Unit Name Copper Basin Formation (Upper and Lower Mississippian)

Map Unit Description

Upper Mississippian part is chiefly shallow-water mudstone to conglomerate containing scattered lenses of fossiliferous limestone and dolostone and thin coal seams. Lower Mississippian part is mostly proximal turbidite deposits consisting of graded beds composed of terrigenous detrital rocks ranging in grain size from mudstone to boulder conglomerate, and subordinate detrital limestone.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Mw

Unit Name: White Knob Limestone (Upper Mississippian)

Map Unit Description

Limestone, interbedded with conglomerate and sandstone in the middle part; locally fossiliferous.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Mcb

Unit Name: Carbonate bank units (Upper Mississippian)

Map Unit Description

Includes Surrett Canyon (Chesterian), South Creek (Chesterian), Scott Peak (Chesterian and Meramecian), and Middle Canyon (Meramecian) Formations. Locally, may include some Permian to Upper Mississippian mixed carbonate and siliciclastic rocks. Primarily limestone, silty and sandy limestone, and calcareous siltstone; locally fossiliferous.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Mm

Unit Name McGowan Creek Formation (Lower Mississippian)

Map Unit Description

Locally includes Upper Devonian Three Forks Formation. Chiefly distal turbidites composed of fine- to coarse-grained terrigenous detrital rocks containing local chert-quartzite-granule and pebble conglomerate, sandstone, siltstone, mudstone, and minor silty limestone.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Dm

Unit Name: Milligen Formation (Devonian)

Map Unit Description

Dark gray to black, cleaved argillite interbedded with chert, quartzite, dolomitic siltstone, limestone, and minor conglomerate.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Dc

Unit Name: Carbonate rocks (Devonian)

Map Unit Description

Includes Three Forks Formation (except where locally mapped with McGowan Creek Formation in the central Lost River Range and southern Lemhi Range), Picabo, Grand View, and Jefferson Formations, and Carey Dolostone. Includes unnamed sandstone, channel sandstones, and carbonates in the central Lemhi Range. Primarily dolostone, including carbonate conglomerate and breccia,argillaceous limestone, and calcareous argillite.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol DOs

Unit Name Argillite and siltstone (Devonian to Ordovician)

Map Unit Description

Includes Trail Creek (Middle Silurian or younger) and Phi Kappa (Middle Silurian to Lower Ordovician) Formations; unnamed Devonian to Silurian argillite, siltstone, and limestone; and black, carbonaceous, graptolite-bearing shale and argillite.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol DSOc

Unit Name Carbonate rocks (Devonian to Ordovician)

Map Unit Description

Carbonate rocks of units Dc and DOc, undivided. Only mapped in southern Lost River Range. Primarily dolostone; includes carbonate conglomerate and breccia, argillaceous limestone, and calcareous argillite.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol DOc

Unit Name Carbonate rocks (Lower Devonian to Ordovician)

Map Unit Description

Includes Roberts Mountains Formation (Lower Devonian to Middle Silurian), Laketown Dolostone (Silurian), Saturday Mountain Formation (Lower Silurian to Middle Ordovician), and Fish Haven Dolostone (Upper Ordovician). Primarily cliff-forming, crystalline dolostone; some interbeds of sandstone, limestone, argillaceous limestone, and calcareous argillite. Metamorphosed to marble in the Pioneer Mountains and in some areas adjacent to intrusive rocks.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Ok

Unit Name: Kinnikinic Quartzite (Middle Ordovician)

Map Unit Description

Fine- to medium-grained, white to light gray, vitreous quartzite; local conglomerate. Locally mapped with Summerhouse Formation (Os).

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: Os

Unit Name: Summerhouse Formation (Lower Ordovician)

Map Unit Description

Mostly white to pale pink, bimodal, vitreous quartzite; also Scolithus-bearing and glauconitic sandstone, silty and sandy dolostone; local fossiliferous limestone in central Lemhi Range.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Oe

Unit Name Ella Dolomite (Middle Ordovician)

Map Unit Description

Primarily medium- to dark-gray, fine-grained, massive dolostone and sandy dolostone; interbeds of sandy dolostone and fine-grained quartzite. Metamorphosed to marble in the Pioneer Mountains.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Oc

Unit Name Clayton Mine Quartzite (Ordovician or older)

Map Unit Description

White, poorly sorted, feldspathic and micaceous quartzite. Only mapped west of long. 114°.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: OZq

Unit Name: Quartzitic rocks (Ordovician to Late Proterozoic)

Map Unit Description

Includes Tyler Peak (Lower Cambrian) and Wilbert (Lower Cambrian and Late Proterozoic(?)) Formations. Locally includes some Summerhouse Formation (Os) in the southern Lemhi Range and interbedded quartzite, dolomite and argillite in the Lost River Range. Contains purple quartzite, sandstone and siltstone; sandy slate; quartz pebble conglomerate.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name ChallisNF-East

Map Unit Symbol Ym

Unit Name Metasedimentary rocks (Middle Proterozoic)

Map Unit Description

Includes Lawson Creek and Swauger Formations; Lemhi Group, which is divided in descending order into Gunsight, Apple Creek, Big Creek, West Fork, and Inyo Creek Formations; Hoodoo Quartzite; and Yellowjacket Formation. Contains phyllitic quartzite, slate, siltstone, arkose, and sandstone. Mostly lower greenschist metamorphic facies; Yellowjacket Formation is biotite-grade facies. The Lawson Creek and Swauger Formations are included in this unit though the Lawson Creek Formation and uppermost Swauger Formation are glauconitic, a characteristic restricted to Late Proterozoic and Paleozoic rocks in eastern Idaho and southwestern Montana. Includes banded calc-silicate, gneissose quartzite and pelitic schist in the Pioneer Mountains.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): ChallisNF_rect

Map Title

Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho

Map name: ChallisNF-East

Map Unit Symbol: XAg

Unit Name: Gneissic rocks (Early Proterozoic to Archean(?))

Map Unit Description

Quartzo-feldspathic, quartzitic, and mafic gneiss, and calc-silicate marble in central Pioneer Mountains.

Map Citation

Wilson, A.B. and Skipp, Betty, 1994, Geologic map of the eastern part of the Challis National Forest and vicinity, Idaho: U.S. Geological Survey Geologic Investigations Series I-2395, 1 plate, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Qa

Unit Name: ALLUVIAL AND COLLUVIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)

Map Unit Description

Unconsolidated stream-laid sand, gravel, and silt, bouldery, poorly to moderately well sorted. Includes alluvial fan, slope wash, colluvial and glacial outwash deposits of Bull Lake and younger in age. Thickness of deposits as much as 10 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Qs

Unit Name: LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)

Map Unit Description

Mostly rock debris, locally coarse angular rock fragments in silt or clay matrix. Forms hummocky topography. Produced by rockfall- and rockslide-avalanches, slump, and earthflow. Thickness possibly as much as 300 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Qg

Unit Name: GLACIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)

Map Unit Description

Drift, heterogeneous mixture of rock fragments in silty clay matrix. Forms hummocky topography. Includes deposits from alpine and continental glaciations; as much as 100 m thick except in Swan River valley where thickness of mostly sand and gravel deposits exceed 300 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ql

Unit Name: LAKE DEPOSITS (PLEISTOCENE)

Map Unit Description

Light-gray to dark-gray and gray-brown, thin- to thick-bedded silty clay, clay, and some sand; deposited in glacial lakes. Thickness of deposits as much as 30 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Qtog

Unit Name: OLDER GRAVEL (PLEISTOCENE AND POSSIBLY PLIOCENE)

Map Unit Description

Coarse stream-laid gravel on remnants of at least four bench surfaces as much as 250 m above modern stream alluvium. Maximum thickness is about 10 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tla

Unit Name: LAKE DEPOSITS (MIOCENE AND OLIGOCENE)

Map Unit Description

Gray, yellowish-gray, gray-brown, sandy silt, silt, clay, shale, marl, and some poorly sorted conglomerate; locally thin coal and carbonates. Locally includes wood and leaf fragments, insects, fish, gastropods, pelecypods, and ostracods. In Landers Fork, Blackfoot River includes tuff. Thickness possibly as much as 125 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ksmr

Unit Name: ST. MARY RIVER FORMATION (UPPER CRETACEOUS)

Map Unit Description

Map unit includes the Paleocene and Upper Cretaceous Willow Creek Formation (Viele, 1960; Schmidt, 1972b) in southeast corner of map where only the lower part of the Willow Creek is present and where it consists of grayish-green, olive-drab, and light-gray mudstone and sandstone. Some coarse to very coarse grained beds of volcanic sandstone. The upper part of the St. Mary River consists of light- to dark-red, purplish-red, brown, gray, greenish-gray mudstone and sandstone, and some beds of volcanic sandstone and conglomerate. A thin bed of white ash-fall tuff occurs near middle part. The formation is as much as 790 m thick.

The upper part of the St. Mary River Formation, west of Augusta, is mostly grayish-green, sandy mudstone with moderate-light-red and purple interbeds. It contains numerous zones of dark-brown limestone nodules. Near Augusta, strata equivalent to the lower part of the St. Mary River are present and consist of grayish-green, olive-drab, and light-gray mudstone, sandy mudstone, and sandstone with some gray argillaceous limestone and carbonaceous shale. Sandstones are fine to medium grained and crossbedded. They are as much as 12 m thick. Thin argillaceous limestone beds as much as 0.3 m thick are locally present. A carbonaceous shale bed as much as 1.0 m thick is beneath a 1.0 m oyster bed near the base of the formation. Some reptile bone fragments and pelecypods are near the base. In the Augusta area the formation thickness is as much as 430 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Kh

Unit Name: HORSETHIEF SANDSTONE AND BEARPAW-HORSETHIEF TRANSITION UNIT (UPPER CRETACEOUS)

Map Unit Description

Horsethief Sandstone is mostly gray to gray-brown, fine- to medium-grained crossbedded sandstone. The upper 6-12 m of the formation commonly contain lentils of titaniferous magnetite sandstone. Southeast of Augusta the Horsethief contains volcanic-rich sandstone and conglomerates (Viele and Harris, 1965). The Horsethief is absent in the southeast part of the quadrangle where its position is marked by an Ostrea glabra bed (Viele, 1960); locally the sandstone contains pelecypods. The Horsethief is as much as 50 m thick.

The Bearpaw-Horsethief transition unit of Cobban (1955) beneath the Horsethief, consists of dark-gray mudstone interbedded with light- to medium-gray mudstone and fine- to medium-grained sandstone that is thin bedded in the lower part becoming thicker bedded in the upper part. Near Sun River a 0.3 m coal bed occurs about 6 m below the top. Thickness of the transition unit as much as 60 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ku

Unit Name: UPPER AND LOWER CRETACEOUS ROCKS UNDIVIDED, INCLUDES TWO MEDICINE FORMATION, VIRGELLE SANDSTONE, TELEGRAPH CREEK FORMATION, MARIAS RIVER SHALE, AND BLACKLEAF, KOOTENAI, AND MOUNT PABLO FORMATIONS

Map Unit Description

Two Medicine Formation: Gray-green and gray mudstone with minor sandstone in upper and middle parts with gray-green, olive-drab, and gray sandstone and mudstone in lower part. Upper and middle parts locally contain reddish-gray, red-brown, and purple interbeds of mudstone. The sandstones are fine to coarse grained and locally conglomeratic. Carbonaceous shale and locally a coal bed are present in the lower part. Petrified wood common about 30 m above base; vertebrate bones common in the upper 150 m. Pelecypods locally present at various horizons. Thickness about 670 m.

Virgelle Sandstone: consists of moderately thick, light-gray, fine-grained sandstone beds of which some are locally iron impregnated and crossbedded. At the top of the Virgelle, a titaniferous magnetite sandstone bed, as much as 6 m thick, forms a prominent rimrock south, west, and northwest of Choteau, as well as numerous other localities in the outcrop area. The Virgelle rarely contains pelecypods; wood fragments are locally in upper part. Thickness ranges from about 40 m to 60 m.

Telegraph Creek Formation: A transitional unit between the underlying Marias River Shale and the overlying Virgelle Sandstone. Consists mainly of beds of gray mudstone and fine-grained sandstone. The sandstone beds are thinly bedded in the lower part becoming thicker bedded in the upper part. Pelecypods and ammonites are common. Thickness ranges from about 90 m in the eastern outcrop to about 165 m in the western outcrop.

Marias River Shale: Mostly a dark-gray mudstone that is divided into four members (listed in descending order), the Kevin, Ferdig, Cone, and Floweree, by Cobban, Erdmann, Lemke, and Maughan (1959, 1976). Total thickness ranges from 365 m to 395 m.

Kevin Member Dark-gray mudstone with some very thin sandstone beds, numerous bentonite beds, and many light-gray calcareous concretions. Pelecypods and ammonites common. Ranges in thickness from 245 m to 305 m.

Ferdig Member Gray, noncalcareous siltstone and shale with many thin, iron-stained sandstone lenses, concretions of yellow-weathering limestone, red-weathering ferruginous dolostone, and some very thin bentonite beds. Contains abundant organic trails and burrows, but pelecypods and ammonites are rare. In the western outcrop, along the tributaries of the Sun River, the Ferdig is mostly sandstone (Mudge, 1972). Ranges in thickness from 50 m to 105 m.

Cone Member Abundant, very thin, medium-gray calcareous siltstone and crystalline limestone beds in the upper part and dark-gray, noncalcareous shale in the lower part. Contains several bentonite beds throughout. Pelecypods and ammonites are common, especially in the upper part. The member ranges in thickness from 18 m to 30 m.

Floweree Member Dark-gray, noncalcareous fissile to thin-bedded shale with medium-gray siltstone in lower part that locally contains lenses of chert-pebble conglomerate. Pelecypods and ammonites are rare. Thickness about 10 m.

Blackleaf Formation: Blackleaf Formation mostly sandstone and mudstone, and includes some fissile shale. Formation divided into three members (listed in descending order), Vaughn, Taft Hill, and Flood. The total thickness about 200 m in the eastern outcrop and 490 m in the western outcrop.

Vaughn Member: Nonmarine, light-gray, gray-green, and green tuffaceous and bentonitic mudstone and sandstone. Dark-gray carbonaceous mudstone locally in the upper part in the southeastern outcrop. The sandstone units are fine to coarse grained, locally crossbedded, and in places contain pebble and cobble conglomerate channel-fill deposits as much as 6 m thick (Mudge and Sheppard, 1968). The member contains wood and leaf fragments, and in the vicinity of Teton Pass contains coal and carbonaceous shale. Thickness from about 90 m in the eastern outcrop to about 150 m in the western outcrop.

Taft Hill Member: Marine, gray, thinly bedded, fine-grained sandstone units interbedded with dark-gray mudstone; the sandstone is locally crossbedded and ripple marked. In the northwest part of the quadrangle the upper part of the member is replaced by nonmarine strata of Vaughn lithologies. Locally the Taft Hill contains numerous pelecypods. Thickness ranges from about 58 m in the southeast to about 183 m in the west.

Flood Member: Two marine, gray, sandstone units separated by as much as 150 m of dark-gray fissile shale. The sandstones are very fine grained, thin to moderately thick bedded, and locally crossbedded and ripple marked. Organic burrows and trails common. Thickness from about 45 m in the eastern outcrop to about 165 m thick in the western outcrop.

Kootenai Formation: Consists of nonmarine, gray-green, and dark-reddish-brown mudstone interbedded with lenticular thin to thick sandstone units. Numerous heavily iron-stained, spheroidal nodules of dark-grayish-red sandy limestone are in the mudstone. The sandstone is fine to coarse grained, grayish-green, with chert and quartz grains and locally magnetite. Pebble and cobble conglomerate, as much as 15 m thick, fill narrow channels locally at the base of some sandstone units. In most places a distinctive hard, dense, brown coquinoid limestone containing abundant pelecypods and some vertebrate fragments at or near the top. Thickness ranges from 198 m to 245 m.

Mount Pablo Formation: Nonmarine. Exposures widespread in the eastern mountains but locally absent in the adjacent foothills. Rests unconformably on the Morrison Formation. In the western drainages of the Sun River area was included as part of the western facies of the Morrison Formation by Mudge (1972). Ranges from a dominantly sandstone sequence with interbedded bright-reddish-brown mudstone to a dominantly reddish brown mudstone sequence with some sandstone. Dense, dark-gray to light-gray limestone beds as much as 9 m thick are present in the upper part of the formation. In many places, coarse sandstone and thin beds of conglomerate occur as channel-fill deposits. The sandstones are medium to very coarse grained, crossbedded, and contain wood fragments. Thickness about 60 m.

Morrison Formation (Upper Jurassic) Nonmarine. A nearly complete section is present in the eastern and southern outcrop, but much of the formation was eroded prior to deposition of the Mount Pablo Formation in the western outcrop. Consists of tuffaceous, grayish-green, olive-green, and olive-gray claystone to siltstone with pink, maroon, purple, and yellowish-gray mudstones in the upper part. A thin, dark-gray carbonaceous shale present near the top in southeastern outcrop. Fine-grained clayey sandstone locally present. Abundant polished quartzite pebbles and limestone nodules characteristic of the Morrison locally. Cherty siderite lenses and nodules locally common about 35 m above the base

Geologic map unit descriptions

of the formation. A thin, dark-gray-brown to gray limestone present in the lower part of the formation and locally in the middle part. Gastropods, pelecypods, plant fragments, ostracods, and vertebrate bones are sparse in the middle and lower parts of the formation. Thickness from 60 m to 82 m.

Swift Formation (Upper and Middle Jurassic) Marine. Consists of thinly bedded gray to gray-brown fine-grained sandstone in the upper part and dark-gray to olive-drab mudstone with many thin beds of sandstone in the lower part. The upper beds are locally ripple marked and contain minute cross laminations and wood fragments. A thin glauconitic sandstone, with water-worn belemnites, present at the base of the formation. Formation rests unconformably on the Rierdon Formation everywhere except in the southeast corner of the map where it rests on the Sawtooth Formation. Thickness about 35 m.

Rierdon Formation: Marine. Widely distributed except in the southeast corner of the map area. Consists mostly of gray, calcareous mudstone with thin interbedded argillaceous limestone. Barite nodules common in the upper and middle parts. Pelecypods and ammonites common throughout. Thickness from 33 m to 60 m.

Sawtooth Formation: Marine. The upper member is gray-brown to yellowish-brown, calcareous, thin-bedded siltstone that contains pelecypods and ammonites. About 8 m thick. The middle member is dark-gray, silty to clayey fissile shale with local thin beds of fine-grained sandstone and conglomerate. Locally rests unconformably on Mississippian rocks. From 5 m to 77 m thick. The lower member is mostly thin bedded, fine-grained gray to yellowish-brown sandstone with a basal conglomerate of Mississippian rock fragments. Dark-gray, silty, thinly laminated shale locally interbedded in the sandstone. Pelecypods are locally abundant. Thickness of the lower member as much as 16 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ktm

Unit Name: TWO MEDICINE FORMATION (UPPER CRETACEOUS)

Map Unit Description

Gray-green and gray mudstone with minor sandstone in upper and middle parts with gray-green, olive-drab, and gray sandstone and mudstone in lower part. Upper and middle parts locally contain reddish-gray, red-brown, and purple interbeds of mudstone. The sandstones are fine to coarse grained and locally conglomeratic. Carbonaceous shale and locally a coal bed are present in the lower part. Petrified wood common about 30 m above base; vertebrate bones common in the upper 150 m. Pelecypods locally present at various horizons. Thickness about 670 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ktv

Unit Name: Volcanic-rich sedimentary rocks, flows, and tuffs

Map Unit Description

South of Augusta. The upper and middle parts are green, grayish-green, gray, brownish-gray, and maroon volcanic sandstone, mudstone, and conglomerate; brown, pink, and white ash-fall and ash-flow tuffs; and interbedded trachyte and latite flows (Viele, 1960; Viele and Harris, 1965; Schmidt and Strong, 1972; and Schmidt, 1972a, b, c). Lower 150 m is gray-green, olive-drab, and gray sandstone and mudstone. Thickness ranges from 640 m too possibly as much as 1,500 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Kvt

Unit Name: VIRGELLE SANDSTONE AND TELEGRAPH CREEK FORMATION (UPPER CRETACEOUS)

Map Unit Description

Virgelle Sandstone: consists of moderately thick, light-gray, fine-grained sandstone beds of which some are locally iron impregnated and crossbedded. At the top of the Virgelle, a titaniferous magnetite sandstone bed, as much as 6 m thick, forms a prominent rimrock south, west, and northwest of Choteau, as well as numerous other localities in the outcrop area. The Virgelle rarely contains pelecypods; wood fragments are locally in upper part. Thickness ranges from about 40 m to 60 m.

Telegraph Creek Formation: A transitional unit between the underlying Marias River Shale and the overlying Virgelle Sandstone. Consists mainly of beds of gray mudstone and fine-grained sandstone. The sandstone beds are thinly bedded in the lower part becoming thicker bedded in the upper part. Pelecypods and ammonites are common. Thickness ranges from about 90 m in the eastern outcrop to about 165 m in the western outcrop.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Km

Unit Name: MARIAS RIVER SHALE (UPPER CRETACEOUS)

Map Unit Description

Mostly a dark-gray mudstone that is divided into four members (listed in descending order), the Kevin, Ferdig, Cone, and Floweree, by Cobban, Erdmann, Lemke, and Maughan (1959, 1976). Total thickness ranges from 365 m to 395 m.

Kevin Member Dark-gray mudstone with some very thin sandstone beds, numerous bentonite beds, and many light-gray calcareous concretions. Pelecypods and ammonites common. Ranges in thickness from 245 m to 305 m.

Ferdig Member Gray, noncalcareous siltstone and shale with many thin, iron-stained sandstone lenses, concretions of yellow-weathering limestone, red-weathering ferruginous dolostone, and some very thin bentonite beds. Contains abundant organic trails and burrows, but pelecypods and ammonites are rare. In the western outcrop, along the tributaries of the Sun River, the Ferdig is mostly sandstone (Mudge, 1972). Ranges in thickness from 50 m to 105 m.

Cone Member Abundant, very thin, medium-gray calcareous siltstone and crystalline limestone beds in the upper part and dark-gray, noncalcareous shale in the lower part. Contains several bentonite beds throughout. Pelecypods and ammonites are common, especially in the upper part. The member ranges in thickness from 18 m to 30 m.

Floweree Member Dark-gray, noncalcareous fissile to thin-bedded shale with medium-gray siltstone in lower part that locally contains lenses of chert-pebble conglomerate. Pelecypods and ammonites are rare. Thickness about 10 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: KJ

Unit Name: LOWER CRETACEOUS AND JURASSIC ROCKS UNDIVIDED

Map Unit Description

Blackleaf Formation: Mostly sandstone and mudstone, and includes some fissile shale. Formation divided into three members (listed in descending order), Vaughn, Taft Hill, and Flood. The total thickness about 200 m in the eastern outcrop and 490 m in the western outcrop.

Vaughn Member: Nonmarine, light-gray, gray-green, and green tuffaceous and bentonitic mudstone and sandstone. Dark-gray carbonaceous mudstone locally in the upper part in the southeastern outcrop. The sandstone units are fine to coarse grained, locally crossbedded, and in places contain pebble and cobble conglomerate channel-fill deposits as much as 6 m thick (Mudge and Sheppard, 1968). The member contains wood and leaf fragments, and in the vicinity of Teton Pass contains coal and carbonaceous shale. Thickness from about 90 m in the eastern outcrop to about 150 m in the western outcrop.

Taft Hill Member: Marine, gray, thinly bedded, fine-grained sandstone units interbedded with dark-gray mudstone; the sandstone is locally crossbedded and ripple marked. In the northwest part of the quadrangle the upper part of the member is replaced by nonmarine strata of Vaughn lithologies. Locally the Taft Hill contains numerous pelecypods. Thickness ranges from about 58 m in the southeast to about 183 m in the west.

Flood Member: Two marine, gray, sandstone units separated by as much as 150 m of dark-gray fissile shale. The sandstones are very fine grained, thin to moderately thick bedded, and locally crossbedded and ripple marked. Organic burrows and trails common. Thickness from about 45 m in the eastern outcrop to about 165 m thick in the western outcrop.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Pz

Unit Name: PALEOZOIC ROCKS. INCLUDES PART OR ALL OF MISSISSIPPIAN, DEVONIAN, AND CAMBRIAN SEQUENCES

Map Unit Description

All or part of the following formations are present in this unit.

Castle Reef Dolomite (Upper and Lower Mississippian) Divided into two members. Sun River Member at the top, which consists of thin to thick beds of medium to finely crystalline light-gray dolomite and locally some interbedded calcitic dolomite. Many beds contain thick lenses of encrinite and scattered brachiopods and corals. The Sun River is from less than 1 m to 137 m thick. The lower member is thick-bedded, fine to coarsely crystalline, light- to medium-gray dolomite, calcitic dolomite, dolomitic limestone, and limestone. The coarsely crystalline beds are encrinite and are more numerous in the northern and western outcrop. The lower member contains brachiopods and corals, locally abundant in the lower part. The lower member is 114 m to 145 m thick. Both members thin eastward, mainly as a result of pre-Jurassic erosion.

Allan Mountain Limestone (Lower Mississippian) Ranges in thickness from 163 m to 200 m, and contains three unnamed members. The upper member consists of gray, fine-grained, thin to thick beds of limestone, magnesian limestone, and dolomitic limestone. Nodules and lentils of gray- to gray-brown chert are common (Mudge, 1972). It has a large and varied fauna, mostly brachiopods and corals, and locally, lenses and beds of encrinite. Upper member 60 to 90 m thick. The middle member consists of dark-gray, fine-grained, thin to medium beds of limestone with some dolomitic limestone. Characteristically contains nodules and irregular-shaped to even-bedded lenses of dark-gray chert, of which some have a fibrous appearance (Mudge, 1972). Contains sparse brachiopods and corals (Mudge, Sando, and Dutro, 1962). The middle member about 45 m thick. The lower member mostly dark-gray, very thin bedded, argillaceous dolomitic limestone with many calcareous shale partings. Contains dense, gray, moderately thick limestone interbedded with dark-gray mudstone. The mudstone has abundant brachiopods and corals. Thickness of lower member 60 m to 89 m.

Three Forks Formation (Upper Devonian) The uppermost unit is a black shale bed of Early Mississippian age unnamed in this quadrangle but called the Sappington Member of the Three Forks elsewhere in Montana and is correlative to the Exshaw Shale in Alberta (Mudge, 1972). In most places it overlies thinly bedded, gray-brown to yellowish-gray limestone. The limestone commonly overlies an evaporite-solution breccia, but locally, in the Sun River area, overlies a thick bed of limestone and in one place a gray-green mudstone (Mudge, 1972). Fossils abound in the dark-gray shale and limestone beds. The rest of the Three Forks consists mostly of a pale-yellowish-brown to yellowish-gray evaporite-solution breccia consisting of angular fragments of dolomite and dolomitic limestone. Thickness from 15 m to 180 m.

Jefferson Formation (Upper Devonian) Consists of two members: the Birdbear and a lower member. The Jefferson thickens eastward from about 190 m in the western outcrop to 247 m in the east. The Birdbear Member consists mostly of pale-yellowish-brown to brownish-gray, finely crystalline dolomite beds that pinch and swell. Brachiopods are commonly present. Ranges in thickness from 45 m to about 72 m. The lower member is mostly dolomite in the eastern outcrop, whereas it is mostly limestone in the western outcrop (Mudge, 1972). Consists of distinctive gray-brown beds (mostly less than 1/2 m thick) that characteristically have a fetid odor on the broken surface. Many beds have a sucrosic texture. The lower part commonly contains one or more thin beds of evaporite-solution breccia. Dark-gray chert lenses common in the lower part in the eastern outcrop. Corals, brachiopods, and stromatoporoids common throughout and Amphipora biostromes are widespread in the upper part. Thickness from 128 m to 198 m.

Maywood Formation (Upper and Middle Devonian) Contains an upper limestone member and a lower mudstone member. The upper member is mainly dark grayish-brown and yellowish-gray, thinly bedded, finely crystalline limestone and dolomitic limestone that thickens eastward from about 21 m in the west to 48 m in the east. Contains brachiopods and corals. The lower member is mostly greenish gray dolomitic mudstone that in the western outcrops is interbedded with maroon mudstone. Contains thin beds of crystalline yellowish-gray to olive-gray dolomite and dolomitic limestone. A widespread dolomite with some breccia present in the middle part of the member. Charophytes and conodonts are locally present in one of the dolomite beds. The lower member ranges in thickness from about 8 m in the eastern outcrop to 63 m in the western outcrop.

Devils Glen Dolomite (Upper Cambrian) A distinctive, thick-bedded, light-gray, finely to very finely crystalline dolomite. Thickness from 54 m to 172 m (Deiss, 1939).

Switchback Shale (Upper and Middle Cambrian) Mostly noncalcareous, greenish-gray, thinly laminated clay shale with local thin interbeds of dolomite, limestone, sandstone, and conglomerate. Thickness from 21 m to 92 m.

Steamboat Limestone (Middle Cambrian) Differs in lithology between western and eastern outcrops. In the west consists of a lower shaly mudstone interval and a much thicker upper limestone interval (Deiss, 1939). In the eastern exposures is about equal parts of alternating sequences of limestone and calcareous shale. The carbonate units in both areas consist mostly of nodular, hard, dark-yellowish-brown, thinly bedded limestone and dolomite with nodules and lentils of dark-yellowish-orange siltstone. The mudstone units are mainly grayish-green noncalcareous shale with interbeds of calcareous siltstone and claystone. Trilobites, locally abundant, and some brachiopods occur in limestone lenses in the shales and locally near the top of the limestone units. Thickness from 65 m to 80 m.

Pentagon Shale (Middle Cambrian) A clastic wedge that consists of very fossiliferous, calcareous, gray to tan-gray, thick-bedded platy shale that contains some platy, blue-gray argillaceous limestone in the upper part (Deiss, 1939). Thickness ranges from less than 1 m to 88 m (Deiss, 1939).

Pagoda Limestone (Middle Cambrian) Forms prominent light-gray cliffs in the Cambrian sequence. The upper part consists of yellowish-gray to light-yellowish-brown, thin- to thick-bedded dolomitic limestone and some dolomite overlying very thin bedded limestone. The lower part consists of grayish-green, thinly laminated to nodular clay shale with some gray-brown limestone and minor sandstone. An intraformational conglomerate locally present in the middle and lower parts. Trilobites and brachiopods locally numerous in the shale (Deiss, 1939). Formation thickens to the south and west, and ranges in thickness from 28 m to about 120 m.

Dearborn Limestone (Middle Cambrian) Composed of an upper thick limestone unit and a lower thin shale unit. The limestone unit is finely crystalline, yellowish-brown to gray, thin to thick bedded and irregularly bedded. The lower unit consists of gray to gray-green clayey shale with some sandy shale and thin interbedded limestone. Trilobites present in the lower part of the shale unit. Thickness from 67 m to 106 m.

Geologic map unit descriptions

Damnation Limestone (Middle Cambrian) Consists of medium- to dark-gray, thin- to thick-bedded, finely crystalline dolomitic limestone and limestone with laminae of grayish-orange to yellowish-gray siltstone that thicken and thin. Locally they are oolitic and contain trilobites, brachiopods, and organic trails and burrows. Thickness from 30 m to 68 m.

Gordon Shale (Middle Cambrian) Mainly a dark-gray to gray-brown, very thinly laminated shale with a greenish tint and locally maroonish-gray beds. Contains many thin beds of sandstone and some beds of limestone, especially in the middle and upper parts. In places the limestones contain glauconite, algal structures, limestone chips, grains of quartz, and fossil fragments. The upper part contains numerous fossils (Deiss, 1939), whereas the lower beds locally contain organic trails and burrows, some by trilobites. Thickness from 42 m to 90 m.

Flathead Sandstone (Middle Cambrian) Consists of thin- to thick-bedded and crossbedded, noncalcareous yellowish-gray, poorly sorted, poorly indurated, fine- to coarse-grained quartzose sandstone with scattered quartz pebbles. Beds are characteristically speckled by disseminated hematite. Interbeds of gray, purple, or maroon mudstone locally present. Thickness from 13 m to 35 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Mu

Unit Name: UPPER AND LOWER MISSISSIPPIAN ROCKS UNDIVIDED

Map Unit Description

Mississippian rocks are the main cliff former in the eastern part of the mountains and are assigned to the Madison Group. The total thickness of the Mississippian rocks ranges from 275 m to 520 m. The Madison is divided into two formations, the Castle Reef Dolomite and the Allan Mountain Limestone, by Mudge, Sando, and Dutro (1962).

Castle Reef Dolomite (Upper and Lower Mississippian) Divided into two members. Sun River Member at the top, which consists of thin to thick beds of medium to finely crystalline light-gray dolomite and locally some interbedded calcitic dolomite. Many beds contain thick lenses of encrinite and scattered brachiopods and corals. The Sun River is from less than 1 m to 137 m thick. The lower member is thick-bedded, fine to coarsely crystalline, light- to medium-gray dolomite, calcitic dolomite, dolomitic limestone, and limestone. The coarsely crystalline beds are encrinite and are more numerous in the northern and western outcrop. The lower member contains brachiopods and corals, locally abundant in the lower part. The lower member is 114 m to 145 m thick. Both members thin eastward, mainly as a result of pre-Jurassic erosion.

Allan Mountain Limestone (Lower Mississippian) Ranges in thickness from 163 m to 200 m, and contains three unnamed members. The upper member consists of gray, fine-grained, thin to thick beds of limestone, magnesian limestone, and dolomitic limestone. Nodules and lentils of gray- to gray-brown chert are common (Mudge, 1972). It has a large and varied fauna, mostly brachiopods and corals, and locally, lenses and beds of encrinite. Upper member 60 to 90 m thick. The middle member consists of dark-gray, fine-grained, thin to medium beds of limestone with some dolomitic limestone. Characteristically contains nodules and irregular-shaped to even-bedded lenses of dark-gray chert, of which some have a fibrous appearance (Mudge, 1972). Contains sparse brachiopods and corals (Mudge, Sando, and Dutro, 1962). The middle member about 45 m thick. The lower member mostly dark-gray, very thin bedded, argillaceous dolomitic limestone with many calcareous shale partings. Contains dense, gray, moderately thick limestone interbedded with dark-gray mudstone. The mudstone has abundant brachiopods and corals. Thickness of lower member 60 m to 89 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Du

Unit Name: UPPER AND MIDDLE DEVONIAN ROCKS UNDIVIDED

Map Unit Description

Consists of limestone, dolomite, and some shale and mudstone; they range in thickness from about 300 m in the eastern outcrop to about 458 m in the western outcrop, and are divided into the Three Forks, Jefferson, and Maywood Formations.

Three Forks Formation (Upper Devonian) The uppermost unit is a black shale bed of Early Mississippian age unnamed in this quadrangle but called the Sappington Member of the Three Forks elsewhere in Montana and is correlative to the Exshaw Shale in Alberta (Mudge, 1972). In most places it overlies thinly bedded, gray-brown to yellowish-gray limestone. The limestone commonly overlies an evaporite-solution breccia, but locally, in the Sun River area, overlies a thick bed of limestone and in one place a gray-green mudstone (Mudge, 1972). Fossils abound in the dark-gray shale and limestone beds. The rest of the Three Forks consists mostly of a pale-yellowish-brown to yellowish-gray evaporite-solution breccia consisting of angular fragments of dolomite and dolomitic limestone. Thickness from 15 m to 180 m.

Jefferson Formation (Upper Devonian) Consists of two members: the Birdbear and a lower member. The Jefferson thickens eastward from about 190 m in the western outcrop to 247 m in the east. The Birdbear Member consists mostly of pale-yellowish-brown to brownish-gray, finely crystalline dolomite beds that pinch and swell. Brachiopods are commonly present. Ranges in thickness from 45 m to about 72 m. The lower member is mostly dolomite in the eastern outcrop, whereas it is mostly limestone in the western outcrop (Mudge, 1972). Consists of distinctive gray-brown beds (mostly less than 1/2 m thick) that characteristically have a fetid odor on the broken surface. Many beds have a sucrosic texture. The lower part commonly contains one or more thin beds of evaporite-solution breccia. Dark-gray chert lenses common in the lower part in the eastern outcrop. Corals, brachiopods, and stromatoporoids common throughout and Amphipora biostromes are widespread in the upper part. Thickness from 128 m to 198 m.

Maywood Formation (Upper and Middle Devonian) Contains an upper limestone member and a lower mudstone member. The upper member is mainly dark grayish-brown and yellowish-gray, thinly bedded, finely crystalline limestone and dolomitic limestone that thickens eastward from about 21 m in the west to 48 m in the east. Contains brachiopods and corals. The lower member is mostly greenish gray dolomitic mudstone that in the western outcrops is interbedded with maroon mudstone. Contains thin beds of crystalline yellowish-gray to olive-gray dolomite and dolomitic limestone. A widespread dolomite with some breccia present in the middle part of the member. Charophytes and conodonts are locally present in one of the dolomite beds. The lower member ranges in thickness from about 8 m in the eastern outcrop to 63 m in the western outcrop.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Cu

Unit Name: CAMBRIAN ROCKS UNDIVIDED

Map Unit Description

Complete sections of these rocks are only in the western outcrop. Deiss (1939) divided these rocks into nine formations: Devils Glen Dolomite (top), Switchback Shale, Steamboat Limestone, Pentagon Shale, Pagoda Limestone, Dearborn Limestone, Damnation Limestone, Gordon Shale, and Flathead Sandstone (bottom). The Pentagon Shale occurs only in the vicinity of Pentagon Mountain where Deiss (1939) noted it to extend about 25 km to the south and about 7 km north of the mountain. The Devils Glen, Switchback, and Steamboat are in thrust blocks in the eastern outcrops. The limestone formations contain considerable mudstone in the east, but they are mostly limestone in the west. All formations locally contain trilobites and some brachiopods. The Cambrian rocks thin northwestward from 681 m near the Dearborn River to 439 m at Pagoda Mountain (Deiss, 1939).

Devils Glen Dolomite (Upper Cambrian) A distinctive, thick-bedded, light-gray, finely to very finely crystalline dolomite. Thickness from 54 m to 172 m (Deiss, 1939).

Switchback Shale (Upper and Middle Cambrian) Mostly noncalcareous, greenish-gray, thinly laminated clay shale with local thin interbeds of dolomite, limestone, sandstone, and conglomerate. Thickness from 21 m to 92 m.

Steamboat Limestone (Middle Cambrian) Differs in lithology between western and eastern outcrops. In the west consists of a lower shaly mudstone interval and a much thicker upper limestone interval (Deiss, 1939). In the eastern exposures is about equal parts of alternating sequences of limestone and calcareous shale. The carbonate units in both areas consist mostly of nodular, hard, dark-yellowish-brown, thinly bedded limestone and dolomite with nodules and lentils of dark-yellowish-orange siltstone. The mudstone units are mainly grayish-green noncalcareous shale with interbeds of calcareous siltstone and claystone. Trilobites, locally abundant, and some brachiopods occur in limestone lenses in the shales and locally near the top of the limestone units. Thickness from 65 m to 80 m.

Pentagon Shale (Middle Cambrian) A clastic wedge that consists of very fossiliferous, calcareous, gray to tan-gray, thick-bedded platy shale that contains some platy, blue-gray argillaceous limestone in the upper part (Deiss, 1939). Thickness ranges from less than 1 m to 88 m (Deiss, 1939).

Pagoda Limestone (Middle Cambrian) Forms prominent light-gray cliffs in the Cambrian sequence. The upper part consists of yellowish-gray to light-yellowish-brown, thin- to thick-bedded dolomitic limestone and some dolomite overlying very thin bedded limestone. The lower part consists of grayish-green, thinly laminated to nodular clay shale with some gray-brown limestone and minor sandstone. An intraformational conglomerate locally present in the middle and lower parts. Trilobites and brachiopods locally numerous in the shale (Deiss, 1939). Formation thickens to the south and west, and ranges in thickness from 28 m to about 120 m.

Dearborn Limestone (Middle Cambrian) Composed of an upper thick limestone unit and a lower thin

Geologic map unit descriptions

shale unit. The limestone unit is finely crystalline, yellowish-brown to gray, thin to thick bedded and irregularly bedded. The lower unit consists of gray to gray-green clayey shale with some sandy shale and thin interbedded limestone. Trilobites present in the lower part of the shale unit. Thickness from 67 m to 106 m.

Damnation Limestone (Middle Cambrian) Consists of medium- to dark-gray, thin- to thick-bedded, finely crystalline dolomitic limestone and limestone with laminae of grayish-orange to yellowish-gray siltstone that thicken and thin. Locally they are oolitic and contain trilobites, brachiopods, and organic trails and burrows. Thickness from 30 m to 68 m.

Gordon Shale (Middle Cambrian) Mainly a dark-gray to gray-brown, very thinly laminated shale with a greenish tint and locally maroonish-gray beds. Contains many thin beds of sandstone and some beds of limestone, especially in the middle and upper parts. In places the limestones contain glauconite, algal structures, limestone chips, grains of quartz, and fossil fragments. The upper part contains numerous fossils (Deiss, 1939), whereas the lower beds locally contain organic trails and burrows, some by trilobites. Thickness from 42 m to 90 m.

Flathead Sandstone (Middle Cambrian) Consists of thin- to thick-bedded and crossbedded, noncalcareous yellowish-gray, poorly sorted, poorly indurated, fine- to coarse-grained quartzose sandstone with scattered quartz pebbles. Beds are characteristically speckled by disseminated hematite. Interbeds of gray, purple, or maroon mudstone locally present. Thickness from 13 m to 35 m

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ygr

Unit Name: GARNET RANGE FORMATION (PROTEROZOIC Y)

Map Unit Description

PROTEROZOIC Y STRATIFIED ROCKS The Proterozoic stratified rocks in the quadrangle are assigned to the Belt Supergroup and consist of quartzite, siltite, argillite, limestone, and dolomite that are metamorphosed to the chlorite subfacies. The Belt Supergroup is divided upper, middle, and lower parts. The upper part is the Missoula Group which consists mostly of fine-grained clastic rocks and minor limestone and dolomite above the Helena Formation. The middle part is the Helena Formation which consists mostly of limestone and dolomite. The lower part, the Ravalli Group, contains mostly siltite and argillite with minor quartzite, limestone, and dolomite. Thickness of the Belt Supergroup in the quadrangle ranges from 2,000 m in the eastern part to more than 10,000 m in the western part.

Consists of pale-olive to medium-gray and moderate brown, poorly sorted, very fine to fine-grained, micaceous, thin even beds of sandstone and siltstone. Locally they are speckled by hematite, crossbedded and ripple marked. The formation varies in thickness due to pre-Middle Cambrian erosion and ranges from less than 1 m to 490 m, attaining its greatest thickness in the southern outcrops.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ybe

Unit Name: MCNAMARA FORMATION, BONNER QUARTZITE, AND MOUNT SHIELDS, SHEPARD, SNOWSLIP, HELENA, EMPIRE, AND SPOKANE FORMATIONS (PROTEROZOIC Y)

Map Unit Description

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ym

Unit Name: MCNAMARA FORMATION (PROTEROZOIC Y)

Map Unit Description

In the central and southern parts of the area the McNamara is divisible into two unnamed members, an upper dominantly reddish-brown quartzite and a lower dominantly grayish-green siltite (Somers, 1966; Mudge and Earhart, 1978).

Quartzite in the upper member is interbedded with siltite and minor argillite. Most of the unit is thin-bedded, fine-grained, micaceous, minutely crossbedded, and locally ripple marked. The lower member contains thin beds of argillite and fine- to medium-grained quartzite and locally some reddish-gray siltite. Ripple marks, minute cross-bedding, and load casts are common. The upper part of the lower member contains thin beds of glauconitic sandstone, some barite nodules, and vuggy reddish chalcedony, particularly in the eastern outcrop area (Mudge, 1972; Mudge and Earhart, 1978). In the northern part of the area, the formation thickens and is dominantly grayish-green siltite. The formation varies in thickness, due in part to pre-Middle Cambrian erosion, and ranges from 47 m to 1,650 m. Where overlain by the Garnet Range Formation its minimum thickness is 640 m; it thickens northward.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ymi

Unit Name: BONNER QUARTZITE AND MOUNT SHIELDS, SHEPARD, AND SNOWSLIP FORMATIONS, UNDIVIDED (PROTEROZOIC Y)

Map Unit Description

Mapped only in the upper reaches of Smith and Elk Creeks.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Yb

Unit Name: BONNER QUARTZITE (PROTEROZOIC Y)

Map Unit Description

Consists mostly of pink, pale-red, and pinkish-gray, fine- to medium-grained, poorly sorted beds of quartzite that range in thickness from 31 cm to 76 cm. The quartzite is mostly feldspathic and locally includes fragments of red argillite. Many beds are crossbedded and ripple marked. Thickness ranges from 213 m to 580 m.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Yms

Unit Name: MOUNT SHIELDS FORMATION (PROTEROZOIC Y)

Map Unit Description

Mostly bright reddish brown, thinly laminated, micaceous siltite, argillite, and thin- to thick-bedded quartzite. Sedimentary features include minute cross-laminations, ripple marks, mud-crack fillings, and mud chips. A grayish-green siltite unit with local interbedded dark-gray fissile shale widespread in the upper part of the formation. Salt-crystal casts widespread in the upper part of the formation, beneath the grayish-green unit. The quartzite beds are mostly fine to medium grained and more common in the middle and lower parts of the formation. A thick (155 m to 305 m) quartzite unit is present in the upper-middle part of the formation in the southern outcrop. It contains poorly sorted, fine- to coarse-grained, pinkish-gray to reddish-brown quartzite beds less than 1 m thick that are separated by thin beds of reddish-brown siltite and argillite. The color, grain size, and sedimentary features of the quartzite beds are similar to those in the Bonner Quartzite. The lower part of the formation in the eastern outcrop commonly contains thin beds of glauconitic quartzite. In the central and northern parts of the area the formation is more argillitic and contains beds of stromatolitic and oolitic limestone. The formation thickens south and west, from 555 m in the eastern outcrop to 2,180 m in the west at Swan Range and to 1,860 m in the south.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ysh

Unit Name: SHEPARD FORMATION (PROTEROZOIC Y)

Map Unit Description

Consists mostly of greenish-gray to grayish-yellow micaceous siltite and some silty limestone and argillite. Beds of maroon siltite and argillite widespread in the middle part and locally in the upper part. Thin glauconitic quartzite lentils widespread in the upper part of the formation in the eastern outcrop, but sparse elsewhere. Ripple marks, minute cross lamination, load casts, and mud cracks also common in the eastern outcrop. An edgewise conglomerate present near the base of the formation in the east, but elsewhere a stromatolitic limestone bed occurs at the same horizon. Other beds of stromatolitic limestone also present in the lower part of the formation in the Mission Range (Harrison and others, 1969). The formation thickens westward and southward, from 249 m in the eastern outcrop to about 900 m in the west in the Swan Range and about 715 m in the south.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ysn

Unit Name: SNOWSLIP FORMATION (PROTEROZOIC Y)

Map Unit Description

Consists of pale-red to reddish-brown beds and interbedded greenish-gray beds of argillite and siltite with some thin beds of very fine to fine-grained quartzite. Thin beds of stromatolitic and oolitic limestone and flat pebble conglomerate locally occur at various horizons. Crossbedded, minute laminae, ripple marks, and mud cracks common features; raindrop impressions mud-chip conglomerates less common. Thin beds of poorly sorted, fine- to coarse-grained quartzite and gritstone common near the lower contact. The formation thickens west and south, from about 215 m in the eastern outcrop to 1, 660 m in the Swan Range and 1,100 m in the southern part of the area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Yh

Unit Name: HELENA FORMATION (PROTEROZOIC Y)

Map Unit Description

In most places the Helena is divisible into three units. The upper unit consists of beds of limestone interbedded with dolomite, siltite, and argillite. Beds of stromatolites, oolites, and edgewise conglomerates widespread. The middle unit, comprising most of the formation, consists of light- to medium-gray, thin to thick-bedded silty limestone, dolomite, and calcitic dolomite that weathers to a yellowish gray to grayish orange. Commonly, vertical ribbons, blobs, horizontal mats, lenses, and pods differentially weather to form crenulating patterns ("molar tooth structure," O Connor, 1967). Stromatolites, oolites, and edgewise conglomerates locally present at various horizons, especially in the eastern outcrop. The lower unit consists mostly of calcareous or dolomitic siltite with some beds of dolomite and quartzite. The siltite is gray, greenish-gray, and locally dark red near the lower contact. The quartzite that occurs at the base is light gray, thinly bedded, calcareous, medium grained, and poorly sorted. The Helena thickens westward and southward, from about 205 m in the central part of the eastern outcrop to about 3,000 m in the Mission Range (Harrison and others, 1969) to 1,662 m in the south (Mudge and others, 1974).

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Yes

Unit Name: SPOKANE AND EMPIRE FORMATIONS UNDIVIDED (PROTEROZOIC Y)

Map Unit Description

Undivided only in the eastern and part of the southern outcrop area. In those areas the unit is pale-red, maroon, green, and gray siliceous argillite and siltite, with minor thin beds of poorly sorted, fine-grained quartzite. Locally in the eastern outcrop also contains some thin beds of dolomite, edgewise conglomerate, and stromatolite beds.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ye

Unit Name: EMPIRE FORMATION (PROTEROZOIC Y)

Map Unit Description

A transitional unit between the Helena and Spokane Formations. Mostly greenish gray argillite and siltite with interbeds of quartzite, dolomite, and locally stromatolitic and oolitic carbonate rock. The quartzites are poorly sorted, ranging from very fine to medium grained, and locally carbonate cemented. The amount of carbonate appears to increase upward. Red to purple beds of predominantly argillite occur in the lower part of the formation. The formation varies in thickness from less than 1 m too as much as 610 m (Mudge and others, 1974, 1978).

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ys

Unit Name: SPOKANE FORMATION (PROTEROZOIC Y)

Map Unit Description

Mostly pale-purplish-red and grayish-red siltite and argillite interbedded with lithologically similar greenish-gray beds. The southeastern and northwestern outcrops contain light-gray, very fine to medium-grained, thin beds of quartzite that locally contain minute cross-beds and ripple marks. The formation as much as 1,500 m thick in the Swan Range (Johns, 1970) and as much as 915 m thick in the southeast (Schmidt and Strong, 1972).

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Yg

Unit Name: GREYSON FORMATION (PROTEROZOIC Y)

Map Unit Description

The oldest unit exposed in and near the map area; therefore, its base is not exposed. Consists of light-gray to greenish-gray, thinly bedded siltite with some quartzite, grading down into dark-gray, greenish-gray, very thinly laminated argillite and siltite in the lower part. Its sedimentary features include ripple marks, mudcracks, and locally salt crystal casts (Schmidt and Strong, 1972). Thickness of the formation is as much as 762 m (Schmidt and Strong, 1972).

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tb

Unit Name: BASALT (PLIOCENE?)

Map Unit Description

Occurs mostly as dark-gray to gray-brown, finely porphyritic flows with numerous calcite- and zeolite-filled cavities. Locally weathers into spheroidal boulders and overlies Tertiary lakebed deposits. Present only in the Keep Cool Lakes area on the southern border of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Td

Unit Name: DACITE (MIOCENE? AND OLIGOCENE)

Map Unit Description

Volcanic neck or plug and sills, gray to light-gray, aphanitic groundmass of greenish-gray feldspar with phenocrysts of light-gray feldspar, hornblende, and biotite. Present only at and near Haystack Butte in southeastern part of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tm

Unit Name: HORNBLENDE MONZONITE (EOCENE?)

Map Unit Description

Light-gray, fine-grained, equigranular dikes and sills composed of andesine, sanidine, hornblende, augite, biotite, magnetite, and apatite. Hornblende needles, 3-4 mm long, characterize the rock (Schmidt, 1972b, c; Schmidt and Strong, 1972). Dated as 46.3 m.y. by the K-Ar method (R. G. Schmidt, 1978). Widespread in southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tmp

Unit Name: MONZONITE PORPHYRY (EOCENE?)

Map Unit Description

Stocks, dikes, and sills, of light-gray, abundant, 1-cm and larger phenocrysts of orthoclase that weather out as euhedral crystals. Dated at 58.3 m.y. by the K-Ar method (Mehnert and Schmidt, 1971; Schmidt, 1978). Present only in southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ta

Unit Name: BIOTITE TRACHYANDESITE AND ANDESITE (PALEOCENE?)

Map Unit Description

Dikes, sills, and irregular-shaped bodies. Includes trachybasalt and biotite trachybasalt of Schmidt (1972b, c, 1978). Dark-gray, aphanitic groundmass with hornblende and some biotite phenocrysts, weathers brown. Present only in the southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tva

Unit Name: ADEL MOUNTAIN VOLCANICS OF LYONS (1944) (PALEOCENE?)

Map Unit Description

Volcanic and volcanic-sedimentary rocks. Trachyandesite and trachybasalt flows (Schmidt, 1972a), volcanic conglomerate, breccia, and lacustrine deposits of volcanic sandstone, siltstone, and mudstone (Schmidt, 1972a, 1978). Present only in southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Tki

Unit Name: TRACHYANDESITE (PALEOCENE OR UPPER CRETACEOUS)

Map Unit Description

Sills, dark grayish brown, aphanitic groundmass of feldspar with phenocrysts of plagioclase, potassium feldspar, pyroxene, and quartz (Mudge, 1972). Widespread near the North Fork Sun River.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: TKr

Unit Name: RHYOLITE (PALEOCENE OR UPPER CRETACEOUS)

Map Unit Description

Dikes and sills, light-gray to white; finely porphyritic with abundant 2-3 mm phenocrysts of quartz and oligoclase (Schmidt, 1972c, 1978). Present only in southeast corner of the map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: TKp

Unit Name: QUARTZ MONZONITE PORPHYRY (PALEOCENE OR UPPER CRETACEOUS)

Map Unit Description

Sills, light-grayish-orange; coarsely porphyritic with abundant 1 cm and larger phenocrysts of potassium feldspar and oligoclase-andesine in a fine-grained groundmass (Schmidt, 1972c, 1978).

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Kl

Unit Name: LATITE (CRETACEOUS)

Map Unit Description

Sill, gray, grayish-purple; massive and porphyritic with abundant phenocrysts of labradorite in an aphanitic groundmass (Schmidt, 1972c, 1978). Present only in southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ks

Unit Name: DIORITE SILLS (CRETACEOUS?)

Map Unit Description

Includes rhyodacite porphyry and diorite as mapped by Schmidt and Strong (1972) and Schmidt (1978). The rhyodacite is greenish gray with phenocrysts of oligoclase and hornblende mainly in a groundmass of quartz and feldspar. The diorite is greenish gray, fine grained, and equigranular (Schmidt and Strong, 1972). Present only in southeast corner of map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Zd

Unit Name: DIORITE SILLS AND LOCAL DIKES (PROTEROZOIC Z)

Map Unit Description

Mostly diorite and quartz diorite, locally minor diorite-gabbro and monzonite. Dark gray, weathers grayish brown. Dated at 750±25 m.y. by K-Ar method (J. D. Obradovich, oral commun., 1966). Widespread throughout map area.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Choteau_geo_rect

Map Title

Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana

Map name: Choteau 250K

Map Unit Symbol: Ydi

Unit Name: ANDESITE, BASALTIC ANDESITE, AND DACITE (PROTEROZOIC Y)

Map Unit Description

Thin sills, grayish-green; amphibole, biotite, and feldspar phenocrysts in aphanitic groundmass of plagioclase and ferromagnesian minerals. Probably equivalent in age (1,075 m.y.) to the Purcell Lava of the Belt Supergroup in Glacier National Park. Present in southern part of map area near and southeast of Red Mountain.

Map Citation

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic and structure map of the Choteau 1° x 2° quadrangle, western Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1300, 2 sheets., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Qal

Unit Name:

Map Unit Description

Alluvial silt, sand, and gravel along stream valleys; silt and peat in filled ponds and lakes.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Qgy

Unit Name: Younger glacial deposits

Map Unit Description

Glaciofluvial deposits of sand and gravel. Includes morainal till around the southwest end of Pend Oreille Lake.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Qls

Unit Name: Landslide deposits

Map Unit Description

Areas of slump along valley walls.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Qgo

Unit Name: Older glacial deposits

Map Unit Description

Glaciofluvial and glaciolacustrine deposits of silt, sand, and gravel, usually stratified and well sorted; includes some kame deposits and morainal material along margins of Spokane Valley and Rathdrum Prairie and in their tributary valleys.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Qp

Unit Name: Palouse Formation

Map Unit Description

Loess deposits of tan to brown silt and fine sand, includes a number of overlapping soil zones of differing ages, some of which have well-developed clay and caliche layers; mantles the basalt plateau and the lower, gentler slopes of hills and ridges of pre-Tertiary rock that protrude above the top surface of the basalt flows and border the flows on the eastern side.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: QTg

Unit Name: Older gravel deposits

Map Unit Description

Poorly consolidated gravel, sand, and silt capping terraces and some flat ridge crests or other gently sloping surfaces. Accumulation of some deposits began after outpouring of basalt flows of the Columbia River Group, which dammed stream drainages; some result from blocking of drainage to west by glacial material in Pleistocene time. Deposits all of local origin.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Tcr

Unit Name: Columbia River Group and Latah Formation

Map Unit Description

Flows of dense, dark, tholeiitic basalt, usually from 50 to 150 feet thick, and all essentially flat lying. Pillow-palagonite tuff complexes are present. The interlayered or underlying lacustrine beds of the Latah Formation are included with the basalt and not shown separately are. The Latah Formation consists of poorly-indurated siltstone, claystone, sandstone, and minor conglomerate that are tan to gray in color, thin bedded, and in part laminated.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: TKg

Unit Name: Granitic rocks

Map Unit Description

Plutons to batholithic complexes that predominantly consist of felsic igneous rocks of quartz monzonitic to granodioritic composition, but including differentiates ranging in composition from diorite to alaskite. Most of rocks are medium- to coarse grained and in large part porphyritic, but also include some sill-like bodies of fine-grained quartz monzonite intruded into the high-grade metamorphic rocks. Some, such as the small pluton south of Wolf Lodge Bay on Coeur d’Alene Lake, have apophyses and dikes of porphyries associated with them.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Cl

Unit Name: Lakeview Limestone

Map Unit Description

Light- to dark-gray, thin- to thick-bedded, blocky limestone; includes blocky gray dolomite unit in upper part; contains some silty to sandy layers and zones. Metamorphosed to marble or hornfels adjacent to granitic intrusives.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Crg

Unit Name: Rennie Shale and Gold Creek Quartzite

Map Unit Description

Rennie Shale - a fissile olive colored fossiliferous shale, about 100 feet thick; exposed only infrequently and generally poorly so. This units lies conformably between the Gold Creek Quartzite and the overlying Lakeview Limestone and is here mapped with the Gold Creek Quartzite.

Gold Creek Quartzite - white- to pinkish- vitreous, coarse-grained quartzite. Some pebble conglomerate is always present at base. The quartzites are usually thick-bedded and commonly crossbedded; the unit is about 500 feet thick.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yl

Unit Name: Libby Formation

Map Unit Description

Dominantly medium-gray to olive-colored siltite or laminated siltite and argillite. Very thinly laminated dark argillite makes up the lowest part of section. The unit also contains rare chert laminae. Mud-chip breccia and ripple marks are common structural features; mud cracks are rare. It characteristically weathers in a blocky habit. Maximum thickness of eroded remnants is approximately 2,000 feet.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ysp

Unit Name: Striped Peak Formation

Map Unit Description

This formation consists of four distinct sub-units: 1) a basal mixed siltite, argillite, and quartzite member of red and green color overlain successively by 2) a tan dolomitic member, 3) a very thinly laminated dark-gray argillite-siltite member, and capped by 4) a dark-red arkosic quartzite unit (Harrison and Jobin, 1963). The combined thickness of the unit is nearly 2,000 feet and is about equally divided among the four sub-units. Basal unit thickens and overlying units wedge out southward. Mud cracks, ripple marks, and mud-chip breccia are found in red to green-colored rocks; salt casts and channeling are much less common structures. Several stromatolite layers occur in this unit. Micaceous sheen on bedding surfaces is characteristic at most outcrops. The transition into the overlying Libby Formation, and into the underlying upper part of Wallace Formation occurs through fairly narrow zones.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ywu

Unit Name: Upper part of Wallace Formation

Map Unit Description

Very thinly bedded dark-gray argillite or thinly laminated dark-gray argillite and light-gray siltite; a few beds or thin zones of lighter colored siltite are scattered through unit. A carbonate-bearing zone several hundred feet thick occurs near the center or toward the top of the map unit and appears to persist throughout area. It consists of greenish-gray to gray to dark-gray interbedded to interlaminated dolomitic argillite to siltite with some gray dolomite to dolomitic limestone beds, similar to basal unit of the lower part of Wallace. At some places dark-gray argillite, also contains carbonates. At most exposures, rocks are noticeably fissile, and fairly regularly bedded. Thickness is approximately 2,500 to 3,000 feet. The lower contact is gradational.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ywl

Unit Name: Lower part of Wallace Formation

Map Unit Description

This map units contains two distinguishable members, which were not differentiated on map. The upper unit consists predominantly of alternating black argillite and light-gray to greenish-gray siltite or quartzite; the latter is usually carbonate bearing. Interspersed in the sequence are layers or zones of rock like that in the Wallace units above and below. The lower unit, green to greenish-gray or gray, usually carbonate -bearing, interbedded or interlaminated argillite and siltite, contains many bluish-gray dolomite and dolomitic limestone beds. Blocky weathering molar-tooth structure, and rusty-tan-weathering are characteristic. Mud cracks (nondesiccate in origin) and ripple marks are common; fine-textured cross bedding is evident on etched surfaces of some siltite and quartzite beds. Irregularity in bedding and minor folds are characteristic. Thickness is estimated to vary from 5,000 to 7,000 feet; the thinnest section is in and around the Coeur d’Alene district.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ysr

Unit Name: St. Regis Formation

Map Unit Description

Dark-red, purplish-red, green, or greenish-gray, interbedded or interlaminated, usually very thin- to thin-bedded argillite and siltite. The unit contains some quartzite beds in its basal part and becomes more argillitic toward top. Some carbonate-bearing beds are found in the upper part. Mud cracks, mud-chip breccia, and ripple marks are very common. It is gradational into units above and below. The unit weathers into platy or flaggy fragments.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yr

Unit Name: Revett Formation

Map Unit Description

Blocky, white to light-gray, thick-bedded, fine- to medium-grained, vitreous quartzite that is somewhat feldspathic. Gray to greenish-gray, thin- to thick-bedded siltite with partings and interbeds of argillite are common in upper and lower parts of the unit; siltite may be dominant rock type over zones tens of feet thick. Cross bedding in vitreous quartzite is common, and a rusty speckling due to weathering of small round carbonate segregations is characteristic in some vitreous beds. The thickness ranges from 2,000 to 3,000 feet. The map unit is transitional over hundreds of feet into units above and below.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yrb

Unit Name: Revett and Burke Formations, undivided

Map Unit Description

Units are lumped together where individual identity questionable in areas west of south end of Coeur d'Alene Lake.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yb

Unit Name: Burke Formation

Map Unit Description

Light- to medium-gray to greenish-gray, thin- to thick- bedded siltite with partings and interbeds of argillite. Some light-gray to white quartzite occurs in scattered beds and zones. At some places, mostly peripheral to Coeur d’Alene mining district and in the lower middle part of section, rocks are reddish-purple to lavender in color. Ripple marks are common in places; some cross bedding is present. At many exposures, the rocks have a faded weathered rind that contrasts with darker fresh rock. Fine magnetite octahedral pepper many of siltite beds. It is transitional into formations above and below. The thickness ranges from 2,800 to 4,500 feet; at most places, it is between 3,000 and 3,500 feet.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yp

Unit Name: Prichard Formation undivided

Map Unit Description

The formation was mapped as a single unit in western part of Coeur d’Alene district near Kellogg. The upper transitional zone and argillitic rocks have not been mapped separately from the predominantly siltite to quartzite below in the western part of the Coeur d’Alene district.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ypu

Unit Name: Upper part of Prichard Formation

Map Unit Description

Dark- to medium- gray, very thin-bedded argillite commonly interlaminated with light-gray siltite and also containing some siltite beds. This sequence grades upward into a interbedded and interzoned argillite, siltite, and quartzite sequence 500 to 1,000+ feet thick, which forms the transition zone into siltitic and quartzitic units above. Argillite is rust-stained on weathered surfaces; occasional ripple marks are present in the upper part. Total thickness ranges from 2,500 to 3,500 feet.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Ypl

Unit Name: Lower part of Prichard Formation

Map Unit Description

Predominantly medium- to light-gray, thin- and regularly bedded siltite, laminated in part; some argillite is present in laminae and beds. Some beds or zones of gray to white quartzite of lenticular habit are present. Disseminated pyrrhotite concentrated within certain laminae is characteristic, and its weathering results in a persistent rusty-red rind on fracture surfaces. Thickness is over 7,500 feet; the base of the unit is not exposed.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: Yqd

Unit Name: Quartz diorite

Map Unit Description

Dark-green, fine- to coarse- grained, hornblende-plagioclase-(quartz-biotite) diabasic-textured rocks intruded as sills into Prichard Formation. The sills can be as much as 1,000 feet thick; only the larger bodies are shown on the map.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: pCbgh

Unit Name: Hauser Lake Gneiss

Map Unit Description

Rusty-weathering, medium-grained, thinly-layered biotite-orthoclase-plagioclase-quartz gneiss and schist that contains minor quartzite. These rocks are foliated and may show lineated, mylontitic fabrics. Sillimanite is common and widespread. Muscovite-biotite schist layers are less than 1 m thick and quartz-feldspar layers are more than 1 m thick. The gneiss is locally intruded by mafic igneous rocks that now are small bodies of garnet-bearing amphibolite. Abundant felsic dikes and irregular crosscutting bodies with wide range of textures and compositions are present. Griggs (1973) thought the Prichard Formation (Belt Supergroup) was the protolith for the gneiss.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: pCmu

Unit Name: Metamorphic rocks, undivided

Map Unit Description

Tan to light-gray, coarse-grained quartz-feldspar-mica gneiss; tan, pink, gray, brown, medium to fine-grained micaceous and sillimanitic schist; gray, prominently layered gneiss and schist, and quartzite. Individual layers in prominently layered gneiss and schist are generally less than 6 inches thick and include quartzite, feldspathic quartzite, micaceous quartz-feldspar gneiss, granitic rock, amphibolite, and schist. Finer-grained sillimanitic facies rocks generally have less well-developed schistosity and are commonly intricately folded and contorted on all scales. Intricate folding and contortion on larger-scale is widespread in coarser-grained rocks. Granitic and pegmatitic lenses, pods, and irregular crosscutting bodies are locally abundant. Amphibolite layers and small, irregular amphibolite bodies present in several places. Griggs (1973) thought the Prichard Formation (Belt Supergroup) was the protolith for the gneiss.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): CDAlene_rect

Map Title

Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana

Map name: Coeur dAlene, ID 100K

Map Unit Symbol: pCmuq

Unit Name: Quartzite

Map Unit Description

Medium to coarse-grained, in part vitreous, but mostly micaceous; in zones to hundreds of feet thick with some interlayered, more micaceous rock. Shown separately only in the more highly metamorphosed rocks.

Map Citation

Munts, S.R., 2000, Digital geologic map of the Coeur d'Alene 1:100,000 quadrangle, Idaho and Montana (digital database, version 1.0): U.S. Geological Survey Open-File Report 00-135, 25 p., 1 digital sheet, scale 1:100000, http://geopubs.wr.usgs.gov/open-file/of00-135/.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Qal

Unit Name: Alluvial deposits (Holocene)

Map Unit Description

Gravel, sand, silt, and clay in flood plains and low terraces along present drainages. Includes alluvial fans

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Qs

Unit Name: Landslide deposits (Holocene and Pleistocene)

Map Unit Description

Includes large rock slumps, flow, and slides. Generally consists of angular blocks of bedrock in a finer grained matrix; mixed at places with glacial debris. Most abundant on slopes topographically below trace of Lewis thrust fault on east and south sides of Glacier National Park (Carrara, 1990)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Qg

Unit Name: Glacial and fluvioglacial deposits (Pleistocene)

Map Unit Description

Includes till (in ground, end, and ablation moraines), outwash, and other fluvioglacial deposits from both continental and mountain glaciers. Includes eskers at a few places in Glacier National Park (Carrara, 1990)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Tk

Unit Name: Kishenehn Formation (Oligocene and Eocene)

Map Unit Description

Conglomerate, sandstone, siltstone, marlstone, oil shale, and coal deposited in the Kishenehn basin. About 3,800 ft thick in the valley of the Middle Fork of the Flathead River in central part of map area (Whipple, 1992)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ku

Unit Name: Upper Cretaceous rocks, undivided

Map Unit Description

Mainly dark-gray mudstone of the Marias River Shale as described by Mudge and Earhart (1983). May include the Horsethief Sandstone and St. Mary River Formation at northeast edge of Glacier National Park. At least 1,500 ft thick.

Mudge and Earhart (1983) description of Marias River Shale: Mainly dark-gray, marine mudstone, ranges from 365 to 395 m thick. Divided into four members by Cobban, Erdmann, Lemke, and Maughan (1959b, 1976), in descending order: Kevin, Ferdig, Cone, and Floweree.

The Kevin is dark-gray, calcareous mudstone with some thin, very fine grained sandstone in upper part. Characteristically contains many thin, micaceous bentonite beds and zones of calcareous and ferruginous limestone concretions. Bentonite beds thicker and far more numerous in southern outcrops. Pelecypods and ammonites common. The Kevin Member ranges from about 226 m thick in the east to as much as 326 m in the west (Mudge, 1972).

The eastern facies of the Ferdig Member contains gray, noncalcareous mudstone with many very thin, iron-stained sandstone beds, concretions of yellow-weathering limestone and red-weathering ferruginous dolostone, and some very thin bentonite beds, about 50 m thick. The western facies of the Ferdig, exposed in the North and South Forks of the Sun River, is about 150 m thick, and resembles the Cardium Formation of southern Alberta, Canada (Mudge, 1972). Contains nodular sandstone, sandy shale, and even-bedded sandstone in the middle and upper parts of the western facies; thick-bedded, light-gray sandstone in upper part. Organic burrows and trails common. The lower part is like that exposed in the eastern facies.

The Cone Member contains abundant, very thin, medium-gray, calcareous siltstone and crystalline limestone beds in the upper part and dark-gray noncalcareous fissile shale with some limestone concretions in the lower part (Cobban, Erdmann, Lemke, and Maughan, 1976); contains several bentonite beds throughout. The upper beds commonly have petroliferous odor on a freshly broken surface. Contains a characteristic fauna which includes Mytiloides labiatus (Cobban, Erdmann, Lemke, and Maughan, 1976). Ranges from 15 to 30 m thick.

The Floweree Member is noncalcareous, dark-gray, nonfossiliferous shale (Cobban, Erdmann, Lemke, Maughan, 1976; Mudge, 1972). Locally contains basal siltstone with chert-pebble conglomerate. The shale has metallic luster and yellowish-brown stains on bedding and fracture planes (Mudge, 1972). Ranges from 9 to 12 m thick

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Kl

Unit Name: Lower Cretaceous rocks, undivided

Map Unit Description

Predominantly gray to olive mudstone and gray sandstone interbedded with some limestone. Includes the Blackleaf, Kootenai, and Mount Pablo Formations as mapped and described by Mudge and Earhart (1983). Thickness about 2,200 ft.

Mudge and Earhart (1983) description of Blackleaf, Kootenai, and Mount Pablo Formations:
BLACKLEAF FORMATION: Gray, marine mudstone and interbedded sandstone. Divided into three members by Cobban, Erdmann, Lemke, and Maughan (1959b, 1976), in descending order: Vaughan, Taft Hill, and Flood. The formation ranges from about 200 m thick in southern outcrop to about 490 m in the west and about 260 m in the north.

The nonmarine Vaughan Member consists of alternating gray to olive-drab mudstones and bentonitic mudstone with many thin interbeds of light-gray, locally cross-bedded sandstone. Contains less sandstone to the north and lower beds are laterally equivalent to upper part of the marine Taft Hill strata to the south. Locally, beds of conglomerate fill small channels at base of some sandstone units (Mudge, 1972). In the Sun River area, the upper part of member contains tuffaceous debris, one bed contains accretionary lapilli (Mudge, 1972). Member locally contains wood and leaf fragments and, in the vicinity of Teton Pass, contains beds of coal and carbonaceous shale. Ranges from 90 m thick in the eastern outcrops to possibly 213 m in the north.

In the south, the marine Taft Hill Member consists of thinly bedded, gray, fossiliferous sandstone, locally cross-bedded and ripple marked (Mudge, 1972), interbedded with dark-gray mudstone containing some very thin bentonite beds. These units grade northward into nonmarine lithologies of the Vaughan. The Taft Hill is as much as 183 m thick in west-central part of the area, thins to 0 m to the north and 58 m in the southeast outcrop.

The marine Flood Member in the south consists of two sandstone units with a distinctive intervening shale unit. Lower sandstone absent to the north where upper sandstone unit is thicker and shale unit thinner, as compared to southern exposures. Gray, thinly cross-bedded, very fine grained, finely micaceous and moderately well sorted sandstones (Mudge, 1972); commonly weather grayish brown. Locally large sandstone nodules in lower part. The shale unit, transitional with upper sandstone unit, is distinct, very dark gray fissile shale with a metallic luster on bedding surfaces. Thin sandstone lentils and nodules of limestone and claystone common, locally phosphatic nodules present. Organic trails and burrows abundant in transition zone. The Flood ranges from 45 m thick in eastern outcrops to 165 m in western. About 40 m thick in the north part of mapped area (Rice and Cobban, 1977).

KOOTENAI FORMATION: Nonmarine, gray-green and maroon mudstone with numerous lenticular, poorly sorted, greenish-gray sandstone beds, locally cross-bedded and contain lenticular basal conglomerates (Mudge and Sheppard, 1968; Mudge, 1972). Brown to brownish-gray limestone with thin to thick lenses of coquina with pelecypods and gastropods is near top of formation. Brown, iron-stained limestone nodules common in mudstone beds. The Sunburst Sandstone Member of Rice and

Cobban (1977) is at base of formation in the southern outcrops and absent to the north. The Sunburst consists of many thin beds of hard, noncalcareous, poorly sorted quartz sandstone with few scattered grains of chert and feldspar. The Kootenai ranges from 198 to more than 305 m thick.

MOUNT PABLO FORMATION: Nonmarine, formerly referred to as the western facies of the Morrison Formation in the Sun River Canyon area (Mudge, 1972). Consists of limestone, mudstone, and sandstone in upper part, variegated mudstone interbedded with sandstone in middle part, and sandstone and conglomerate in lower part (Mudge and Rice, 1980). Everywhere overlain unconformably by the Kootenai Formation (Kk). The lower sandstone and conglomeratic sandstone is the Cut Bank Sandstone Member, an important hydrocarbon reservoir rock near Cut Bank, Mont. The upper and middle parts of the formation are mostly gray to gray-green mudstone with some maroon and orange-red mudstone and thin beds of fine-grained sandstone. Mostly reddish-brown mudstone with some sandstone in southwestern area (Mudge, 1972). Widespread, light-gray, lacustrine limestone, as much as 10 m thick, near top of the formation. The Cut Bank Sandstone Member in places contains coarse-grained, cross-bedded sandstone in the upper part, composed of nearly equal amounts of quartz and black chert. Grades upward into very fine grained sandstone as much as 10 m thick in the north. The lower conglomeratic sandstone unit is prominent, cross-bedded, poorly sorted, very coarse grained sandstone that grades upward into very fine sandstone. In many places has dominantly chert-pebble conglomerate at its base, to the south conglomeratic lenses common at various horizons. Commonly about 8 m thick, the lower sandstone unit is as much as 30 m thick. The Mount Pablo Formation (KJm) ranges from 0 to about 90 m thick, unconformably overlies the Morrison Formation except in northeastern outcrops where overlies the Swift Formation.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: KJu

Unit Name: Mount Pablo Formation (Lower Cretaceous), Morrison Formation (Upper Jurassic), and Ellis Group (Upper and Middle Jurassic), undivided

Map Unit Description

Includes siltstone, sandstone, and shale accompanied by minor limestone and thin conglomerate at base of some members as mapped and described by Mudge and Earhart (1983). About 1,500 ft thick.

Mudge and Earhart (1983) description of Mount Pablo Formation (Lower Cretaceous), Morrison Formation (Upper Jurassic), and Ellis Group (Upper and Middle Jurassic), undivided unit: The Morrison Formation is not mapped separately and therefore is described below.

The most complete sections of the Morrison are in east-central and southern outcrop areas. Mainly grayish-green, tuffaceous siltstone with interbedded sandstone, limestone, and some cherty siderite in the eastern part of the Sun River Canyon area (Mudge, 1972). Maroon and tints of pinkish-gray beds common in the upper part. Cherty siderite occurs as lenses in the middle part, limestone occurs as beds or nodules in the lower part. The Morrison is about 61 m thick in the Sun River area (Mudge, 1972), about 82 m thick in the Wolf Creek area (Schmidt, 1972a). Mostly eroded prior to deposition of the Mount Pablo Formation north of the Sun River area. In most places, the Morrison is less than 30 m thick.

Mudge and Earhart (1983) description of ELLIS GROUP: Divided into three formations by Cobban (1945), in descending order: Swift, Rierdon, and Sawtooth. In the Wolf Creek area the Rierdon Formation is absent, the combined thickness of the Swift and Sawtooth Formations is about 65 m. The three formations have an aggregate thickness of about 87 m in the Sun River area, about 205 m thick west of that area, and more than 188 m in the northern part of mapped area (Mudge and Earhart, 1978).

The Upper and Middle Jurassic Swift Formation was divided into upper and lower unnamed members by Cobban (1945). Ranges from 30 to 36 m thick in the southeast to more than 60 m in the northwest. In the northeast, part of the upper member was eroded prior to sedimentation of the Cretaceous Mount Pablo Formation. The upper member is thin-bedded, gray to gray-brown, very fine to fine-grained sandstone. As much as 30 m thick in the Sun River area (Mudge, 1972), less than 3 m thick in the northeast outcrop. The lower member is dark-gray shale with some interbeds of sandstone. A thin bed of poorly indurated glauconitic sandstone with water-worn belemnites and locally chert pebbles, at base of the member except in the northern outcrops. The lower member averages about 15 m thick in the south and about 21 m thick in the north. The Swift unconformably overlies the Rierdon Formation.

The Middle Jurassic Rierdon Formation contains calcareous gray-brown siltstone and claystone in the upper part and calcareous, dark-gray, laminated shale and claystone in the lower part. Many thin beds of argillaceous limestone scattered throughout formation. Barite nodules, numerous pelecypods and some ammonites common. Phosphatic nodules common in the lower part of northern exposures. About 44 m thick in the Sun River area, as much as 56 m thick to the north.

Geologic map unit descriptions

The Middle Jurassic Sawtooth Formation is divided into three unnamed members by Cobban (1945), the lower member is absent in the northern outcrop area. Ranges in thickness from 15 to 69 m, thickening to the north. The upper siltstone member is a prominent unit, many thin beds of grayish-brown to yellowish-gray siltstone with a few thin beds of shale, increasingly sandy northward. Lenses of phosphatic pellets common in the western and northern outcrops. Pelecypods common and ammonites rare. Member 6-13 m thick in the south (Mudge, 1972), thickens northward to about 18 m (Imlay, 1962). The shale member is dark-gray shale with some siltstone, sandstone, and a few beds of limestone. Thickens northward from 5 m in the Sun River area to about 77 m near Mount Patrick Pass. Some beds locally pyritic. North of the Teton River contains black, phosphatic pellets and lies unconformably on Mississippian carbonate rocks. The lower sandstone member in the southern part of the area rests unconformably on Mississippian rocks. In most places, hard, fine-grained, and light-gray sandstone beds, conglomeratic in the basal part. Locally consists of two beds of sandstone separated by dark-gray shale. The conglomerate consists of pebbles and cobbles and locally boulders of Mississippian carbonate and chert (Mudge, 1972). The sandstone member ranges from 0-6 m thick, in most places 0.6-2 m thick (Mudge, 1972).

Mudge and Earhart (1983) description of MOUNT PABLO FORMATION: Nonmarine, formerly referred to as the western facies of the Morrison Formation in the Sun River Canyon area (Mudge, 1972). Consists of limestone, mudstone, and sandstone in upper part, variegated mudstone interbedded with sandstone in middle part, and sandstone and conglomerate in lower part (Mudge and Rice, 1980). Everywhere overlain unconformably by the Kootenai Formation (Kk). The lower sandstone and conglomeratic sandstone is the Cut Bank Sandstone Member, an important hydrocarbon reservoir rock near Cut Bank, Mont. The upper and middle parts of the formation are mostly gray to gray-green mudstone with some maroon and orange-red mudstone and thin beds of fine-grained sandstone. Mostly reddish-brown mudstone with some sandstone in southwestern area (Mudge, 1972). Widespread, light-gray, lacustrine limestone, as much as 10 m thick, near top of the formation. The Cut Bank Sandstone Member in places contains coarse-grained, cross-bedded sandstone in the upper part, composed of nearly equal amounts of quartz and black chert. Grades upward into very fine grained sandstone as much as 10 m thick in the north. The lower conglomeratic sandstone unit is prominent, cross-bedded, poorly sorted, very coarse grained sandstone that grades upward into very fine sandstone. In many places has dominantly chert-pebble conglomerate at its base, to the south conglomeratic lenses common at various horizons. Commonly about 8 m thick, the lower sandstone unit is as much as 30 m thick. The Mount Pablo Formation (KJm) ranges from 0 to about 90 m thick, unconformably overlies the Morrison Formation except in northeastern outcrops where overlies the Swift Formation.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Mz

Unit Name: Mesozoic sedimentary rocks, undivided

Map Unit Description

Shown only in cross section B-B'. Probably at least includes Cretaceous and Jurassic strata mapped by Mudge and Earhart (1983) at southeast end of Glacier National Park where Mesozoic rocks are overridden by the Lewis thrust fault

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Mm

Unit Name: Madison Group (Upper and Lower Mississippian)

Map Unit Description

Upper part is the Castle Reef Dolomite and lower part is the Allan Mountain Limestone as mapped and described by Mudge and Earhart (1983). About 1,200 ft thick

Mudge and Earhart (1983) description of MADISON GROUP: Divided into the Castle Reef Dolomite and the underlying Allan Mountain Limestone (Mudge, Sando, and Dutro, 1962), equivalent in age to the Mission Canyon and Lodgepole Limestones in Central Montana. The Madison ranges from about 275 m to 550 m thick, much of the variation in thickness is a result of pre-Jurassic erosion (Mudge, 1972).

The Upper and Lower Mississippian Castle Reef Dolomite, ranges from about 230 m thick in the eastern outcrops to about 305 m in the west, is divided into an upper member, the Sun River Member, and a lower unnamed member (Mudge, Sando, and Dutro, 1962). The Sun River Member, 76-137 m thick, consists mostly of thick beds of fine- to medium-crystalline dolomite (Mudge, 1972), and is main hydrocarbon reservoir rock on the Sweetgrass Arch (Chamberlain, 1955). In many places oil residues common in cavities, pores, fractures, and on bedding planes in the upper part of the member. The lower member of the Castle Reef consists of thin to thick beds of fine to coarsely crystalline, light-gray dolomite, calcitic dolomite, and dolomitic limestone, dolomite content increases westward. Beds of coarsely crystalline encrinites at various horizons in the Castle Reef, increasingly abundant to the north and west. Lenses and nodules of dark-gray chert common in lower and middle parts, light-gray chert nodules common in upper part. In places, sand-filled joints and bedding planes in upper part (Mudge, 1972). Corals and brachiopods common in the formation.

The Lower Mississippian Allan Mountain Limestone, ranges from about 165 to 200 m thick, contains three widespread unnamed members. The upper member is mainly gray, medium- to thick-bedded, fossiliferous limestone with some beds of dolomitic and magnesium limestone (Mudge, Sando, and Dutro, 1962). In places encrinite beds occur in middle and upper parts of member. Member ranges from 42 to 106 m thick. The middle member contains abundant, irregular-shaped lenses and nodules of very dark chert in sparsely fossiliferous, medium-bedded, dark-gray limestone and dolomitic limestone, ranges from 45 to 58 m thick. Chert is dispersed throughout member at 15-25 cm intervals. The lower member consists of very thinly bedded, dark-gray, argillaceous limestone and dolomitic limestone with dark-gray shale partings (Mudge, Sando, and Dutro, 1962). The lower part of lower member contains alternating beds of dark-gray to gray-brown limestone and very calcareous shale, locally potential hydrocarbon source rocks (Mudge, Rice, Earhart, and Claypool, 1978); ranges from 50 m to 67 m thick.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Du

Unit Name: Three Forks (Upper Devonian), Jefferson (Upper Devonian), and Maywood (Upper and Middle Devonian) Formations, undivided

Map Unit Description

Mainly limestone and dolomite in upper part; in lower part mudstone increases downward. Units mapped and described by Mudge and Earhart (1983). About 1,700 ft thick.

Mudge and Earhart (1983) description of THREE FORKS, JEFFERSON, AND MAYWOOD FORMATIONS, UNDIVIDED: Widespread in the Lewis, Hoadley, and Eldorado thrust plates in western part of mapped area and in numerous thrust plates in the Sawtooth Range. Range from 290 m thick in the southeast exposures to 457 m northwestward at Slategoat Mountain (Mudge, 1972) and northward to about 519 m southwest of Swift Reservoir. Natural gas produced from Birdbear Member of the Jefferson on the Sweetgrass Arch, and from equivalent rocks and the Three Forks Formation in southern foothills of Alberta.

In most places the Upper Devonian Three Forks almost entirely an evaporite-solution breccia, consists of angular fragments (mostly less than 1 m across) of pale-yellowish-brown dolomite and dolomitic limestone (Mudge, 1972). Grayish-green mudstone and massive gray limestone bed, as much as 30 m thick, overlie breccia in the southern outcrop (Mudge, 1972). Elsewhere beds above the breccia are thinly bedded, yellowish-gray, silty limestone and siltstone and black shale. Black shale mostly about 30 cm thick, locally as much as 1 m thick, observed at north end of Sawtooth Ridge, in Deep Creek (Mudge, 1972), on north side of Crown Mountain, in tributary of the Dearborn River, south of Steamboat Mountain, on South Fork Teton River across from Rierdon Gulch, on a mountain on south side of the upper reaches of that fork, on northeast side of Family Peak, on southeast side of Mount Drewyer, and at head of the north fork of Whitetail Creek. The presence of black shale at these widely scattered localities indicates that it is widespread, but in places is absent as a result of tectonic deformation and in places is covered by thick talus deposits. Fossils recorded in black shale by Gutschick, Suttner, and Switek (1962) and Sandberg (1965). The Three Forks Formation as much as 60 m thick, locally about 15 m thick in eastern outcrops (Mudge, 1972). Thickens westward to 180 m at Slategoat Mountain.

The Upper Devonian Jefferson Formation contains the Birdbear Member at the top (Sandberg,1965) and a lower unnamed member. Ranges from 225 to 245 m thick in the eastern outcrop, thins westward to about 190 m at Slategoat Mountain. The Birdbear Member consists mostly of pale-yellowish-brown, very fine to finely crystalline, thin dolomite beds, characteristically pinches and swells, weathers light yellowish gray. Brachiopods most common fossil (Mudge, 1972). The Birdbear ranges from about 16 m thick in the north to 45 m in the southeast, about 72 m in the southwest. The lower member is mostly limestone in northern and southwestern exposures, mostly dolomite in southeastern exposures. Commonly gray-brown and locally light-gray fetid beds, about 30 cm thick. One or more thin, evaporite-solution breccias in lower part in southern outcrops; thicker and more numerous throughout member in northern outcrops. Biostromes of Amphipora widespread in upper part and locally in lower part, corals and brachiopods occur at several horizons. The lower member ranges from 200 to 210 m thick in the central part of the Sawtooth Range, thinning to about 120 m to the west at Slategoat Mountain and to 130 m to the southeast near Gibson Dam (Mudge, 1972).

The Upper and Middle Devonian Maywood Formation is divisible into two unnamed members (Mudge, 1972). Ranges from 16 to 85 m thick. The upper member is mostly thinly bedded, finely crystalline, somewhat fossiliferous limestone and dolomitic limestone, forms resistant ledges. Mostly grayish-brown, mottled to pale yellowish orange to yellowish gray on the weathered beds (Mudge, 1972). Locally thin, evaporite-solution breccia in lower part. The upper member thickens westward from about 8 m in the southeastern outcrops, 16 m in the northeastern, to about 50 m in the western outcrops. The lower member is mostly greenish-gray mudstone with thin beds of dolomite, dolomitic limestone, and breccia in the lower part. Maroon mudstone common in the upper part of member in the western outcrops. In places, coarse-grained sandstone at base. North of the Sun River, the lower part of member contains channel fills as much as 6 m deep; the Cambrian- Devonian unconformity is at the base of channel fill deposits, The lower member thickens westward from about 8 m in the Sun River area (Mudge, 1972), about 4 m west of Swift Reservoir, to about 63 m at Slategoat Mountain.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Cu

Unit Name: Upper and Middle Cambrian rocks, undivided

Map Unit Description

Alternating units of carbonate and shale above a basal sandstone. In Montana disturbed belt, includes (in descending order): Devils Glen Dolomite (Upper Cambrian), Switchback Shale (Upper and Middle Cambrian), and Steamboat Limestone, Pentagon Shale, Pagoda Limestone, Dearborn Limestone, Damnation Limestone, Gordon Shale, and Flathead Sandstone (Middle Cambrian) (Mudge and Earhart. 1983). Only lower three or four formations exposed unconformably above Belt rocks in southern part of map area. Maximum exposed thickness about 1,000 ft.

Mudge and Earhart (1983) description of CAMBRIAN ROCKS: Includes, in descending order: Devils Glen Dolomite, Switchback Shale, Steamboat Limestone, Pentagon Shale, Pagoda Limestone, Dearborn Limestone, Damnation Limestone, Gordon Shale, and Flathead Sandstone. Limestone formations contain considerable mudstone in the east, mostly limestone in the west. All formations well exposed in the western part of mapped area. Only upper three formations exposed in some thrust blocks in the Sawtooth Range. In the western part of the mapped area, Cambrian rocks thin northward from about 535 m in the southwest to about 440 m at Pagoda Mountain, and to 495 m at Pentagon Mountain (Deiss, 1939). In the southern part of the mapped area, the Dearborn River area, they are 680 m thick

The Upper Cambrian Devils Glen Dolomite is thick-bedded, light-gray dolomite, in most places forms prominent, light-gray cliff. Trilobites recorded in the upper part in the Sun River Canyon area (Mudge, 1972). Ranges from about 32 m thick at Pagoda Mountain (Deiss, 1939) in the west to as much as 167 m at Nineteen Mountain (Mudge, 1972) in the southeast, and about 60 m thick to the north; variation in thickness very likely a result of pre-Devonian erosion.

The Upper and Middle Cambrian Switchback Shale is mostly noncalcareous, greenish-gray, thinly laminated, clayey shale with thin local interbeds of dolomite, limestone, sandstone, and conglomerate. Conglomerates locally contain brachiopods (Mudge, 1972). The Switchback varies considerably in thickness from about 35 m at Pentagon Mountain to 23 m at Pagoda Mountain (Deiss, 1939) to 77 m at Nineteen Mountain, and to 82 m at Arsenic Mountain (Mudge, 1972).

The Middle Cambrian Steamboat Limestone consists of two parts in the western outcrop, a lower shaly interval and a much thicker upper limestone and dolomite interval (Deiss, 1939; Mudge, 1972), whereas in the eastern outcrop, in the Sawtooth Range, is about equal parts of alternating sequences of limestone and dolomite, and calcareous shales. Carbonates in both areas consist of hard, nodular, dark-gray to yellowish-brown, thinly bedded, finely crystalline beds of limestone and dolomite with nodules and lentils of dark-yellowish-orange, limey siltstone. Thin beds of intraformational conglomerate present locally. Mudstone units mainly grayish-green, noncalcareous, clayey shale with interbedded calcareous siltstone and claystone. Trilobites and some brachiopods locally in both limestone and shale beds. The Steamboat Limestone is about 92 m thick at its type locality in Dearborn Canyon, 66 m at Pentagon Mountain, 81 m at Pagoda Mountain (Deiss, 1939), and 67 m at Nineteen Mountain (Mudge, 1972).

Geologic map unit descriptions

The Middle Cambrian Pentagon Shale is present only in the northern part of mapped area, occurs as clastic wedge that extends south from Pentagon Mountain about 22 km (Deiss, 1939), and north about 7 km. The Pentagon consists of calcareous, gray to tan-gray, thick-bedded, platy, fossiliferous shale, contains some platy, blue-gray, argillaceous limestone in upper part (Deiss, 1939). Ranges from 0 to 88 m thick.

The Middle Cambrian Pagoda Limestone consists of an upper limestone member and a lower shale member. Upper member is finely crystalline, pale-yellowish-brown, very thin bedded limestone and thin- to thick-bedded dolomitic limestone and dolomite, the most prominent cliff-forming unit in the Cambrian sequence. Intraformational conglomerate locally in the middle part of the Pagoda. The lower member consists of beds of grayish-green, thinly laminated to nodular, clay shale with some gray-brown limestone and minor sandstone. Fossils locally present in limestone beds. The Pagoda, in general, thickens to the south and west; varies from about 53 m thick along the Continental Divide in the central part of mapped area to about 107 m at Pagoda Mountain, and 111 m near Prairie Reef Lookout Station (Deiss, 1939).

The Middle Cambrian Dearborn Limestone consists of an upper, finely crystalline, pale-yellowish-brown to gray, very thinly and irregularly bedded limestone unit and a lower mudstone unit of gray to gray-green, clayey shale with some sandy shale that contains trilobites. Ranges from about 67 to 106 m thick, averages about 90 m (Deiss, 1939).

The Middle Cambrian Damnation Limestone consists of thinly bedded, finely crystalline, medium- to dark-gray dolomitic limestone and limestone with laminae of grayish-orange to yellowish-gray siltstone. Mottled, grayish-orange limestone beds. Trilobites present in lower part of formation (Deiss, 1939). The Damnation is 31 m thick on the Continental Divide near Cliff Mountain, thickens northward to 58 m at Pentagon Mountain, southward to 45 m at Prairie Reef (Deiss, 1939), and about 51 m thick in the Dearborn Canyon area (Deiss, 1939).

The Middle Cambrian Gordon Shale is mainly a dark-gray to gray-brown, very thinly laminated shale with greenish tint. Contains many thin beds of sandstone and some beds of limestone. In places, limestone contains glauconite, algal structures, fossil fragments, limestone chips, and quartz grains (Mudge, 1972). Organic burrows and trails common in lower sandstone beds. Trilobites numerous in upper part (Deiss, 1939). Thickens southward from about 43 m at Pentagon Mountain to about 90 m along the Continental Divide near Cliff Mountain (Deiss, 1939), from that area it thins southward to 60 m at Prairie Reef (Deiss, 1939).

The Middle Cambrian Flathead Sandstone consists of thin- to thick-bedded, noncalcareous, yellowish-gray, poorly sorted, poorly indurated, fine- to coarse-grained, cross-bedded quartzose sandstone with scattered quartz pebbles. Commonly contains organic trails and burrows, speckled with brown hematite. Ranges from about 13 to 35 m thick, rests unconformably on rocks of the Belt Supergroup.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Pz

Unit Name: Paleozoic sedimentary rocks, undivided

Map Unit Description

Shown only in cross section B-B'. Probably includes Mississippian, Devonian, and Cambrian strata as mapped by Mudge and Earhart (1983) south of Glacier National Park

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: ZYd

Unit Name: Mafic sills and dikes (Late and Middle Proterozoic)

Map Unit Description

Dioritic to gabbroic rocks that commonly show alteration of mafic minerals to calcite, epidote, clinozoisite, and hematite or limonite. Sills range in thickness from a few tens to a few hundreds of feet. Thicker sills tend to have contact-metamorphic zones around them. Sills commonly persist for many miles and in most places maintain approximately the same stratigraphic position. Locally, they cut across the section at a low angle or, rarely, cut steeply across section to form dikes. Intruded in map area probably at about 1,000 Ma, or 800 Ma, or both (Harrison, 1972)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ygr

Unit Name: Garnet Range Formation (Middle Proterozoic)

Map Unit Description

Gray to olive, micaceous siltite to quartzarenite interlaminated or interbedded with gray-green, micaceous, argillitic siltite. Occurs only in small exposures at south edge of map area beneath Cambrian unconformity. Maximum thickness of remnant about 500 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ym

Unit Name: McNamara Formation (Middle Proterozoic)

Map Unit Description

Predominantly grayish-green, interbedded and interlaminated argillite and siltite that contain thin chert laminae and chips. Oolites, stromatolites, quartzarenite, and stratabound cooper [sic] minerals present at places. Relatively thin red-bed sequences locally interbedded in the green strata. Small-scale sedimentary features include ripple marks, shrinkage cracks, scours, and cross-beds. Rests sharply on Bonner Quartzite. About 4,000 ft thick

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ybo

Unit Name: Bonner Quartzite (Middle Proterozoic)

Map Unit Description

Red to pink, micaceous, arkosic, cross-bedded, fine- to medium-grained quartzite containing red argillite interclasts. Tabular and trough cross-beds and climbing ripple marks common. Interbeds of red, laminated argillite and pink, planar-laminated siltite scattered throughout unit. Rests in sharp contact on Mount Shields Formation. Thickness ranges from about 800 to 1,200 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation (Middle Proterozoic)

Map Unit Description

Consists of a series of informal members similar to those seen to the west in the Kalispell 1°x2° quadrangle (Harrison and others, 1992) where six informal members are described; sequence in the Cut Bank quadrangle is similar, but member 5 is missing. Type section (Childers, 1963), about 2,550 ft thick, is between the Blacktail and Roosevelt faults in southeast corner of Glacier National Park on Mount Shields. Childers did not use the informal members subsequently found to be widespread in the formation. Maximum thickness in map area about 2,900 ft.

Uppermost unit in map area (member 6) is a thinly laminated, black argillite and white or green siltite that commonly displays small-scale slump folds and shrinkage cracks. Thickness about 200 ft. Conformably below is member 4, which consists of blocky, green, dolomitic, silty argillite that shows parallel-laminated graded couplets. Foot-thick carbonate beds are scattered throughout unit, as are rare salt casts. Thickness about 900 ft. Grades downward into member 3, which is predominantly alternating red and green beds of interlaminated argillite and siltite. Mud chips, mud cracks, ripple marks, and fluid-escape structures are common. Salt casts are abundant, particularly in red beds. Thickness about 500 ft. Grades by interlayering, through a few tens of feet, to member 2 below. Member 2 is pale-red, flat-laminated, coarse-grained siltite to fine-grained quartzarenite that is blocky, feldspathic, and dolomitic. Dolomite is in cement or in streaks and pods parallel to bedding. Minor layers of red or green argillite. Red or buff stromatolites and oolites in a zone of one or more beds at top. Thickness about 700 ft. Grades downward into member 1. Member 1 is red to maroon, feldspathic quartzarenite interbedded with red siltite. Siltite increases in abundance to east and north. Red argillite beds and partings common between coarser-grained beds. Cross stratification, mud chips, and heavy-mineral streaks common. Rare stromatolites. Thickness about 600 ft in southern part of map area

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ysh

Unit Name: Shepard Formation (Middle Proterozoic)

Map Unit Description

Consists of a variety of rock types, most of which are carbonate bearing or carbonate rich. The most characteristic lithology is green to gray, dolomitic argillite and siltite in even-parallel to wavy laminae that show graded couplets. This rock weathers into distinctive orange-brown platy slabs. Common interbeds a few to a few tens of feet thick include gray dolomitic limestone, stromatolites and oolites, laminated green argillite, gray argillitic siltite, and white quartzarenite. All rock types may contain pyrite cubes, small-scale wiggly calcite segregations (molar tooth structure), horizontal carbonate pods, ripple marks, or mud cracks. Base of unit is marked at places by shallow channels of quartzarenite, or in northwestern part of map area by an unconformity that separates the Shepard from the underlying Purcell Lava. Shepard thickness ranges from about 700 ft in Glacier National Park to about 2,700 ft in the Swan Range in southwestern part of map area (fig. 2)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ypr

Unit Name: Purcell Lava (Middle Proterozoic)

Map Unit Description

Exposed only in northeastern part of map area. Black to greenish-black basalt of continental alkaline basalt affinity (McGimsey, 1985). Multiple flow units, commonly 5-10 ft thick, that intertongue with the upper part of the Snowslip Formation or separate the Snowslip and Shepard Formations. Can be divided into three parts in most areas. Upper part is multiple basalt flow units, fine grained in their lower parts and amygdaloidal and vesicular in their upper parts; ropy flow structures cap many flow units. Middle part is flow units that have indistinct contacts and fine-grained porphyritic zones. Lower part is flow units that are porphyritic, contain long (1-2 in.) tabular plagioclase crystals in a fine-grained and highly altered groundmass and are locally pillowed. Maximum thickness about 200 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ysn

Unit Name: Snowslip Formation (Middle Proterozoic)

Map Unit Description

Type section of the Snowslip Formation (Childers, 1963) is on the south spur of Mount Shields in the southern part of Glacier National Park. Detailed study of the Snowslip by Whipple and Johnson (1988) in the park has led to recognition of six informal members that can be correlated over at least the 1,000 mi2 of the park. The Snowslip generally consists of two alternating intervals that are each one hundred to several hundred feet thick. One interval consists of thinly laminated, red to purple argillite and siltite interbedded with thinly laminated green argillite and siltite. The other interval consists of couplets of greenish-gray siltite and olive argillite. Within both intervals are beds of stromatolites, arenite, and carbonate as layers or cement; certain characteristics of these carbonate and arenite interbeds help to distinguish the various members of the Snowslip (Whipple and Johnson, 1988). Small-scale sedimentary structures include mud cracks, ripple marks, mud-chip breccias, fluid-escape structures, cross lamination (particularly in the arenite beds), and flat-pebble conglomerate. Sharply overlies Helena Formation. The Snowslip and its members generally thin to the north and thicken to the west across depositional strike. Ranges in thickness from about 1,200 ft in the north to about 4,000 ft in the Swan Range to the south (fig 2)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Yh

Unit Name: Helena Formation (Middle Proterozoic)

Map Unit Description

The most carbonate-rich formation in the Belt Supergroup. Contains abundant beds of dolomite, stromatolitic or oolitic limestone, and molar-tooth limestone and dolomite, and lesser amounts of quartzarenite and black argillite. In Glacier National Park contains an interval of stromatolitic limestone about 100 ft thick (the conophyton zone of Rezak, 1957) that separates the upper and middle parts of the Helena. Commonly displays sedimentary cycles, 6-50 ft thick, that in eastern exposures have a clastic bed at the base, stromatolitic and oolitic beds in the middle, and dolomite at the top (Eby, 1977). Abundance of stromatolites and oolites decreases rapidly to the west and south where cycles are still well defined but change to a clastic bed at the base, a middle unit of silty dolomite containing pods and ribbons of calcite, and an Lipper unit of dense, conchoidal-fracturing dolomite. Rests on laminated green argillite beds of the Empire Formation. Formation changes thickness rapidly across the various structural blocks in the map area (fig. 2), ranging from about 1,200 ft in southeastern Glacier National Park to about 7,000 ft in the Swan Range

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ye

Unit Name: Empire Formation (Middle Proterozoic)

Map Unit Description

Thinly laminated, dark-green and light-green dolomitic argillite and silty argillite or siltite. Laminae mostly wavy and discontinuous although some are even parallel. Fluid-escape structures are characteristic, and horizontal pods of white or pink calcite are particularly abundant in upper part. Ripple marks, syneresis cracks, and mud chips common in places. Lower part contains white dolomitic quartzarenite beds as thick as 10 ft. Pyrite cubes common in more carbonate-rich strata, and a few exposures display stratabound copper minerals. A few purple interlaminated argillite and siltite beds commonly occur near base and at places near middle of unit. Thickness about 500 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ys

Unit Name: Spokane Formation (Middle Proterozoic)

Map Unit Description

Three lithologic units are found in most areas. The upper member has beds a few feet to a few tens of feet thick of laminated, green argillite and siltite that alternate with much thicker beds of purple, laminated argillite and siltite. Dolomitic cement is common as are ripple marks, mud chips, desiccation cracks, fluid-escape structures, ball-and-pillow structures, and flute casts. Beds a few inches to a few feet thick of white, rounded grains forming medium-grained, crossbedded quartzite that displays mud chips and balls on cross strata are abundant in northern part of map area but decrease rapidly in both number and thickness in southern and western parts. The middle member is predominantly pink to purple-gray, very fine grained, feldspathic quartzite or coarse siltite that has planar lamination or long tabular cross lamination. Interbeds of purple argillite are common. The lower member is similar to the upper member but has more purple argillitic beds, is more dolomitic, and has scattered iron-carbonate specks and cement. The Spokane changes facies eastward and northward where abundance of distinctive white, rounded-grain quartzite has been used arbitrarily to define the laterally equivalent Grinnell Formation. Maximum thickness of the Spokane is about 4,500 ft in the Swan Range, but the unit thins to about 1,700 ft in northern exposures (fig. 2)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ygl

Unit Name: Grinnell Formation (Middle Proterozoic)

Map Unit Description

Term used in Glacier National Park for the quartzarenite-rich lithofacies equivalent to the Spokane Formation. White, rounded-grain, crossbedded quartzarenite containing red argillite chips and pellets forms about 60 percent of the formation and almost 100 percent of the upper part. Amount of quartzarenite decreases rapidly westward and southward (fig. 2). Red to purple laminated siltite, silty argillite, and argillite form interbeds that make up most of the remainder of the unit. Argillitic beds generally have even-parallel lamination, and couplets of argillite and siltite display ripple marks, mud cracks, and fluid-escape structures. Grades by interlayering into the Appekunny Formation. Thickness ranges from about 1,700 to 2,600 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Yap

Unit Name: Appekunny Formation (Middle Proterozoic)

Map Unit Description

Predominantly bright-green to olive argillite interbedded and interlaminated with laminated olive siltite and gray pyritic quartzarenite that weathers brown. Lower part contains maroon argillite and siltite. Can be divided into five informal members in Glacier National Park (Whipple, 1992). Various members' display mud cracks, mud-chip breccia, load structures, fluid-escape structures, and a few scour-and-fill structures. Rests unconformably on Altyn Formation in Glacier National Park but apparently intertongues with Prichard Formation transition member to southwest where unit mapped as Appekunny along west side of Flathead Range has beds characteristic of both Appekunny and Prichard. Maximum thickness about 2,000 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Yapp

Unit Name: Appekunny and Prichard Formations, undivided (Middle Proterozoic)

Map Unit Description

Shown only in southwestern part of Glacier National Park where map data is insufficient at most places to subdivide the unit. Consists of a few hundred feet of the upper part of the Appekunny (Yap) underlain by about 1,000 ft of the Prichard's transition member (Ypt) and about 4,000 ft of the Prichard's upper laminated argillite member (Ypu) whose base is not exposed.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Yp

Unit Name: Prichard Formation, undivided (Middle Proterozoic)

Map Unit Description

Shown only in cross sections to indicate inferred rocks of the Prichard that are not exposed but are known from the Kalispell 1°x2° quadrangle to the west (Harrison and others, 1992)

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ypt

Unit Name: Transition member

Map Unit Description

Generally consists of three units: a basal unit of medium-gray blocky-weathering siltite and minor quartzite, a middle unit of interlaminated light- and dark-gray siltite and argillite, and an upper unit similar to the middle but containing interbeds of light-olive-gray siltite and quartzite similar to those in the overlying Appekunny Formation. These three units are present nearly everywhere, but their relative proportions vary from place to place. Laminae are wavy to lenticular; scour-and-fill structures, fluid-escape structures, and syneresis cracks are common. Iron sulfide weathers to give rusty aspect to many outcrops. Randomly oriented biotite porphyroblasts common, particularly near top, in all but easternmost exposures. Calcareous siltite and argillite beds, some in the middle but most in the upper unit, make up a small part of the member. Contains some stromatolitic beds in Glacier National Park. Probably intertongues with Altyn Formation to east. Basal contact is sharp. Thickness about 2,000 ft.

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ypu

Unit Name: Upper laminated argillite member

Map Unit Description

Medium-gray argillite that contains planar laminae and thin planar beds of light- and dark-gray silty argillite. Alternating light and dark layers, 0.05-0.3 in. thick, give lined or banded appearance. Dark-gray silty argillite contains discontinuous laminae of carbonaceous matter and iron sulfide (mostly pyrrhotite, but locally pyrite). Iron sulfide weathers to give rusty appearance to outcrops. Randomly oriented biotite porphyroblasts except in Glacier National Park. In the park, upper part contains thin lenticular beds and pods of calcareous and dolomitic silty argillite. Maximum thickness of about 3,500 ft exposed near head of McDonald Lake in Glacier National Park. Base not exposed

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ya

Unit Name: Altyn Formation (Middle Proterozoic)

Map Unit Description

Occurs only on east side of Glacier National Park. Predominantly interbedded white too light-gray to black dolomite, dolomitic arenite, and cross-laminated arenite. Stromatolites common. Probably intertongues with Prichard transition member to west. Thickness about 1,200 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ywt

Unit Name: Waterton Formation (Middle Proterozoic)

Map Unit Description

Present only in northeastern Glacier National Park where formation is truncated by Lewis thrust fault. Predominantly gray to tan dolomite and dark-gray to bluish-gray limestone. Minor dolomitic siltite and arenite. Chert nodules or layers and stromatolites common. Maximum thickness exposed above Lewis thrust is about 800 ft

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: Ylb

Unit Name: Lower Belt rocks, undivided (Middle Proterozoic)

Map Unit Description

Shown only in cross section B-B' to indicate inferred rocks of the lower Belt that are not exposed. May include Prichard, Altyn, or Waterton Formations

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Cutbank_rect

Map Title

Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana

Map name: Cutbank 250K

Map Unit Symbol: B

Unit Name: Basement rocks (Early Proterozoic?)

Map Unit Description

Shown only in cross sections to indicate inferred crystalline rocks of uncertain character and pre-Belt age

Map Citation

Harrison, J.E., Whipple, J.W., and Lidke, D.J., 1998, Geologic map of the western part of the Cut Bank 1° x 2° quadrangle, northwestern Montana: U.S. Geological Survey Geologic Investigations Map I-2593, 1 sheet, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Qa

Unit Name: Alluvium (Holocene)

Map Unit Description

Silt, sand, and gravel in channels and flood plains of major rivers and streams and in related alluvial fans. May be partly of Pleistocene age. Maximum thickness unknown

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ql

Unit Name: Landslide deposits (Holocene and Pleistocene)

Map Unit Description

Angular fragments of bedrock mixed with soil or heterogeneous boulders and finer grained material derived from glacial deposits on steep valley walls; characterized by irregular, hummocky topography; boggy in places. Many landslides are marked by torn sod, tilted trees, and steep unvegetated slopes that indicate continuing movement

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Qf

Unit Name: Alluvial-fan deposits (Holocene and Pleistocene)

Map Unit Description

Poorly sorted silty sand and gravel deposited in broad alluvial fans along valley margins. Includes gravel veneer on pediments

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name Dillon 250K

Map Unit Symbol Qs

Unit Name Lacustrine sand and silt (Holocene and Pleistocene)

Map Unit Description

Silt and sand in thin-bedded, well-sorted deposits in the Big Hole basin in western part of map area

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Qm

Unit Name: Till (Pleistocene)

Map Unit Description

Unsorted mixture of boulders, cobbles, pebbles, and sand deposited by glaciers. Includes deposits of at least two, and in some places three, episodes of glaciation. Boulder fields in south-central part of map area are characterized by frost riving and frost-heaved boulders in locally boggy and commonly terraced terrane that formed by creep and solifluction on flanking hills. These boulder fields probably formed as a result of weathering in severe cold climate adjacent to Pleistocene glaciers. Rocks in the boulder fields are essentially in place, but structural information is incomplete or lacking.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Qo

Unit Name: Glacial outwash (Pleistocene)

Map Unit Description

Poorly sorted bouldery gravel and sand deposited by glacial meltwater.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: QTg

Unit Name: Alluvial and pediment gravels (Quaternary and Tertiary)

Map Unit Description

Unconsolidated, deeply weathered angular to rounded pebbles, cobbles, and small boulders of quartzite, arkosic sandstone, and granitic rocks in sand matrix; commonly covered by a thin layer of eolian silt; most deposits are located along southeast flank of Highland Mountains. Elsewhere, consists of poorly sorted silt, sand, and bouldery gravel of uncertain age. Present on ridge crests in the vicinity of Fish Creek in northeastern part of map area, near Wise River in north-central part, and in Lemhi Valley. Overlies tuffaceous rocks of late Tertiary age at Fish Creek and in Lemhi Valley and Paleozoic and Mesozoic rocks at Wise River. Present locally overlying Bozeman Group and related valley-fill deposits (Tbz) but not mapped separately. Thickness 0-50 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tbz

Unit Name: Bozeman Group and related valley-fill deposits, undivided (Pliocene to Eocene)

Map Unit Description

Light-gray to yellowish-brown, moderately indurated to well-indurated tuffaceous sandstone and siltstone containing subordinate interbeds of limestone and marl and lenses of pebble and cobble conglomerate composed of locally derived rock fragments. Exposures of related valley fill in Horse Prairie basin and in Salmon River valley include lignitic rocks of Oligocene age (Cavender, 1977; Harrison, 1982, 1985; Ruppel and Lopez, 1984, 1988). Commonly veneered with residual gravel or a thin layer of eolian silt. Thickness ranges from less than 300 m to about 3,000 m in the valley of Grasshopper Creek near the confluence of Grasshopper and Swamp Creeks and as much as 4,600 m in the Bighole basin. Deposits also include Tertiary landslide deposits derived from flanking mountains. Bozeman Group has been divided into Sixmile Creek and Renova Formations (Kuenzi and Fields, 1971), mainly on the basis of mammalian fossil data ; however, formation names are not used here because in most places in Dillon quadrangle the two formations cannot be separated lithologically (Hanneman, 1989). Maximum thickness, in Big Hole basin, exceeds 4,000 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ts

Unit Name: Basaltic rocks near Sweetwater Creek (Pliocene)

Map Unit Description

Grayish-black vesicular basalt or basaltic andesite flows near Sweetwater Creek in south-central part of map area are about 4 Ma (Daniel and Berg, 1981, p. 110); similar basaltic rocks are present in the central part of Ruby Range (James, 1990).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tc

Unit Name: Challis Volcanics (Eocene)

Map Unit Description

Basaltic andesite, andesite, latite, rhyodacite, and rhyolite as flows, ash-flow tuffs, and tuff and flow breccias. Mainly dark-gray or very dark red to medium-gray and pale-reddish brown, partly vesicular to scoriaceous, porphyritic hornblende or pyroxene basaltic andesite and andesite, and pale-red or light-brownish-gray to light-gray and pale-brown, porphyritic, partly welded quartz latite, latite, and rhyodacite. Locally contains thin interbeds of light-olive-gray, biotitic, tuffaceous, coarse-grained sandstone and conglomerate composed of volcanic detritus. Present only in southwestern and west-central parts of map area. Includes rocks in Withington Creek caldera, about 10 km in diameter, at north end of Lemhi Range; caldera contains massive ash-flow tuffs at least 600 m thick that pass laterally across caldera margin into 50-100 m of thinly layered ash-flow tuffs and andesitic flows. Age probably about 40-45 Ma (Staatz, 1979, p. 12-23; Ruppel and Lopez, 1984). Preserved thickness in most places probably less than 200 m. Volcanic rocks east of Idaho-Montana State line are not clearly related to Challis volcanic field of east-central Idaho and are mapped as Tvu.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tvu

Unit Name: Volcanic rocks (Tertiary)

Map Unit Description

Basaltic andesite, andesite, dacite, and rhyodacite. Light-brownish-gray to brownish-gray (tinted purple in places), fine-grained, locally porphyritic volcanic and associated intrusive rocks. Phenocrysts include sodic plagioclase, sanidine, quartz, and biotite. Partly equivalent to Eocene Lowland Creek Volcanics directly north of map area. Present mainly along east flank of Pioneer Mountains. Age 50-46 Ma (Zen, 1988). Individual flows as much as 50 m in thickness.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tibd

Unit Name: Intrusive basalt and diorite (early Tertiary)

Map Unit Description

Includes mainly dikes of dark-gray aphanitic basalt containing sparse phenocrysts of olivine(?) near North Fork of Salmon River in west-central part of map area (Lopez, 1982b) and a finely crystalline diorite dike that intrudes Beaverhead Divide-Miner Lake fault zone directly south of Center Mountain in the Beaverhead Mountains east of Salmon.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Trd

Unit Name: Rhyodacite, dacite, andesite, and rhyolite (Tertiary)

Map Unit Description

Dikes, dike swarms, and associated extrusive volcanic rocks. Dark-green to pale-yellowish-brown, gray or yellowish-gray to pale-red, fine-grained, porphyritic volcanic and related intrusive rocks containing phenocrysts of sanidine, plagioclase, alkali feldspar, and quartz, or of plagioclase, biotite, and hornblende in more mafic rocks. Mainly rhyodacite and dacite. Extrusive rocks principally rhyodacite and dacite tuffs and breccias and rhyolite flows, tuffs, and welded tuffs. Present in northwestern and north-central parts of map area. Age about 43 Ma (Desmarais, 1983, p.49-50, 106).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ti

Unit Name: Intrusive rocks (Tertiary)

Map Unit Description

Greenish-black basaltic plug intruded along Grasshopper Creek in south-central part of map area. May be related to Tvu.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tq

Unit Name: Monzogranite, granodiorite, quartz monzodiorite, and related intrusive granitic rocks (Tertiary)

Map Unit Description

Intrusive rocks in Carmen and Napoleon Ridge stocks and small plutons south of Gibbonsville in Beaverhead Mountains, in western part of map area; rocks intrude Yellowjacket Formation (Middle Proterozoic) and lower part of Medicine Lodge thrust plate. Age about 55-48 Ma; eastern part of Carmen stock contains small areas of more mafic rocks that are about 83-80 Ma (Kilroy, 1981; Ruppel and Lopez, 1988).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name Dillon 250K

Map Unit Symbol Tgd

Unit Name Granodiorite (Tertiary)

Map Unit Description

Complex mixture of porphyritic, fine- to medium-grained, gray to dark-gray granodiorite stocks and dikes. Phenocrysts consist of orthoclase, plagioclase, and rounded glassy quartz. K-Ar age determined on biotite is 51 Ma (Desmarais, 1983).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tbmg

Unit Name: Biotite-muscovite granodiorite (Tertiary)

Map Unit Description

Light gray, medium to coarse grained, equigranular to porphyritic, and nonfoliated. Phenocrysts, where present, consist of orthoclase, microcline, and locally plagioclase. K-Ar ages determined on biotite and muscovite range from 58 to 50 Ma (Desmarais, 1983).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: TKgd

Unit Name: Hornblende-biotite granodiorite (Tertiary and Cretaceous)

Map Unit Description

Fine- to medium-grained, nonporphyritic granodiorite

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kmg

Unit Name: Monzogranite (Cretaceous)

Map Unit Description

Granitic batholithic rocks in the Anaconda Range: Porphyritic and equigranular, medium-grained rocks in stocks and minor dikes.

Granitic rocks in the Boulder and Tobacco Root batholith: Light-gray, equigranular to strongly porphyritic, medium-grained to very coarse grained granitic rocks that compose the Moose Creek stock, Hell Canyon pluton, and most of the Butte Quartz Monzonite in central part of Boulder batholith. Slight textural and compositional variants are present. Includes small bodies of dark-gray diorite and gabbro.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kfgt

Unit Name: Foliated hornblende-biotite granodiorite and tonalite (Cretaceous)

Map Unit Description

Gray, medium to coarse grained, equigranular; characterized by distinctive foliation. K-Ar ages determined on biotite and hornblende range from 74 to 60 Ma (Desmarais, 1983).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Tsi

Unit Name: Silicic dikes (Tertiary)

Map Unit Description

Light-gray rhyolitic dike, in southern Pioneer Mountains, composed of quartz and sanidine phenocrysts in a finely granular groundmass of quartz and potassium feldspar. Age about 46 Ma (Snee, 1982; Pearson and Zen, 1985).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: TKg

Unit Name: Biotite-muscovite granite (Tertiary and Cretaceous)

Map Unit Description

Light gray, medium to coarse grained, locally porphyritic. Age about 65-61 Ma (Snee 1982, p. 153-154; Marvin and others, 1983). Includes Clifford Creek Granite of Paleocene and Late Cretaceous age in north-central Pioneer Mountains (Zen, 1988).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kbgg

Unit Name: Biotite granodiorite and granite (Late Cretaceous)

Map Unit Description

Pinkish gray, medium to coarse grained; contains euhedral potassium feldspar phenocrysts about 1 cm long. Includes associated tonalite, rhyodacite porphyry, rhyolite porphyry, intrusive breccia, pegmatite, and Grayling Lake Granite in north-central Pioneer Mountains (Zen, 1988). Age about 68-73 Ma (Snee, 1982, p. 134-152).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kgtd

Unit Name: Granodiorite, tonalite, and quartz diorite (Late Cretaceous)

Map Unit Description

Light-gray, medium-grained hornblende-biotite granodiorite of Uphill Creek Granodiorite (Zen, 1988), the predominant rock exposed in Pioneer batholith; includes plutons, mainly in northwestern part of batholith, of dark-gray to bluish-gray, medium-grained biotite and biotite-hornblende tonalite and quartz diorite. Ages of various plutons range from 68 to 77 Ma, age of granodiorite about 75 Ma (Snee, 1982, p. 104-134; Pearson and Zen, 1985; Pearson and others, 1987, 1988). Includes granitic rocks in McCartney Mountain stock, directly east of Pioneer Mountains, and in stocks north of Pioneer Mountains, in north-central part of map area.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Khg

Unit Name: Hornblende gabbro (Late Cretaceous)

Map Unit Description

Dark greenish gray, medium to coarse grained. Contains as much as 50 percent hornblende in most places, but as much as 80 percent hornblende in northeastern part of Pioneer Mountains. Age about 80 Ma (Snee, 1982, p. 93-104).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kfm

Unit Name: Foliated meta-igneous rocks (Cretaceous?)

Map Unit Description

Bluish-gray, weakly to moderately foliated, fine-grained, porphyritic metadacite and meta-andesite; phenocrysts commonly fractured parallel to foliation; hornblende locally present as elongate crystals parallel to foliation. Exposed in northwestern Pioneer Mountains; interpreted by Berger and others (1983) as Precambrian cratonic rock.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kfr

Unit Name: Granite gneiss of Foolhen Ridge (Cretaceous?)

Map Unit Description

Bluish gray, strongly foliated, medium to coarse grained; contains porphyroblasts as much as 2 cm long of plagioclase, smoky quartz, and sparse microcline aligned parallel to foliation. Accessory minerals include sphene, magnetite, zircon, and apatite. Original rock may have been coarse-grained granodiorite or porphyritic dacite or andesite. Exposed only in northwestern part of Pioneer Mountains and interpreted by Berger and others (1983) as Precambrian cratonic rock.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Khbg

Unit Name: Hornblende biotite gneiss (Cretaceous?)

Map Unit Description

Dark bluish gray to bluish gray, medium to fine grained, strongly foliated; contains porphyroblasts of plagioclase and smoky quartz. Accessory minerals include epidote, sphene, magnetite, and zircon. Exposed in northwestern Pioneer Mountains; interpreted by Berger and others (1983) as Precambrian cratonic rock.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kal

Unit Name: Alaskite, aplite, and pegmatite and related felsic rocks (Cretaceous)

Map Unit Description

Leucocratic, fine- to coarse-grained granite; occurs as small, irregular pods and stocks in Butte Quartz Monzonite. Only largest bodies are shown, many being too small to be shown.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kgd

Unit Name: Granodiorite (Cretaceous)

Map Unit Description

Medium- to dark-gray, equigranular, fine- to medium-grained rocks of Rader Creek and Donald plutons intruded along southeast margin of Boulder batholith. Also includes Tobacco Root batholith, a zoned pluton that is mostly a medium-gray, coarse-grained, porphyritic granodiorite in map area (O’ Neill, 1983), and related stocks in the Tobacco Root Mountains.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ki

Unit Name: Granitic rocks, undivided (Late Cretaceous)

Map Unit Description

Principally monzogranite, granodiorite, and related granitic intrusive rocks in small stocks and plugs in east-central and southern parts of map area. Includes porphyritic, high-potassium dacite in a 16-km-long intrusive sheet and as a 1-km-diameter plug that is hydrothermally altered and mineralized 15 km west of Dillon.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kvu

Unit Name: High-potassium dacite and minor andesite and dacite (Late Cretaceous)

Map Unit Description

Comprises an upper lava-flow and breccia unit of intermediate composition and a lower silicic pyroclastic unit. The upper unit is high-potassium dacite and minor andesite and dacite as volcanic breccia, lava flows, a volcanic dome, and minor volcanic-pebble conglomerate, volcaniclastic sandstone, tuff, and dikes. The lower unit comprises pale-colored pyroclastic flow deposits and tuff that are nonporphyritic to slightly porphyritic and, in most places, zeolitic.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kem

Unit Name: Elkhorn Mountains Volcanics (Late Cretaceous)

Map Unit Description

Light-gray to dark-gray and grayish-red to greenish-gray dominantly andesitic to latitic welded tuff and tuff breccia, tuff, lapilli tuff, lava flows, flow breccia, and poorly sorted volcanic sandstone and conglomerate in northeastern part of map area.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: TKb

Unit Name: Beaverhead Group (Tertiary? and Upper Cretaceous)

Map Unit Description

Moderately indurated massive boulder, cobble, and pebble conglomerate having a quartz-sand matrix and cemented with calcite, and some interbedded sandstone and fresh-water limestone; in most places these rocks consist of rounded to subangular fragments of Proterozoic quartzite and Paleozoic carbonate rocks; however, near Bannock the sequence can be divided into an upper unit composed mainly of quartzite clasts that is separated from underlying carbonate-rich unit by volcanic rocks (Kvu) not assigned to the Beaverhead; as much as 350 m thick. Exposed only in south-central part of map area.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Km

Unit Name: Sedimentary rocks of McCartney Mountain (Cretaceous)

Map Unit Description

Thick succession of poorly known, partly metamorphosed sandstone and shale that underlie McCartney Mountain in east-central part of quadrangle.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ks

Unit Name: Sedimentary rocks (upper and lower parts) and Blackleaf Formation, undivided (Upper and Lower Cretaceous)

Map Unit Description

Includes poorly known rocks of Blackleaf Formation and overlying strata. Blackleaf Formation of this report formerly was designated as part of Colorado Group, undivided, or as Aspen Formation.

Upper part (Upper Cretaceous) - Greenish-gray or light yellowish-gray to grayish-white, tuffaceous subgraywacke, tuffaceous sandstone, quartz sandstone, and tuff, locally interlayered with conglomerate lenses. Interbedded with grayish-green, greenish-blue, and dark-gray silty mudstone, shale, and siltstone. Beds near top of section locally contain plant fragments and pollen indicating mid-Campanian to Maastrichtian age (Zen, 1988). Thickness uncertain, but possibly as thick as 1,200 m. Exposed only along east flank of Pioneer Mountains northward to area of Granulated Mountain north of Wise River.

Lower part (Upper Cretaceous) - Sandstone, conglomerate, shale, mudstone, and porcelaneous mudstone, siltstone, limestone, and bentonite. Sandstone is yellowish gray, light olive gray, light to medium bluish gray to pale yellowish brown, brownish gray and medium to dark gray; mostly medium to coarse, rounded to angular grains, but finer grained in places; medium to thick bedded; prominent trough cross-stratification in many beds; commonly calcareous and stained with limonite, and contains disseminated carbonaceous material. Conglomerate commonly grades laterally into coarse-grained sandstone and contains rounded fragments as much as 30 cm in diameter predominantly of quartzite, chert, porcelaneous mudstone, and, less commonly, limestone, in a sandstone matrix. Mudstone, shale, and siltstone are light olive green and bluish gray to dark gray, calcareous, bentonitic, and commonly porcellanitic; commonly burrowed and bioturbated, and locally contains abundant carbonaceous material and leaf and wood impressions. Limestone, in rare, scattered, discontinuous beds 1 m or less thick, is medium gray to greenish gray, fine grained, silty, commonly bioturbated, and grades laterally into calcareous mudstone. In part lithologically equivalent to Frontier Formation near Lima Peaks in southern Beaverhead County (Dyman and others, 1989). Measured thickness as much as 420 m, but top of formation not present in this region (Dyman, 1985a, 1985b, 1985c; Dyman and Tysdal, 1989; Tysdal and others, 1989).

Blackleaf Formation (Upper and Lower Cretaceous)-Separable into two members. Flood Member separable into three informal lithofacies units as described by Dyman (1985a, 1985b, 1985c), Dyman and Nichols (1988), and Dyman and Tysdal (1989). Total thickness is 940 m at Rock Creek in Pioneer Mountains and about 460 m in Snowcrest Range.

Vaughn Member - Mudstone, porcelaneous mudstone, siltstone, volcanic-rich sandstone, conglomerate, and limestone. Predominantly mudstone and siltstone, which are light olive gray, light greenish gray, dusky red, greenish gray, and medium gray, partly thinly laminated, commonly porcelaneous in middle and upper parts of unit, partly calcareous, hard and dense, locally bentonitic, and locally pyritic; contains locally abundant lithophysae in tuffaceous beds. Sandstone and conglomerate occur in thin, laterally discontinuous channel fills. Sandstone and conglomerate are light olive gray and greenish or bluish gray to dark gray, mostly fine to medium grained, consisting of subrounded to angular grains; partly calcareous, partly pyritic, thin to medium bedded; conglomerate zones contain rounded to angular fragments as much as 3 cm in diameter of mudstone, shale, siltstone, quartzite, and chert. Silty, micritic limestone is rare and typically occurs in thin argillaceous lenses and grades into highly calcareous mudstone. Thickness 340-356 m in eastern Pioneer Mountains; thins eastward to 80 m in Snowcrest Range.

Flood Member - Clastic lithofacies-Interbedded with subordinate siltstone, mudstone, shale, and conglomerate. Sandstone is light olive gray and light greenish gray to dark yellowish brown and pale red, fine to coarse grained and locally conglomeratic; grains are rounded to angular; medium to thick bedded, ripple or horizontally laminated or trough cross stratified; commonly calcareous, micaceous, and contains abundant carbonaceous material and wood fragments. Siltstone, mudstone, and shale are yellowish-gray and light olive gray to yellowish brown and dark gray, partly calcareous, commonly bioturbated, and contain carbonaceous material and wood fragments. Thickness about 75 m in eastern Pioneer Mountains, thinning eastward to 4-15 m in and near Snowcrest Range.

Mudstone-shale lithofacies - Mudstone, shale, siltstone, and greatly subordinate sandstone. Mudstone, shale, and siltstone are medium gray to dark gray, partly thinly laminated, calcareous, and contain abundant calcareous nodules as much as 5 cm in diameter in discrete zones; commonly bioturbated, limonite stained, and commonly contain carbonaceous material, wood fragments, and coal. Sandstone is pale blue to medium light gray, very fine to fine grained, thin bedded and parallel laminated, and calcareous. Grains are rounded to subangular. Thickness about 20-50 m in eastern Pioneer Mountains, thickens eastward to about 75 m in and near Snowcrest Range.

Transitional clastic lithofacies - Sandstone, siltstone, mudstone, and subordinate limestone, shale, and conglomerate. Sandstone is medium light gray, light olive-gray, pale yellowish brown, and medium gray, and generally very fine to medium grained. Grains are rounded to subangular grains. Is in part horizontally laminated, ripple laminated, or trough cross-stratified, and in places coarse grained and conglomeratic, containing fragments of limestone and mudstone as much as 2.5 cm in diameter; calcareous, partly bioturbated, and contains carbonaceous material. Mudstone, shale, and siltstone are medium light gray and light olive gray to medium bluish gray, medium dark gray, and greenish black; calcareous, and locally contains calcareous nodules as much as 1 cm in diameter; partly thinly laminated, thin bedded, commonly bioturbated, and contains carbonaceous material. Limestone is medium light gray, light bluish gray, yellowish gray to medium gray, and medium bluish gray, micritic, thin bedded, typically nodular with nodules as much as 10 cm in diameter, carbonaceous, partly silty to sandy, and grades laterally into siltstone or sandstone. Thickness about 80-85 m near Pioneer Mountains, thinning eastward to about 15 m near Snowcrest Range.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Mudstone, siltstone, limestone, and sandstone. Upper part of formation is principally limestone with subordinate interbedded mudstone, siltstone, and sandstone; limestone beds also occur in middle part of formation (Myers, 1952; Schwartz, 1983; Pearson and Zen, 1985). Limestone is medium light gray to medium dark gray, finely to coarsely crystalline, thin to medium bedded, and fossiliferous; abundant fragments of gastropods in some beds. Mudstone and siltstone, principally in middle and lower parts of formation, are light olive gray, grayish green, and medium light gray to pale red, grayish red, and medium dark gray, partly thinly laminated, partly fissile, calcareous, and contain carbonaceous material and fragments of fossil wood. Sandstone occurs in subordinate interbeds throughout formation but is predominant in lower part; typically it is light olive gray and medium light gray to medium dark gray, fine to coarse grained, thin to thick bedded, and calcareous; rounded to subangular quartz grains and grains of dark chert are abundant; basal sandstone commonly is conglomeratic and contains abundant pebbles and cobbles of chert. Thickness 200-400 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: JT_ru

Unit Name: Jurassic and Triassic rocks

Map Unit Description

Includes Jurassic Morrison Formation and the Triassic Thaynes Limestone, Woodside Formation, and Dinwoody Formation, undivided.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Jm

Unit Name: Morrison Formation (Upper Jurassic)

Map Unit Description

Grayish-red, yellowish-gray, and greenish-gray shale and siltstone, and minor interbedded fine- to medium-grained sandstone. Maximum thickness about 60-65 m in Argenta and Wise River areas and about 10 m in Blacktail Mountains and Snowcrest Range, where these rocks are mapped with Kootenai Formation; absent elsewhere in Dillon region.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: T_ru

Unit Name: Triassic rocks, undivided

Map Unit Description

Thaynes Limestone (Lower Triassic) - Light-gray limestone, sandstone, and siltstone. Maximum thickness about 120 m in south-central and southeastern parts of map area; absent elsewhere in Dillon region.

Woodside Formation (Lower Triassic) - Reddish-brown, reddish-purple, and medium-gray calcareous mudstone, siltstone, and limestone. Maximum thickness about 30 m in south-central part of map area and in Snowcrest Range; absent elsewhere in Dillon region.

Dinwoody Formation (Lower Triassic) - Grayish-green, yellowish-gray, and grayish-brown, calcareous, thinly laminated siltstone; fine-grained sandstone; shale; gray, pale-red and light-brownish-gray-weathering, thin-bedded limestone. Maximum thickness, in south-central part of map area, is about 250 m but most commonly 100-160 m.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Pmu

Unit Name: Permian to Mississippian rocks

Map Unit Description

Includes the Phosphoria Formation (Permian) and Quadrant Formation (Pennsylvanian and Upper Mississippian).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Pp

Unit Name: Phosphoria Formation

Map Unit Description

Divisible into upper and lower units. Upper unit is yellowish-brown to brownish-gray and dark-gray, partly glauconitic chert, cherty fine-grained sandstone, and quartzitic sandstone. About 40-45 m thick. Lower unit, in most places, includes, from top to bottom, (1) dark-gray, carbonaceous, phosphatic mudstone and shale and phosphate rock, and oil shale on Retort Mountain and Dalys Spur; (2) a unit of light-gray to grayish-brown, cherty, fine-grained quartzitic sandstone and cherty or sandy dolomite; (3) a yellowish-brown and medium-bluish-gray chert, yellowish-brown to dark-gray, cherty, carbonaceous and phosphatic mudstone and phosphate rock; and (4) a basal unit of light-gray to yellowish-gray, pale-reddish-brown, fine-grained dolomitic sandstone, siltstone, chert, and cherty limestone containing minor interbeds of vitreous quartzite. Total thickness of formation ranges from 50 to 180 m; it thins northward mainly by disappearance of lower part of lower unit.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: [PMq

Unit Name: Quadrant Formation

Map Unit Description

Light-gray to pale-yellowish-brown, fine- to medium-grained, quartzitic sandstone and vitreous quartzite; contains well-sorted, subrounded to well-rounded quartz grains; commonly cross-stratified, locally hematitic. Locally includes thin interbeds of light-gray to medium-gray, micritic, silty or sandy dolomite or limestone; in some places lower 15-55 m of formation is mainly dolomite or limestone containing thin interbeds of dolomitic or calcareous, fine-grained sandstone. Thickness ranges from 210 m in Blacktail Mountains to 115 m near Wise River, thickness is 200-400 m in Pioneer Mountains, about 90 m in the Ruby Range, and 150 m in Snowcrest Range (Saperstone and Ethridge, 1984).

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: [Pmu

Unit Name: Snowcrest Range Group (Lower Pennsylvanian and Upper Mississippian) and Madison Group (Upper and Lower Mississippian), undivided

Map Unit Description

Snowcrest Range Group - Formerly mapped as Amsden Formation and (or) Big Snowy Group in this region, but now defined as Snowcrest Range Group, which contains Conover Ranch Formation, Lombard Limestone, and Kibbey Sandstone (Wardlaw and Pecora, 1985; Tysdal and others, 1987).

Conover Ranch Formation (Lower Pennsylvanian and Upper Mississippian) - Pale-reddish-brown to pale-reddish-purple, thin-bedded, calcareous mudstone and minor interbeds of limestone, calcareous sandstone and siltstone, limestone-pebble conglomerate, and phosphatic claystone. About 13-33 m thick. Mainly of late Chesterian age but includes a few thin beds of Pennsylvanian age at top of formation.

Lombard Limestone (Upper Mississippian) - Light-olive-gray, thin- to thick-bedded fossiliferous limestone and thin interbeds of silty limestone, siltstone, and shale, about 85-125 m thick, underlain by olive-gray and medium-red to pale-reddish-purple calcareous mudstone about 40 m thick. Chesterian to late Meramecian age.

Kibbey Sandstone (Upper Mississippian) - Pale-red to pale-yellow, thin- to medium-bedded siltstone, sandstone, and claystone, and interbedded limestone solution breccia and evaporite solution breccia in middle part of formation. About 5-45 m thick. Late Meramecian age.

Madison Group - Limestone, dolomitic limestone, and shale included in Mission Canyon Limestone and Lodgepole Limestone.

Mission Canyon Limestone (Upper and Lower Mississippian) - Olive-gray to yellowish-gray and dark-yellowish-brown, light-gray-weathering, medium- and thick-bedded to massive, generally fine- to medium-grained (but ranges from very fine grained to coarse-grained) limestone. Locally cherty. Includes a few beds of dolomitic limestone in places. Upper part of formation includes pale-red to grayish-orange limestone solution breccia. Thickness ranges from 240 m in Blacktail Mountains to as much as 420 m in Ruby Range and Pioneer Mountains.

Lodgepole Limestone (Lower Mississippian) - Medium- to dark-gray, fine- to medium-grained, thin- to thick-bedded limestone, overlying medium- to dark-gray and brownish-gray, thin-bedded, laminated, argillaceous limestone, containing thin interbeds and bedding partings of dark-gray shaly limestone and calcareous shale. In Blacktail Mountains, Ruby Range, and Highland Mountains the formation is composed of Woodhurst Member (upper) and Paine Member (lower). Thickness is 180-230 m in Ruby Range and Blacktail Mountains, and 100-200 m in Pioneer Mountains region.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Mdu

Unit Name: Three Forks Shale and Jefferson Formation (Mississippian? and Upper and Middle Devonian), undivided

Map Unit Description

Three Forks Shale (Mississippian? and Upper Devonian) - Composed of, at top, Sappington Member of yellowish-orange calcareous or argillaceous siltstone and fine-grained sandstone; underlain by Trident Member of dark-gray shale and interbedded fossiliferous dark-gray limestone and yellowish-gray to yellowish-orange argillaceous limestone; and at base the Logan Gulch Member of brownish- to purplish-gray, finely crystalline limestone, yellowish- and brownish-gray to purplish-gray, thin- to thick-bedded limestone and dolomite solution breccia interbedded with greenish-gray shale near base. Thickness about 20-50 m in Ruby Range and Blacktail Mountains, 0-50 m in Pioneer Mountains region.

Jefferson Formation (Upper and Middle Devonian) - Moderate- to dark-yellowish-brown to dark-gray, medium- to thick-bedded, locally thinly laminated, fine- to medium-grained, fetid dolomite and interbedded yellowish-brown to yellowish-orange, thin-bedded, fine-grained dolomite and silty, shaly dolomite; locally includes minor beds of shale and solution breccia. Thickness ranges from about 30-35 m in Blacktail Mountains and 80 m in Ruby Range to 150-200 m in Pioneer Mountains region.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Oq

Unit Name: Quartzite of Dickie Peak (Ordovician?)

Map Unit Description

White to grayish-white, vitreous quartzite, locally containing dark, heavy minerals in planar layers and cross-beds; interlayered near base with greenish-black, silty, locally sandy argillite (Lewis, 1990). Argillite contains numerous trace fossils that are definitely of Paleozoic age, most probably Ordovician (M.W. Reynolds, written commun., 1987).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Cu

Unit Name: Cambrian rocks, undivided (Upper and Middle Cambrian)

Map Unit Description

Contains Snowy Range Formation, Pilgrim Formation, Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone (Ruppel and Lopez, 1984; Ruppel, 1985). In northern part of Pioneer Mountains, unit made up of Hasmark and Silver Hill Formations (Zen, 1988).

Snowy Range Formation (Upper Cambrian) - The name "Red Lion Formation" used in some areas. Both formations divided into Sage Dolomite Member and underlying Dry Creek Shale Member. Sage Member is yellowish-brown to light-gray, very fine grained to fine-grained, thin- to thick-bedded dolomite, mottled and ribboned grayish red in lower part; locally contains thinly laminated algal beds and dome-shaped to columnar stromatolites in upper part. Dry Creek Member is olive-gray to reddish-gray, fissile, finely micaceous shale. Thickness about 20-50 m; absent in Blacktail Mountains, southern Tobacco Root Mountains, and locally absent in Pioneer Mountains.

Pilgrim Formation (Upper Cambrian) - Pale-yellowish-brown to light-gray, fine- to medium- to thick-bedded dolomite; upper part is sandy and includes interbeds of fine- to medium-grained sandstone. About 90-120 m thick in eastern and central parts of Dillon region; thins to 12-13 m in western part, near Jackson.

Park Shale (Middle Cambrian) - Pale-olive or grayish-green, finely micaceous, fissile shale and minor thin interbeds of yellowish-brown, medium-grained dolomite and yellowish-gray, thinly platy, calcareous, fine-grained sandstone, siltstone, and mudstone. About 45-60 m thick, pinches out to the west.

Meagher Limestone (Middle Cambrian) - Medium-gray, medium-light-gray and yellowish-brown, fine- to medium-grained limestone, dolomitic limestone, and dolomite that partly is irregularly mottled yellowish gray, light gray, or pale red. Mainly limestone and dolomitic limestone in Tobacco Root Mountains and mainly dolomitic limestone and dolomite farther south and west, in Dillon region. Thickness about 75-150 m in Tobacco Root Mountains, 170-230 m in Ruby Range and Highland Mountains, and 166 m in Blacktail Mountains; thins westward to 12-13 m near Jackson.

Wolsey Shale (Middle Cambrian) - Olive-green, grayish-red and reddish-brown, micaceous, glauconitic siltstone and olive-green, fissile, micaceous shale interbedded with grayish-red and yellowish-gray, glauconitic, argillaceous, fine-grained, platy sandstone and medium-gray, fine-grained limestone. Thickness about 15-75 m in Tobacco Root Mountains, 80 m in Highland Mountains, 18-30 m in Ruby Range, 20 m in Blacktail Mountains, and 85-120 m near Jackson.

Flathead Sandstone (Middle Cambrian) - Pale-orange, light-yellowish-gray, and yellowish-brown, thin- to medium-bedded, mostly fine- to medium-grained, but locally coarse-grained, quartzitic sandstone and arkosic sandstone, locally conglomeratic. Upper part of formation commonly includes interbeds of glauconitic, fine-grained sandstone, and olive-green and pale-red mudstone and shale. Basal part of formation locally includes interbeds of yellowish-gray to pale-brown siltstone, mudstone, and shale.

Geologic map unit descriptions

Thickness 0-43 m in Tobacco Root Mountains, 9-16 m in Ruby Range and Blacktail Mountains, and 20-30 m in Pioneer and Highland Mountains.

Hasmark Formation (Upper and Middle Cambrian) - Light-gray, thin- to thick-bedded dolomite; locally contains oolites, pisolites, pellets, and algal structures. About 235-300 m thick. Correlative of Pilgrim Formation, Park Shale, and Meagher Limestone.

Silver Hill Formation (Middle Cambrian) - Light-yellowish-brown calcareous shale, limestone, and dolomite and olive-green shale and mudstone; includes minor interbeds of thin-bedded sandstone. Thickness 0-100 m. Correlative of Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone. Locally, also includes fine-grained clastic rocks of probable Middle Proterozoic Belt Supergroup age.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ys

Unit Name: Swauger Formation (Middle Proterozoic)

Map Unit Description

Grayish-pink to pale-reddish-purple, light-brown, and grayish-green, thick-bedded, cross-laminated, medium- to coarse-grained hematitic quartzite. Present as thin, fault-bounded tectonic slivers along Carmen Creek. Maximum thickness directly west of map area is near 3,100 m, but unit is much thinner or absent in Dillon quadrangle as a result of Late Proterozoic erosion. Probably correlative with rocks of Missoula Group farther east.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yl

Unit Name: Lemhi Group (Middle Proterozoic)

Map Unit Description

Includes Gunsight Formation, Apple Creek Formation, and Big Creek Formation in Dillon quadrangle.

Gunsight Formation - Light-brownish-gray, medium-light-gray to grayish-red-purple, thin- to medium-bedded, fine- to medium-grained feldspathic quartzite; many beds laminated or cross-laminated. Minimum thickness about 1,800 m, but no unfaulted sections known.

Apple Creek Formation - Grayish-green, thin-bedded siltite and very fine grained feldspathic quartzite that contains irregular streaks and lenses of light-gray, ferrodolomite-cemented fine-grained sandstone; laminated or cross-laminated, commonly displaying mud cracks and ripple marks; locally pyritic. Lower part of formation includes subordinate beds of grayish-red-purple and dark-gray siltite and argillite. Thickness about 760-900 m.

Big Creek Formation - Pale-greenish-gray too light-gray, mostly thick-bedded or massive, fine-grained feldspathic quartzite. Many beds laminated or cross-laminated. Thickness about 3,100 m.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yy

Unit Name: Yellowjacket Formation (Middle Proterozoic)

Map Unit Description

Medium-gray to medium-dark-gray, mostly thin- to medium-bedded, very fine grained to fine-grained, feldspathic, finely biotitic quartzite and subordinate interbedded dark-greenish-gray to medium-dark-gray, thin- to medium-bedded siltite and argillite. Probable thickness more than 8,000 m, but the base of the formation has not been found and the upper part is everywhere bounded by Late Cretaceous Medicine Lodge thrust plate in east-central Idaho and adjacent southwestern Montana (Lopez, 1981,1982a).

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yg

Unit Name: Porphyritic granite (Middle Proterozoic)

Map Unit Description

Medium-gray to pinkish-gray, coarse-grained, porphyritic biotite granite; potassium-feldspar phenocrysts are as much as 15 cm in diameter. Intrudes the Yellowjacket Formation only. Age about 1.37 Ga (Evans and Zartman, 1990).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ym

Unit Name: Missoula Group (Middle Proterozoic)

Map Unit Description

Pioneer Mountains and the east flank of the Beaverhead Mountains: Unit includes Garnet Range Formation, McNamara Formation, Bonner Quartzite, and Mount Shields Formation and probable metamorphosed equivalents.

Garnet Range Formation-Grayish-red, medium-red to pale-red, and light-brown, fine- to coarse-grained feldspathic, limonitic sandstone in thin and platy beds separated by thin beds and bedding partings of grayish-red to dusky-red siltite and fissile argillite. Bedding surfaces commonly spangled with white mica. In part thinly laminated or cross-laminated. Thickness 0-800 m. Known to occur in vicinity of Warm Spring Creek near Jackson, on Big Hole Divide, and in Argenta mining district in south-central part of map area.

McNamara Formation-Grayish-red to pale-red, thin-bedded, platy, medium-grained, partly thinly laminated or cross-laminated feldspathic quartzite and quartzitic sandstone; thin interbeds and bedding partings of grayish-red argillite and interbedded greenish-gray, fine-grained quartzite and light-greenish-gray siliceous argillite; muscovite common on bedding surfaces; locally mud cracked and ripple marked. Thickness uncertain, possibly as much as 2,300 m. Known to occur in Warm Spring Creek area, as isolated outcrops near Jackson, and in northern part of Pioneer Mountains.

Bonner Quartzite and Mount Shields Formation-Grayish-pink, grayish-red, and pale-red to light-gray and medium-light-gray, medium- to coarse-grained, but locally fine grained, thin- to thick-bedded, commonly cross-laminated, micaceous feldspathic quartzite and subordinate grayish-green to grayish-red siltite and argillite, most commonly as thin bedding partings and chips in quartzite. Includes conglomerate beds and lenses as much as 3 m thick, mainly in northern part of Wise River valley and east of French Creek. Thickness unknown. Occurs in central part of map area from Horse Prairie Creek northward through Pioneer Mountains to French Creek and Little Granulated Mountain. In most places unit is probably the middle and upper parts of Mount Shields Formation, but probably mostly the overlying Bonner Quartzite in area between French Creek and Little Granulated Mountain.

In Beaverhead Mountains, quartzitic rocks included in Mount Shields Formation differ from those farther east, and probably are mostly lower part of Mount Shields Formation. Upper part of sequence is mainly light- brownish-gray, greenish-gray to light-gray, pale-red, or less commonly grayish-red-purple or dark-reddish-gray, fine- to medium-grained, thin-bedded to massive, locally ripple-marked, laminated and cross-laminated feldspathic quartzite; contains well-sorted, well-rounded glassy quartz grains and pink quartz and reddish chert grains in some places, and abundant dark-gray heavy minerals disseminated throughout the rock or concentrated on laminae and cross-laminae. Muscovite common on bedding surfaces; bedding partings and thin interbeds of dark-gray to greenish-gray and grayish-red argillite and siltite are present locally. Thickness unknown but probably more than 1,500 m.

Lower part of the Mount Shields in Beaverhead Mountains consists of three zones: (1) Upper zone of 10 to 50-m-thick units of interlayered thin- and thick-bedded to massive, light-brownish-gray to light-

Geologic map unit descriptions

gray, fine- to medium-grained, laminated and cross-laminated feldspathic quartzite and quartzitic sandstone interlayered with thin beds of dark-gray argillite; bedding surfaces and partings are commonly calcareous or dolomitic; probably about 150-200 m thick. (2) Middle zone, as much as 500-700 m thick, of light-brownish-gray to pale-purple, fine- to medium-grained, thick-bedded to massive, in part coarsely laminated and cross-laminated, feldspathic, partly calcareous or dolomitic quartzite and quartzitic sandstone containing bedding partings and sparse thin beds of dark-gray argillite; sparse floating pebbles and pebbly zones are common on bedding surfaces, and dark-gray heavy minerals are disseminated throughout rock and concentrated on laminae and cross laminae. (3) Lower zone, about 150-200 m thick, of light-brownish- or greenish-gray to light-gray, pebbly and conglomeratic, fine-grained to very coarse grained, cross-laminated calcareous or dolomitic quartzite, quartzitic sandstone, and sparse lenticular beds of sandy dolomite and sparse bedding partings and thin interbeds of dark-gray argillite; includes conglomerate lenses, as much as 2 m thick, of subangular to subrounded pebbles 1-4 cm in diameter of white quartz and less common quartzite, granite, and feldspar pebbles in sand matrix and on bedding surfaces.

Lower part of Mount Shields Formation in Beaverhead Mountains exposed from vicinity of Ajax Lake and Lena Lake south to Hamby Lake; best exposed in vicinity of Ajax and Rock Island Lakes. Estimated thickness of lower part about 1,000 m; base not exposed.

Anaconda Range and in the northern Beaverhead Mountains: Mount Shields Formation-Grayish-white to pink, fine- to coarse-grained, feldspathic quartzite locally interlayered with quartz-pebble conglomerate. Quartzite beds, generally less than 1 m thick, commonly become fine upward and are locally capped by siltite and argillite. The distinctive feldspathic quartzite beds of this formation grade downward into interlayered dark-gray argillite and feldspathic quartzite; argillite becomes predominant in lower part of formation, Upper contact of formation is not exposed. Thickness about 500 m.

Shepard Formation-Tan, calcareous and dolomitic siltite, fine-grained quartzite, and minor conglomerate. Thickness about 200 m.

Snowslip Formation-Tan to pinkish-white, fine- to medium-grained quartzite interbedded with dark-gray, thin-bedded, irregularly laminated siltite, silty argillite, and argillite. Contains sparse, thin (less than 20 cm thick) interbeds of clean, white, medium-grained quartzite. Thickness exceeds 450 m.

Highland Mountains and in the northern Tobacco Root Mountains: Interlayered quartzite and siltite that pinches out to the east and west within Highland Mountains. Upper part consists of white to pinkish-white, fine- to medium-grained quartzite interlayered with minor tan siltite. Middle part consists of interlayered white to tan, thick-bedded, locally platy and cross-bedded quartzite interlayered with laminated, very fine grained, argillaceous quartzite. Quartzite grades laterally into subangular, pebble to cobble intraformational conglomerate in central part of Highland Mountains. Lower part consists of medium-gray, laminated, very fine-grained sandstone and siltstone showing even parallel lamination. Maximum thickness about 300 m.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ymm

Unit Name: Foliated metasedimentary rocks, probably part of the Bonner Quartzite and Mount Shields Formation (Middle Proterozoic)

Map Unit Description

Metasediments in the Pioneer Mountains and the east flank of the Beaverhead Mountains: Interlayered gray to greenish-gray and brownish-gray, fine-grained biotite-muscovite metaquartzite; locally contains garnet and sillimanite. Previously interpreted by L.W. Snee in Berger and others (1983) to be pre-Belt in age.

Metamorphosed Belt rocks in the Anaconda Range and in the northern the Beaverhead Mountains: Quartz-feldspar-biotite gneiss and minor schist. Gneiss is medium gray to tan, micaceous, and well foliated, and contains thin interlayers of dark-gray to black schist. Locally, schist is predominant rock type and consists of dark-gray to black mica schist enclosing thin stringers of quartz and feldspar. These rocks can be traced laterally into unmetamorphosed sedimentary rocks.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yq

Unit Name: Quartzite of Grace Lake (Middle Proterozoic?)

Map Unit Description

Light-gray, tan, and white, slightly feldspathic, medium- to coarse-grained, thick- to thin-bedded quartzite. Contains a distinctive quartz-pebble to quartz-cobble conglomerate, as much as 5 m thick, in middle part. Unconformably overlies conglomerate (Ycg). Maximum thickness 300 m. Quartzite is best exposed at Grace Lake, located 1.5 km south of Black Lion Mountain.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ycg

Unit Name: Conglomerate (Middle Proterozoic?)

Map Unit Description

Light- to medium-gray, matrix-supported pebble conglomerate, pebbly quartzite, and poorly sorted, argillaceous quartzite and sandstone grit. Most of unit is very similar to parts of LaHood Formation of Belt Supergroup in Highland Mountains to the east. Zen (1988) named this unit Black Lion Conglomerate and inferred a Cambrian age.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ysc

Unit Name: Quartzite, siltite, and argillite of Swamp Creek (Middle Proterozoic)

Map Unit Description

White, yellowish-white, and pinkish-white, medium- to coarse-grained, weakly feldspathic, evenly parallel-laminated to cross-bedded quartzite common in the upper 20 m of the section. Quartzite is underlain by, and locally interbedded with, yellow-tan to greenish-tan, parallel to cross-laminated argillaceous sandstone and siltstone, minor laminated argillite, and rare brownish-gray limestone. Base not exposed. Equivalent to the sequence of Swamp Creek of Zen (1988) and to Belt Supergroup rocks of Frazer and Waldrop (1972) exposed 3-5 km directly south of Wise River. Upper quartzite is similar to quartzite of Grace Lake, and underlying argillaceous rocks are similar to the laminated Greyson Shale in Highland Mountains to the east. Maximum exposed thickness near 50 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ysg

Unit Name: Quartzite of Queener Mountain and Greyson Shale (Middle Proterozoic)

Map Unit Description

Greyson Shale rocks in the Anaconda Range and in the northern Beaverhead Mountains: Quartzite is equivalent to Spokane Formation in Highland Mountains to the east.

Quartzite of Queener Mountain-Light-gray to white, fine- to medium-grained quartzite interlayered with minor dark-gray argillite and siltite. Quartzite grades upward into dark-gray argillite interlayered with minor dark-gray, fine-grained quartzite, and local, thin beds of clean, white, medium- to coarse-grained quartzite. Thickness is nearly 600 m. Quartzite is best exposed at Queener Mountain at the head of Seymour Creek, directly north of the quadrangle boundary. Unit is stratigraphically equivalent to Spokane Formation of Ravalli Group in Helena embayment of Belt Basin. It was mapped as Ravalli Formation by Emmons and Calkins (1913); however, Elliot and others (1985) included this unit in Missoula Group rocks.

Greyson Shale-Dark-gray to dark-greenish-gray, well-laminated argillite and silty argillite. Beds, generally less than 5 cm thick, commonly contain uneven, parallel lamellae of white to tan, very fine grained sandstone and siltstone. Contains thin, dark-gray quartzite lenses in the upper part. Thickness in excess of 1,000 m. Unit is stratigraphically equivalent and lithologically similar to Greyson Shale of the Helena embayment of the Belt basin. Unit was mapped as the Prichard Formation by Emmons and Calkins (1913) and included with Missoula Group rocks by Elliot and others (1985).

Spokane and Greyson Formation rocks in the Highland Mountains and in the northern Tobacco Root Mountains: (Unit named "Spokane and Greyson Formations (Middle Proterozoic)", but has same map label.) Spokane Formation consists of grayish-tan to tan, structureless to laminated and commonly cross-bedded, argillaceous siltite and minor dark-grayish-green silty argillite interlayered with 0.2- to 1-cm-thick, discontinuous, very fine grained sandy lenses. Conspicuous white to pinkish-white, fine- to coarse-grained, grain-supported quartzite beds 1-2 m thick are common in upper part of formation and are thickest and most abundant in central part of Highland Mountains.

Greyson Formation, underlying the Spokane, is thickest in central part of Highland Mountains, and consists of an upper dark-gray to black, laminated and platy to massive argillite and silty argillite that contains numerous soft-sediment slump structures. Basal part consists of light- to dark-gray silty argillite and argillaceous siltite having uneven to even parallel laminations and locally interlayered with tan, discontinuous silty lenses, commonly less than 1 cm thick; these basal siltite beds locally are interlayered with 0.2- to 0.5-m-thick, laterally discontinuous beds of matrix-supported quartzite composed of well-rounded grains, and locally dense, tan to white, cross-bedded quartzite. Thickness of combined formations ranges from less than 400 m in the west to more than 900 m in central part of Highland Mountains.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yhe

Unit Name: Helena and Empire Formations (Middle Proterozoic)

Map Unit Description

Helena and Empire Formation rocks in the Highland Mountains and in the northern Tobacco Root Mountains: Helena and Empire Formations are thickest in central part of Highland Mountains, pinch out to the west, and thin to the east. The Empire generally underlies the Helena, but the formations are locally complexly interlayered and grade laterally into one another. Helena Formation typically consists of tan, pinkish-gray to grayish-green, laminated to thin-bedded, calcareous, and commonly vuggy siltite; locally shows water-expulsion features, mud cracks, and very finely laminated, upwardly convex pods that may be algal mounds. In central part of range, upper part of the Helena consists of calcareous siltite and argillite that locally show well-developed water-expulsion structures and rip-up conglomerate lenses; lower part consists of upward-fining cycles of very fine grained sandstone showing wavy parallel lamination overlain by argillaceous siltite interlayered with very fine grained sandstone lenses. Empire Formation consists of dark-gray to black, very fine grained, argillaceous siltite containing elongate pods of tan, silty limestone that is locally interlayered with thick-bedded, purplish-gray siltstone. Maximum thickness of unit about 350 m.

Helena and Empire Formation rocks in the Anaconda Range and in the northern Beaverhead Mountains: Helena Formation consists of dark- to medium-gray, laminated, locally silty, calcareous argillite, argillaceous limestone, and dolomite. Bedding is uneven, wavy, and laterally discontinuous. In eastern part of range, basal part of the Helena locally contains abundant interbeds of fine- to medium-grained, gray to tan quartzite. Underlying Empire Formation consists of dark-gray to black, calcareous siltite containing irregular pods of white to light-gray limestone. Combined thickness of these formations exceeds 1,000 m.

Middle Belt carbonate rocks appear to be present beneath rocks of Medicine Lodge thrust plate in Beaverhead Mountains north of Salmon, Idaho. Exposures directly north of North Fork consist of alternating sequences of calc-silicate rock, characterized by a basal upward-fining, fine-grained and laminated sandstone, 0.1 to about 2 m or more in thickness, capped by 0.1- to 1-m thick units of calcareous mud, silt, and sand in beds about 1 cm thick. The calcareous deposits are metamorphosed, are medium to dark green, and contain abundant porphyroblasts of actinolite-tremolite. In a few places the calcareous units become very thinly laminated. These calc-silicate units are interlayered with laminated to cross-bedded tan quartzites. Pinch-and-swell, centimeter-thick couplets of tan sand and brown to dark-gray argillite are common in upper part of sequence. These rocks, originally mapped as Yellowjacket Formation by Lopez (1982b), resemble the lower Yellowjacket Formation at its type locality at Yellowjacket Creek as well as similar exposures at Hayden Creek, where the unit exceeds 1,600 m (Lopez, 1981, p. 16-24). The cyclical clastic to carbonate cycles present in these rocks are also similar to sedimentary cycles of Wallace Formation of middle Belt carbonate to the north in Montana (D. Winston, personal commun., 1990) and are here tentatively correlated with these rocks rather than with the Yellowjacket. Rocks exposed directly south of Lost Trail Pass consist of at least three south-southwest-dipping rock units. Upper part of upright section consists mainly of cyclical deposits of clastic to calc-silicate rocks similar to those rocks to the south. These rocks are underlain by laminated, light-colored quartzite, very poorly exposed only on the

Geologic map unit descriptions

east along Continental Divide, which in turn overlie thinly laminated siltite-argillite. The calc-silicate rocks are correlated with rocks directly to the south; these rocks were originally mapped as the Wallace Formation by Desmarais (1983). The underlying quartzite and laminated siltite-argillite are similar in sequence and lithology to the lower Belt quartzite and underlying siltite-argillite beneath the Helena Formation in the Anaconda Range (Ysg). Thickness of these units is not known.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ynl

Unit Name: Newland and LaHood Formations (Middle Proterozoic)

Map Unit Description

The Newland Formation consists of dark-gray to pinkish-gray argillite, silty argillite, and minor marl. Thin, discontinuous lenses of finely crystalline to medium-crystalline, medium-gray limestone are present in the upper part. The argillaceous rocks show a distinctive blocky bedding character: nonlaminated, structureless beds, 1-3 cm thick, of argillite are separated by ruler-straight, single to multiple lamellae of tan silt and very fine grained sandstone. Outcrops and float from the Newland are characterized by tabular, centimeter-thick beds having extremely planar parting surfaces. The Newland is everywhere underlain by a mappable sequence of argillite, siltite, and minor sandstone that lacks both the tabular, blocky beds of the Newland and the argillaceous grit found only in underlying LaHood Formation. The LaHood Formation consists of coarse sedimentary conglomerate and breccia; in Highland Mountains, cobble to boulder conglomerate grades laterally into quartz-pebble conglomerate, into coarse, argillaceous, lithic grit, and into arkose. The arkose grades into interlayered shale, siltstone, sandstone, and subordinate pebble conglomerate and argillaceous grit. Newland and LaHood Formations, like the overlying units, are thinnest on the west-less than about 700 m-and thickest in central part of Highland Mountains, more than 1,500 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ytm

Unit Name: Quartzite of Table Mountain (Middle Proterozoic)

Map Unit Description

Quartzite, siltite, and argillite present only in Highland Mountains. Upper part of unit consists of massive white quartzite beds separated by 1- to 5-m-thick, upward-fining sequences of intraformational conglomerate, sandstone, siltstone, and argillite. Lower part consists of about 250 m of quartzite that is overlain by interbedded clean to argillaceous quartzite, siltite, and argillite. Basal contact is gradational into LaHood pebble and cobble conglomerate and sandstone; unit thins and pinches out to the west and is locally interlayered with Newland Formation on the east. Maximum thickness is more than 500 m.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Yd

Unit Name: Diabase (Middle Proterozoic)

Map Unit Description

Dark-greenish-gray to black, fine- to medium-grained diabase dikes. Most dikes were intruded along pre-existing, northwest-trending faults in pre-Belt crystalline rocks between 1.4 and 1.1 Ga (Wooden and others, 1978).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Xga

Unit Name: Gneiss and amphibolite (Early Proterozoic)

Map Unit Description

Light-colored, medium- to coarse-grained, generally equigranular microcline-plagioclase gneiss interlayered with dark-gray to black, fine-grained amphibolite, minor migmatitic and augen gneiss, and rare garnet-bearing calc-silicate schist and fine-grained calc-silicate gneiss. Exposed on north flank of Sheep Mountain. Age about 1.8-1.6 Ga (Arth and others, 1986; Zen, 1988).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Xmb

Unit Name: Mylonitic biotite gneiss (Early Proterozoic)

Map Unit Description

Dark-gray, medium- to coarse-grained, biotite-rich gneiss. Contains wispy lenses, seams, and augen of quartz and feldspar. In part, rock is very similar in composition and texture to mylonitic biotite gneiss (X(A)m) in Highland Mountains. Locally cut by numerous quartz-rich pegmatite dikes and large quartz veins. Exposed east of Bloody Dick Creek. Age about 1.8 Ga (R.E. Zartman, oral commun., 1987).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Xg

Unit Name: Granite, aplite, and pegmatite (Early Proterozoic)

Map Unit Description

Dense swarm of leucocratic, granitic aplite and pegmatite sills and minor dikes, and augen-bearing orthogneiss; interlayered mainly with mylonitic biotite gneiss and quartz-feldspar-biotite gneiss.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Xi

Unit Name: Mylonitic orthogneiss and granite sills (Early Proterozoic)

Map Unit Description

Interlayered granitic to granodioritic, mylonitic orthogneiss and nonfoliated, leucocratic, medium- to coarse-grained granite sills.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: X(A)b

Unit Name: Biotite gneiss (Early Proterozoic and Archean)

Map Unit Description

Dark-gray to black, medium-grained to very coarse grained, strongly folded, garnet-rich biotite gneiss; locally contains abundant thin ptygmatic quartz-feldspar veins.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: X(A)m

Unit Name: Mylonitic biotite gneiss (Early Proterozoic and Archean)

Map Unit Description

Dark-gray to black, medium- to coarse-grained, biotite-rich gneiss and minor schist. Contains conspicuous porphyroclasts of quartz and plagioclase that are commonly anhedral and broken, are sheared and drawn out in plane of foliation, or are augen; locally interlayered with granitic, augen-bearing orthogneiss.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name Dillon 250K

Map Unit Symbol X(A)g

Unit Name Garnetiferous gneiss and schist (Early Proterozoic and Archean)

Map Unit Description

A diverse sequence chiefly composed of garnet-rich gneiss and schist; also contains discontinuous lenses of marble, quartzite, iron-formation, and amphibolite, Ranges in thickness from 0 to 100 m.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: X(A)qf

Unit Name: Quartz-feldspar-biotite gneiss (Early Proterozoic and Archean)

Map Unit Description

Gray to tan, fine- to medium-grained quartz-feldspar-biotite gneiss in which compositional banding defines a distinct, platy foliation; locally interlayered with seams of finely layered mylonitic leucogneiss or sills of fine- to coarse-grained granite.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: X(A)q

Unit Name: Quartzofeldspathic gneiss (Early Proterozoic and Archean)

Map Unit Description

Leucocratic, massive, medium- to coarse-grained, strongly deformed and lineated quartz-feldspar gneiss that contains sparse biotite or muscovite. Locally contains well-developed quartz-feldspar augen ranging in diameter from less than 1 cm to more than 6 cm.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Xau

Unit Name: Ultramafic rocks (Early Proterozoic? and Archean)

Map Unit Description

Black to dark-greenish-brown, coarse-grained rocks present as small lenses and irregularly shaped pods commonly less than 30 m in length or width but locally more than 1.5 km long. Consists of orthopyroxene, olivine, spinel, hornblende, and magnetite; locally partly altered to serpentine and talc (Desmarais, 1981).

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name Dillon 250K

Map Unit Symbol Aqf

Unit Name Quartzofeldspathic gneiss (Archean)

Map Unit Description

Complexly interlayered granitic, tonalitic, quartz-feldspar-biotite and hornblende-plagioclase gneiss (Vitaliano and Cordua, 1979). In Ruby Range the gneiss appears to underlie main metasedimentary succession (James, 1990); in Tobacco Root Mountains the gneiss is complexly interlayered with, and overlies, these metasedimentary rocks. In core of Armstead anticline, unit includes minor metasedimentary rocks (Lowell, 1965). Rb-Sr age determined from these rocks is 2.76 Ga (James and Hedge, 1980).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Aa

Unit Name: Amphibolite (Archean)

Map Unit Description

Dark-gray to greenish-black, medium- to coarse-grained, hornblende-rich gneiss; forms lenses ranging from less than 1 m to more than 500 m in thickness. Rock composed mainly of hornblende and plagioclase.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Aas

Unit Name: Aluminous schist (Archean)

Map Unit Description

Light-colored, coarse-grained quartz-muscovite schist. Subordinate minerals include sillimanite or, locally, kyanite and minor garnet, anthophyllite, and biotite. Aluminous schist is closely associated with quartzite and marble.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Asg

Unit Name: Interlayered schist and gneiss (Archean)

Map Unit Description

Composed mainly of quartz-feldspar-biotite gneiss, granitic gneiss, and amphibolite.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Am

Unit Name: Marble (Archean)

Map Unit Description

Medium-gray to dark-brown, coarsely crystalline, carbonate-rich rocks present as layers that range from less than 1 m to more than 500 m thick. Rock composed mainly of calcite and dolomite, and contains subordinate amounts of quartz, diopside, tremolite, and forsterite.

Map Citation

Ruppel, E.T., O’Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Aq

Unit Name: Quartzite (Archean)

Map Unit Description

White to pinkish-gray, coarse-grained quartzite in lenses less than 2 cm thick to persistent beds 30-100 m thick. Commonly associated with marble and iron-formation. Thickest beds are present in southern Tobacco Root Mountains.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Aif

Unit Name: Iron-formation (Archean)

Map Unit Description

Dark-gray rock consisting of alternate quartz-rich and magnetite-rich layers and lenses. All layers consist of essential magnetite, quartz, orthopyroxene and clinopyroxene, and garnet; individual layers typically 1-2 cm thick, but mappable units are as much as 30 m thick (James, 1981). Commonly associated with quartzite and aluminous schist. Present in southern Tobacco Root Mountains and Ruby Range.

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Dillon_rect

Map Title

Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana

Map name: Dillon 250K

Map Unit Symbol: Ag

Unit Name: Gneissic rocks (Archean)

Map Unit Description

Well-foliated medium- to dark-gray biotite-hornblende-garnet gneiss, migmatite, augen gneiss, and aluminous schist. Structurally lowest sequence in Ruby Range (Karasevich and others, 1981).

Map Citation

Ruppel, E.T., O'Neil, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, 1 sheet., scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qal

Unit Name: Alluvium (Holocene)

Map Unit Description

Silt- to boulder-size, moderately sorted to well-sorted sediments in modern floodplains, including overbank deposits. Larger clasts are moderately rounded to well-rounded. Maximum thickness greater than 5 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qs

Unit Name: Swamp deposits (Holocene)

Map Unit Description

Black to dark-brown organic-rich clay, silt and sand in grassy or willow-covered flat outcrops. Mostly represents eutrophication of shallow lakes.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qcl

Unit Name: Colluvium and loess (Holocene and upper Pleistocene)

Map Unit Description

Unconsolidated to slightly indurated, mostly massive, dark-brown to light-gray-brown deposits that mantle gently to moderately sloping surfaces; sediment types are intermixed by downslope movement. Colluvium contains cobbles and pebbles derived from weathering of bedrock; loess is very fine grained sand, silt, and minor clay. Commonly contains poorly to moderately developed soil profile in upper part. Includes alluvium in small channels and sheetwash on steeper hillsides. Some small areas (as in Tobacco Root Mountains) underlain by till in valleys above about 2,000 m. Unmapped in many areas, particularly where deposit is thin and forms discontinuous veneer. Maximum thickness probably less than 10 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qt

Unit Name: Talus (Holocene and upper Pleistocene?)

Map Unit Description

Angular and subangular cobbles and boulders at base of steep valley walls or cliffs. Boulders generally as large as 2 m, although in places as large as 10 m. Locally includes minor alluvial deposits and rock-glacier deposits. Maximum thickness greater than 20 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ql

Unit Name: Landslide deposits (Holocene and upper Pleistocene)

Map Unit Description

Ranges from chaotically oriented debris to almost intact slump blocks of bedrock. About 10 m to greater than 50 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qr

Unit Name: Rock glacier deposits (Holocene and upper Pleistocene?)

Map Unit Description

Hummocky, lobate deposits of angular boulders having a frontal slope near the angle of repose; locally active. In places, grade into and include some talus (unit Qt). About 20 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qf

Unit Name: Fan deposits (Holocene and upper Pleistocene)

Map Unit Description

Moderately well sorted pebble- to boulder-size gravel in fan-shaped deposits at base of mountain fronts. Includes piedmont-slope deposits and debris-flow deposits

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qfc

Unit Name: Fan deposits of the Cedar Creek alluvial fan (Holocene and upper Pleistocene)

Map Unit Description

Moderately well-sorted cobble and boulder gravel that forms a prominent alluvial fan at mouth of Cedar Creek in Madison Valley. Clasts rounded to subrounded. Surface characterized by braided stream pattern. Locally mantled by loess less than 1 m thick. Fan formed mainly during Pinedale (about 20-14 ka) and Bull Lake (about 140-100 ka) glaciations; deposits of both ages exposed at surface (Ritter and others, 1990); minor proximal fan development during Holocene. Modern channel of Cedar Creek incised about 10 m into fan deposits near mouth of creek, indicating proximal fan deposits presently eroding. As much as 150 m thick. Unit shown separately from other fan deposits due to its prominent size and detailed studies (Ritter and others, 1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qti

Unit Name: Till (upper Pleistocene)

Map Unit Description

Unsorted, unstratified, unconsolidated, subangular to subrounded boulders in an unsorted matrix as fine as silt. Most till deposited during Pinedale (about 20-14 ka) and Bull Lake (about 140-100 ka) glaciations. Pinedale-age till preserved in hummocky deposits that contain numerous closed depressions and have a thin or non-existent soil profile; deposits of Bull Lake-age till have more rounded topography, are more dissected, and generally exhibit a well-developed soil profile. As much as about 50 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qd

Unit Name: Diamicton (upper? Pleistocene)

Map Unit Description

Unsorted, unstratified, nonconsolidated deposit composed of angular to subangular clasts of Archean gneiss as large as 2 m. Believed to be mostly debris-flow deposits, but may include some till and landslide deposits. Mapped only in Jack Creek area. Maximum thickness greater than 20 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qg

Unit Name: Terrace-gravel deposits (upper Pleistocene)

Map Unit Description

Moderately sorted, moderately rounded to well-rounded sand and gravel. Underlies about 12 recognized terrace surfaces in Madison Valley. Bearzi (1987) recognized 11 geomorphic surfaces along Jack Creek. In Madison Valley, east of Madison River, includes all but the highest (and oldest) terrace-gravel deposit, which is shown separately (unit Qgc). West of Madison River in Madison Valley, highest terrace-gravel deposits may correlate with terrace-gravel deposits of the Cameron bench (unit Qgc). Mantled by less than 2 m of loess at most places, although loess on many higher surfaces is thick enough to support cultivation. Mostly less than 10 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Qgc

Unit Name: Terrace-gravel deposits of the Cameron bench (Pleistocene)

Map Unit Description

Moderately sorted, moderately rounded to well-rounded sand and gravel underlying topographically highest (and oldest) terrace deposits in Madison Valley. Formed during Bull Lake glaciation (about 140-100 ka) (Schneider and Ritter, 1987). Mantled by less than 2 m of loess in most places

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: QTbf

Unit Name: Basin-fill deposits (Pleistocene and Pliocene?)

Map Unit Description

Interbedded, moderately sorted, poorly consolidated to unconsolidated, well-bedded to massive silt, sand, and well rounded cobbles that are exposed in slopes adjacent to, and below, terraces in Madison Valley. Exposed basin-fill deposits are interpreted to be no older than Pliocene, although they overlie deeply buried basin-fill deposits, as thick as 4,500 m, that may be as old as Eocene in the Madison Valley (Rasmussen and Fields, 1983)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tht

Unit Name: Huckleberry Ridge Tuff (Pliocene)

Map Unit Description

Light brown to gray, massive welded tuff that contains sparse phenocrysts of sanidine, quartz and plagioclase. Matrix is mostly devitrified glass shards, opaque minerals, and aphanitic minerals. Contains sparse pumice fragments. Lithophysae and vesicles not observed in quadrangle. Forms prominent cap to many ridges and buttes. Age of unit is 2.0 Ma and source is from Yellowstone caldera (Christiansen and Blank, 1972), the northern edge of which is about 30 km south of quadrangle’s southeastern corner. Thickness increases to south and maximum thickness in quadrangle about 50 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ts

Unit Name: Limestone, sandstone, conglomerate, and ash deposits (Miocene)

Map Unit Description

White, light gray, and light-brownish-gray, moderately to well indurated, locally vuggy limestone, limy sandstone, ash-bearing sandstone, pebbly sandstone, and pebble conglomerate. Interlayered ash deposits common, especially is association with limestone. Limestone may be either lacustrine deposits or carbonate paleosols (Hanneman and others, 1991). Mapped along Madison River, east of Ennis Lake, and in Spanish Creek basin. One maximum 40Ar/39Ar age on sanidine from just east of Ennis Lake in Madison Valley (NE 1/4, Sec. 6, R. 1 E., T. 5 S.), is 16.2±0.19 Ma (K.K. Kellogg and S.S. Harlan, unpublished data, 1990). Deposits in Spanish Creek basin undated, but probably Miocene. Maximum thickness greater than 1,000 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tl

Unit Name: Freshwater limestone (Miocene)

Map Unit Description

Light brownish-gray to yellowish-gray, locally vuggy, well-bedded, fine-grained limestone. Similar to thin limestones associated with ash-bearing sediments in unit Ts, although much thicker, so is considered to be Miocene in age; maximum thickness greater than 20 m. Mapped along west side of Madison Valley (Hadley, 1969a, b)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tvd

Unit Name: Diatreme (Oligocene?)

Map Unit Description

Probably basaltic, contains fragments of clay and basalt (Wier, 1982). Intrudes both volcanic rocks and Archean gneiss. One oval outcrop mapped, about 200 m in diameter, just south of Virginia City

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tvv

Unit Name: Andesite and basalt flows (Oligocene and Eocene)

Map Unit Description

Mostly dense to scoriaceous basalt and andesite flows, volcanic agglomerates, sandy tuff, and interbedded basaltic cinder deposits. Flows are black and dark brown and contain small phenocrysts of calcic plagioclase, olivine, augite, opaque minerals, and, in places, potassium feldspar and biotite (Hadley, 1980). At least one silicic (latitic?) plagioclase-phyric flow occurs near base of unit, 4 km southeast of Virginia City. Three localities gave the following potassium-argon (K-Ar) dates: 1) 49.3±2.5 and 51.1±1.9 Ma (biotite) and 51.0±3.8 Ma (plagioclase); this flow is just north of Virginia City and overlies Archean basement, 2) 34.4±3.0 Ma (whole rock), and 3) 32.7±1.4 Ma (whole rock) (Marvin and others, 1974). Unit greater than 200 m thick.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tvr

Unit Name: Rhyolite flows (Oligocene or Eocene)

Map Unit Description

Dark-gray to black aphanitic rhyolite flows north and northwest of Ennis Lake (Kellogg, 1993b; Vitaliano and Cordua, 1979). Cut by many faults; local steep dips. Correlated with volcanic rocks of Virginia City volcanic field

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tvt

Unit Name: Felsic tuff (Eocene)

Map Unit Description

Pale gray to white rhyolitic air-fall ash, tuffaceous sandstone, and sparse gravel lenses. Poorly exposed in most places and occurs locally at base of sequence of volcanic rocks of Virginia City volcanic field. Large areas mapped by Hadley (1969b) as felsic tuff are underlain mostly by chaotic, locally tuffaceous landslide deposits. Thickness as great as about 40 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tg

Unit Name: Volcaniclastic sandstone and gravel deposits (Eocene)

Map Unit Description

Coarse-grained, well bedded, cross-bedded volcaniclastic sandstone, pebbly sandstone, and pebble and cobble conglomerate that in places underlie the rocks of the Virginia City volcanic field (Hadley, 1969b, 1980)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tib

Unit Name: Intrusive basalt dike

Map Unit Description

Intrudes Archean gneiss in southern part of quadrangle (Hadley, 1969b)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tv

Unit Name: Andesite and basalt flows

Map Unit Description

Mapped in Madison Valley in southern part of quadrangle (Hadley, 1969b); may be outlier of volcanic rocks of Virginia City volcanic field

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ti

Unit Name: Dacite porphyry sills and stocks (Eocene)

Map Unit Description

Light- to medium-gray, and brownish-gray, dense, porphyritic dacite. Phenocrysts are euhedral plagioclase, hornblende, and biotite. Petrographically very similar to dacite porphyry of Fan and Lone Mountains, but at least some stocks intrudes Eocene volcanic rocks; other nearby rocks of similar composition intrude Cambrian strata and Archean gneiss. One potassium-argon biotite date of 49.5±1.5 Ma (Chadwick, 1969, p. 160)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tai

Unit Name: Intrusive rocks

Map Unit Description

Dark gray, very fine-grained basalt or andesite intrusive breccia containing sparse, small phenocrysts of plagioclase. Forms two small necks in upper Porcupine Creek, east of Gallatin Valley. Intrudes Eocene volcanic rocks and Archean gneiss. Not included in Absaroka Volcanic Supergroup by Simons and others (1985), but unit probably formed feeder vents for younger rocks of Supergroup

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tam

Unit Name: Mt. Wallace Formation

Map Unit Description

Mapped where proportion of mostly andesitic and basaltic flows predominate over volcaniclastic rocks, as mapped by the U.S. Geological Survey (1972). Compositions similar to those in Sepulcher Formation, described below. Conformably overlies rocks of Sepulcher Formation

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tas

Unit Name: Sepulcher Formation

Map Unit Description

Mafic and intermediate-composition volcaniclastic rocks, flow breccias, and lava flows. Contains sparse beds of light-reddish-brown welded tuffs. Includes the Fortress Mountain and Daly Creek Members (Smedes and Prostka, 1972), and Hyalite Peak Volcanics (Chadwick, 1969; Hiza, 1994). Most of unit composed of dark grayish-brown laharic breccias, volcaniclastic conglomerate, and light- to medium-gray volcaniclastic sandstone. Both laharic deposits (vent facies) and conglomeratic deposits (alluvial facies) are greater than 100 m thick in places, crudely stratified, and well indurated. Laharic deposits composed of unsorted, angular to subrounded volcanic debris containing clasts as large as 3 m across. Both lahars and conglomerates contain much silicified wood, commonly as large trunks as thick as 3 m, in growth positions.

Lavas are mostly medium-gray to dark-gray, fine-grained to sparsely porphyritic pyroxene or olivine-pyroxene andesite and basalt. Flows with compositions as silicic as latite or trachyandesite occur in upper part of section (as on Steamboat Mountain). Proportion of flows appears to increase upward in section.

Basal Daly Creek Member of Sepulcher Formation commonly mapped on basis of lighter color and preponderance of alluvial-facies material. However, except for a gradual increase upward in percentage of flows, no distinct difference was noted between lower and upper parts of Sepulcher Formation

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tc

Unit Name: Basal conglomerate and siltstone (early Eocene)

Map Unit Description

Cobbles and boulders predominantly of Archean rocks, with subordinate clasts of Paleozoic carbonate and Tertiary volcanic rocks, mapped near Garnet Mountain in the northeastern part of quadrangle (McMannis and Chadwick, 1964). Conglomerate is locally overlain by a thin, discontinuous siltstone of late early Eocene age. Not overlain by volcanic rocks in quadrangle, but similar rocks in adjacent areas occur at the base of volcanic sequences of the Absaroka Supergroup

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: TKf

Unit Name: Intrusive felsite (lower Tertiary or Upper Cretaceous)

Map Unit Description

Greenish-gray to pinkish-gray, sparsely porphyritic, massive, siliceous dacite or rhyolite. Most phenocrysts consist of as much as 15 percent white, strongly saussuritized plagioclase crystals as long as 3 mm. Rock commonly stained black by manganese oxide. Mainly forms thin sills, dikes, and irregular pods intruding exclusively Archean rocks. Described by Kellogg (1993b). Unit undated, but shares compositional and textural similarities with both Upper Cretaceous dacite porphyry of Fan and Lone Mountains and Eocene rhyolite and rhyodacite plugs near Norris (Kellogg, 1994, 1995), about 10-15 km north of quadrangle

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: TKg

Unit Name: Gabbro sills (Eocene to Late Cretaceous)

Map Unit Description

Black, medium-grained plagioclase-clinopyroxene gabbro that typically weathers into spheroidal blocks. In places completely weathered into grussy orange-brown soil. Several larger sills contain irregular dikes, as wide as 2 m, of fine-grained pinkish-gray inequigranular clinopyroxene-biotite syenite, in which the clinopyroxene forms conspicuous rods as long as 1 cm. Syenite, in turn, intruded by thin aplitic dikes. Unit crops out near Meadow Village at Big Sky and intrudes Upper and Lower Cretaceous rocks

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kd

Unit Name: Dacite porphyry of Fan and Lone Mountains (Upper Cretaceous)

Map Unit Description

Gray to greenish-gray porphyritic dacite that weathers to a very light gray or tan. Euhedral to subhedral phenocrysts compose 30-50 percent of the rock; phenocrysts, 70-90 percent zoned plagioclase (An25-35) as long as 1 cm, trace to 15 percent green hornblende as long as 6 mm, 0-15 percent biotite as long as 3 mm, and 0-10 percent equant quartz as long as 5 mm. Mafic minerals commonly altered to chlorite and epidote; plagioclase sericitized. Matrix is very fine grained and dense, and contains about 5 percent opaque minerals. Fine-grained chill zone extends inward several centimeters from contacts. Commonly contains mafic autoliths as large as about 0.5 m. Forms sills, some greater than 80 m thick, in two intrusive centers underlying Fan Mountain and Lone Mountain. The sills are thought to form a "Christmas-tree laccolith" complex underlying both mountains (Swanson,1950), although Kellogg (1992) found no evidence for a central "trunk." Late Cretaceous beds dip away from the central peaks at both Fan and Lone Mountains. Intrudes rocks that range in age from Middle Cambrian to Late Cretaceous. Where less than about 20 m thick, unit is indicated on map by a single line. Potassium-argon (K-Ar) and 40Ar/39Ar ages from hornblende are about 68-69 Ma (Tysdal and others, 1986; K.S. Kellogg and S.S. Harlan, unpublished data)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kgd

Unit Name: Granodiorite of Tobacco Root batholith (Late Cretaceous)

Map Unit Description

Gray, coarse-grained, inequigranular to porphyritic, massive hornblende-biotite granodiorite, monzogranite, and monzodiorite (classification of Streckeisen, 1976). Typically contains 50 percent normally zoned oligoclase (An25-An28), 15-25 percent green hornblende, 10-20 percent microcline (slight development of braid perthite) commonly as phenocrysts as long as 3 cm, 0-20 percent quartz, 5 percent biotite, 0-1 percent clinopyroxene cores in some hornblende, trace to 3 percent magnetite, and traces of apatite and conspicuous sphene and zircon; hypidiomorphic texture. Includes minor dark-gray hornblende diorite and granodiorite along border and in satellitic stocks east of main batholith. Weathers light gray, in rounded tors or flat grussy outcrops. K-Ar age of batholith is 71-74 Ma (Vitaliano and Cordua, 1979).

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ks

Unit Name: Sphinx Conglomerate (Upper Cretaceous)

Map Unit Description

Reddish-orange conglomerate with sandstone matrix cemented by calcite and hematite. Contains well-rounded cobbles and boulders derived from Paleozoic and Mesozoic strata shed from thrust plates to west; represents an unroofing sequence, with clasts generally increasing in age upwards (DeCelles and others, 1987). Lower contact is conformable with underlying Livingston Formation. Well exposed only on Sphinx Mountain and The Helmet. Minimum thickness about 610 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kb

Unit Name: Beaverhead Group (Upper Cretaceous)

Map Unit Description

Conglomerate and interbedded limestone containing well-rounded clasts of Archean gneiss and Belt Supergroup quartzite. Mapped by Hadley (1969b) as two separate units (Sphinx Conglomerate and Tertiary gravel) but both units reinterpreted on fossil and stratigraphic evidence as Beaverhead Group rocks of Cretaceous age (J.M. O'Neill, personal commun., 1997)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kl

Unit Name: Livingston Formation, undivided (Upper Cretaceous)

Map Unit Description

Livingston Formation exposed on west side of Madison Range, near Sphinx Mountain, and east of Gallatin River, south of the Spanish Peaks fault. Does not crop out west of Madison Valley. Undivided unit shown only in southeastern part of quadrangle. Description after Tysdal (1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Klu

Unit Name: Upper member

Map Unit Description

Cobble and boulder conglomerate of well-rounded volcanic clasts in matrix of coarse-grained volcaniclastic sandstone; upper part predominantly sandstone. Lower contact is conformable. Thickness as much as 180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Klm

Unit Name: Middle member

Map Unit Description

Brown, maroon, and gray dacite to basalt flows, autoclastic breccia, tuff breccia, and welded tuff; minor interlayered volcaniclastic sandstone. Lower contact is conformable. Thickness estimated 300-450 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kll

Unit Name: Lower member

Map Unit Description

Complexly intertonguing units of dark-green to dark-brown, medium- to coarse-grained, locally pebbly volcaniclastic sandstone, olivine basalt, mudflow breccia, volcaniclastic conglomerate, and mudstone. Conformable with underlying Everts(?) Formation. Thickness ranges from about 60 to 210 m)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ku

Unit Name: Everts Formation, Virgelle Sandstone, Telegraph Creek Formation, Cody Shale, and Frontier Formation, undivided (Upper Cretaceous)

Map Unit Description

May locally include Muddy Sandstone and Thermopolis Shale. Mapped in area of Cretaceous outcrops east of Gallatin River.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kev

Unit Name: Everts Formation and Virgelle Sandstone, undivided (Upper Cretaceous)

Map Unit Description

Everts Formation - Thin- to medium-bedded light-gray to dark-gray, poorly to moderately sorted quartz-rich sandstone; intercalated with thin-bedded, greenish-gray to dark gray mudstone and siltstone. Contains a few thin beds of dense limestone, porcellanite, and coal. About equal quantities of sandstone and finer-grained sedimentary rocks. Does not crop out west of Madison Valley. Conformably overlies Virgelle Sandstone. About 425 m thick.

Virgelle Sandstone - Thin- to thick-bedded, medium- to coarse-grained, light-brown to yellowish-brown, trough-cross-bedded quartz sandstone that forms prominent white-weathering ledges. Conformably overlies Telegraph Creek Formation. Does not crop out west of Madison Valley. About 25-50 m thick.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ktc

Unit Name: Telegraph Creek Formation (Upper Cretaceous)

Map Unit Description

Light-gray to dark-brown, thin- to medium-bedded, feldspathic, calcite-cemented sandstone and interbedded dark-gray siltstone and mudstone. Middle marker sequence is a 20-m thick white tuffaceous siltstone and sandstone. Contains thin flaggy sandstones in lower part. Conformably overlies Cody Shale. Does not crop out west of Madison Valley. Thickness about 200 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kc

Unit Name: Cody Shale (Upper Cretaceous)

Map Unit Description

Upper part consists of thin-bedded black fissile shale that is interbedded with minor amounts of thin-bedded, brown, commonly bioturbated calcareous, fine-grained sandstone. Lower part consists of black, fissile shale and minor siltstone that weathers dark gray. Does not crop out west of Madison Valley. Conformably overlies Frontier Formation. Thickness about 300 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kf

Unit Name: Frontier Formation (Upper Cretaceous)

Map Unit Description

Mostly a sequence of alternating black shale and light-gray to yellowish-tan, thin- to very thick bedded, cross-bedded sandstone. In the Madison Range, sandstone ledges as thick as 3 m; ratio of sandstone to shale about 1:3. Shale is locally carbonaceous or coaly. Shale sequences are as thick as about 20 m and commonly contain equally spaced 5- to 10-cm-thick sandstone beds, spaced 15-20 cm apart. Contains several white porcellanite beds; one prominent porcellanite bed in the Madison Range, about 6 m thick, is about 15 m above base of sequence and displays well-developed ball-and-pillow structures. Conformable with underlying Mowry Shale. Formation thickens greatly to the west; thickness in Madison Range about 140-180 m while that in Gravelly Range is greater than 1,500 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kmo

Unit Name: Mowry Shale (Upper Cretaceous)

Map Unit Description

Mostly brownish-gray and greenish-gray tuffaceous mudstone and shale and, in upper part, contains abundant thin sandstone beds. Lower Vaughn Member consists of conspicuous gray, green, yellow, brown, orange, pink, and cream-colored bentonitic mudstone, porcellanite, siltstone, and minor interbedded quartz sandstone, although strikingly varicolored units missing in northern Madison Range. Poorly exposed in most places. Unconformable with underlying Muddy Formation. Thickness 90-180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kmt

Unit Name: Muddy Sandstone and Thermopolis Shale, undivided (Lower Cretaceous).

Map Unit Description

Muddy Sandstone: Thin- to medium-bedded, medium- to coarse-grained, brown to brownish-gray, poorly to moderately indurated, clayey, ledge-forming, salt-and-pepper sandstone; locally contains mud chips as long as 1 cm. In northern Madison Range, formation typically exposed as upper and lower sandstone sequence with central, poorly exposed shaly sequence. Thickness varies widely; in the northern Madison Range is about 20-45 m thick; further south in the Madison Range it is as great as 107 m (Tysdal, 1990); in the Gravelly Range it is about 15 m thick (Hadley, 1969b, 1980).

Thermopolis Shale: Composed of an upper sequence (three-quarters of the total thickness) that is black to dark-gray, locally carbonaceous fissile shale and poorly indurated, thin-bedded, silty brown sandstone. Lower one-quarter of unit is thin- to medium-bedded, fine-grained white to tan quartzite that contains black shale interbeds; Ripple marks and Liesegang bands are common in sandstone beds. Unconformable contact with underlying Kootenai Formation. Thickness throughout quadrangle about 70-80 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Upper 10-15 m is medium-bedded light-gray, micritic, oolitic limestone that contains abundant gastropod fossils in uppermost part. Middle part is variegated red, purple, yellow, and gray shale, mudstone, siltstone, sandstone, and locally nodular freshwater limestone. Formation typically weathers to a reddish soil. Lower 10-40 m is medium- to coarse-grained gray, well-indurated, ledge-forming salt-and-pepper sandstone that contains a basal chert-pebble conglomerate as thick as 1 m. Lower contact is unconformable. Total thickness in the northern Madison Range is about 90 m (Kellogg, 1992, 1993a); in the Gravelly Range it is as thick as 170 m (Hadley, 1980), and in the southeastern part of the map area it as much as about 130 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: JT_ru

Unit Name: Morrison Formation (Upper Jurassic), Ellis Group (Upper and Middle Jurassic), and Woodside Siltstone and Dinwoody Formation (Lower Triassic), undivided

Map Unit Description

Morrison Formation: Upper 20-30 m is mostly black and locally purple shale that contains minor intercalated thin- to medium-bedded, rusty-brown and gray quartz sandstone that is lensoidal in places. The lower, thicker part of the Morrison is composed of thin-bedded, gray, yellow, orange, red, and green shale and siltstone interbedded with lesser amounts of gray quartzite and thin-bedded, brown limestone. Unconformable with underlying unit. About 75-100 m thick.

Ellis Group includes: Swift Sandstone--brown, medium- to coarse-grained glauconitic sandstone, locally containing abundant chert pebbles, and minor olive-green shale; glauconite commonly weathered to orange limonitic clots. More calcareous in eastern part of map area (Tysdal, 1990). Unconformably overlies Rierdon Limestone. Less than 12 m thick.

Rierdon Limestone - Thin- to thick-bedded, yellowish-gray to brownish-gray, fine-grained, oolitic limestone; contains a few limy siltstone interbeds. Bivalves Camptonectes sp. and Gryphaea sp. locally abundant. Forms prominent cliffs near Shell Creek in western Madison Range. Thickness about 8-30 m.

Sawtooth Formation - Interbedded limestone and shale, weathers yellowish-brown, and is very poorly exposed. Sawtooth unconformably overlies Dinwoody Formation. Thickness 25-55 m.

Woodside Siltstone - Brick-red to orange-red, thin-bedded siltstone and mudstone, interbedded with gypsum and scattered thin beds of gray limestone. Mostly poorly exposed, although forms prominent red soil. Thickness increases markedly to southeast; nonexistent north of Porcupine Creek in the Gallatin Range (Simons and others, 1985) and only a "feather edge" may exist in the northernmost Gravelly Range (Hadley, 1980). Unit previously mapped as Chugwater Formation in the southeastern part of the quadrangle (Simons and others, 1985). Thickness 0 to about 220 m (Tysdal, 1990).

Dinwoody Formation - Brown, silty sandstone, siltstone, and thin-bedded brown limestone. Small brachiopods locally abundant. Weathers light yellowish-brown and is poorly exposed. Dinwoody unconformably overlies Shedhorn Sandstone. Thickness ranges between about 20 and 80 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name Ennis 100K

Map Unit Symbol Jm

Unit Name Morrison Formation

Map Unit Description

Upper 20-30 m is mostly black and locally purple shale that contains minor intercalated thin- to medium-bedded, rusty-brown and gray quartz sandstone that is lensoidal in places. The lower, thicker part of the Morrison is composed of thin-bedded, gray, yellow, orange, red, and green shale and siltstone interbedded with lesser amounts of gray quartzite and thin-bedded, brown limestone. Unconformable with underlying unit. About 75-100 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: JT_red

Unit Name: Swift Sandstone, Rierdon Limestone, and Sawtooth Formation of Ellis Group (Upper and Middle Jurassic), Woodside Siltstone (Lower Triassic), and Dinwoody Formation (Lower Triassic), undivided

Map Unit Description

In most places this combined unit is poorly exposed. Total thickness about 185 m.

Swift Sandstone - Brown, medium- to coarse-grained glauconitic sandstone, locally containing abundant chert pebbles, and minor olive-green shale; glauconite commonly weathered to orange limonitic clots. More calcareous in eastern part of map area (Tysdal, 1990). Unconformably overlies Rierdon Limestone. Less than 12 m thick.

Rierdon Limestone - Thin- to thick-bedded, yellowish-gray to brownish-gray, fine-grained, oolitic limestone; contains a few limy siltstone interbeds. Bivalves Camptonectes sp. and Gryphaea sp. locally abundant. Forms prominent cliffs near Shell Creek in western Madison Range. Thickness about 8-30 m.

Sawtooth Formation - interbedded limestone and shale, weathers yellowish-brown, and is very poorly exposed. Sawtooth unconformably overlies Dinwoody Formation. Thickness 25-55 m.

Woodside Siltstone - Brick-red to orange-red, thin-bedded siltstone and mudstone, interbedded with gypsum and scattered thin beds of gray limestone. Mostly poorly exposed, although forms prominent red soil. Thickness increases markedly to southeast; nonexistent north of Porcupine Creek in the Gallatin Range (Simons and others, 1985) and only a "feather edge" may exist in the northernmost Gravelly Range (Hadley, 1980). Unit previously mapped as Chugwater Formation in the southeastern part of the quadrangle (Simons and others, 1985). Thickness 0 to about 220 m (Tysdal, 1990).

Dinwoody Formation - Brown, silty sandstone, siltstone, and thin-bedded brown limestone. Small brachiopods locally abundant. Weathers light yellowish-brown and is poorly exposed. Dinwoody unconformably overlies Shedhorn Sandstone. Thickness ranges between about 20 and 80 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: PMu

Unit Name: Shedhorn Sandstone (Permian), Quadrant Sandstone (Pennsylvanian), and Amsden Group (Lower Pennsylvanian and Upper Mississippian), undivided

Map Unit Description

Mapped in Garnet Mountain quadrangle by McMannis and Chadwick (1964), who used the term Phosphoria Formation instead of Shedhorn Sandstone.

Shedhorn Sandstone - Mostly medium- to massive-bedded, gray, fine- to coarse-grained, very well indurated quartz-rich sandstone that contain white cherty stringers and nodules. Thin, shaly phosphorite beds in middle of formation are rarely exposed. Dolomitic near base. In Gravelly Range, chert is locally massive and filled with voids, so that chert outcrops commonly have a rubbly appearance. Conformably overlies Quadrant Sandstone. Formation about 35-70 m thick, though is about 50 m thick in northern Madison Range.

Quadrant Sandstone - Medium- to thick-bedded, white to yellowish-tan, well-sorted, fine- to medium-grained, dolomite-cemented quartzite; cross-beds common. Lower half and at least upper 15 m of formation contain a few medium-bedded, light-yellowish-tan dolostone beds. Crops out prominently.

Conformable contact with underlying Amsden Group. Thickness about 75 m.

Amsden Group - Varies widely, both in stratigraphy and thickness. In central and southern Madison Range, and in the Gravelly Range east of the Greenhorn Thrust, the unit consists of about 12 to 50 m of brick-red, reddish-brown, and pink calcareous siltstone, silty shale, shale, sandstone, and light-gray limestone and yellowish-gray dolomite. Along western Madison Range, upper part contains medium- to thin-bedded gray to grayish-tan dolostone, locally quartzitic, that grades downward into gray limestone beds (correlated by Kellogg, 1992, with the Middle and Lower Pennsylvanian Devils Pocket Formation and Alaska Bench Limestone of Wardlaw and Pecora, (1985); this sequence overlies maroon siltstone and shale that contain a few thin beds of gray limestone and dolostone (correlated with Lower Pennsylvanian Tyler Formation of Wardlaw and Pecora, 1985). Total thickness of Amsden Group rocks in the western Madison Range is 88 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ps

Unit Name: Shedhorn Sandstone (Lower Permian)

Map Unit Description

Mostly medium- to massive-bedded, gray, fine- to coarse-grained, very well indurated quartz-rich sandstone that contain white cherty stringers and nodules. Thin, shaly phosphorite beds in middle of formation are rarely exposed. Dolomitic near base. In Gravelly Range, chert is locally massive and filled with voids, so that chert outcrops commonly have a rubbly appearance. Conformably overlies Quadrant Sandstone. Formation about 35-70 m thick, though is about 50 m thick in northern Madison Range

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: [PMqa

Unit Name: Quadrant Sandstone (Pennsylvanian), Amsden Group (Lower Pennsylvanian and Upper Mississippian), and Snowcrest Range Group (Upper Mississippian), undivided

Map Unit Description

Quadrant Sandstone - Medium- to thick-bedded, white to yellowish-tan, well-sorted, fine- to medium-grained, dolomite-cemented quartzite; cross-beds common. Lower half and at least upper 15 m of formation contain a few medium-bedded, light-yellowish-tan dolostone beds. Crops out prominently.

Conformable contact with underlying Amsden Group. Thickness about 75 m.

Amsden Group - Varies widely, both in stratigraphy and thickness. In central and southern Madison Range, and in the Gravelly Range east of the Greenhorn Thrust, the unit consists of about 12 to 50 m of brick-red, reddish-brown, and pink calcareous siltstone, silty shale, shale, sandstone, and light-gray limestone and yellowish-gray dolomite. Along western Madison Range, upper part contains medium- to thin-bedded gray to grayish-tan dolostone, locally quartzitic, that grades downward into gray limestone beds (correlated by Kellogg, 1992, with the Middle and Lower Pennsylvanian Devils Pocket Formation and Alaska Bench Limestone of Wardlaw and Pecora, (1985); this sequence overlies maroon siltstone and shale that contain a few thin beds of gray limestone and dolostone (correlated with Lower Pennsylvanian Tyler Formation of Wardlaw and Pecora, 1985). Total thickness of Amsden Group rocks in the western Madison Range is 88 m.

Snowcrest Range Group - Mapped only in western Madison Range (Kellogg, 1992), although rocks of the group may have been either unrecognized elsewhere or placed in the Amsden Group. The upper 57 m of the Snowcrest Range Group (Upper Mississippian Lombard Limestone) is mostly thin- to medium-bedded gray limestone that becomes more dolomitic and shaly toward base. The Lombard overlies the Kibbey Sandstone, which consists of about 75 m of thin- to medium-bedded yellowish-gray to maroon friable dolomitic sandstone, sandy dolostone, and siltstone

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Mbs

Unit Name: Big Snowy Group (Upper Mississippian)

Map Unit Description

Mapped only west of Greenhorn thrust in Gravelly Range (Hadley, 1969b, 1980); upper, thicker part consists of thin- to thick-bedded, pale olive gray, locally very fossiliferous limestone and minor dark-greenish or olive-gray mudstone and shale. Lower 60 m or so consists of red and greenish-gray shale and calcareous sandstone and minor greenish-gray cherty limestone; sandstone and red color increase downward in sequence. Detailed description of the Big Snowy Group is given by Hadley (1980). Total thickness 135-275 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Mm

Unit Name: Madison Group, undivided (Upper and Lower Mississippian)

Map Unit Description

Includes: Mission Canyon Limestone - Medium- to massive-bedded, light-gray, gray, and brownish-gray, medium-crystalline limestone and minor dolostone. Weathers light gray. Chert stringers and nodules common; locally fossiliferous; solution breccias in uppermost part. Prominent ridge-forming unit. Conformable with underlying Lodgepole Limestone. Thickness about 240 m.

Lodgepole Limestone - Thin- to medium-bedded, gray to brownish-gray, finely crystalline limestone that commonly grades into silty limestone interbeds several centimeters thick. Locally cherty; upper half is profusely fossiliferous. Conformable with underlying Three Forks Formation (erroneously described as unconformable above the Three Forks in Kellogg, 1992, 1993a). Thickness about 180 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Mmc

Unit Name: Mission Canyon Limestone (Upper and Lower Mississippian)

Map Unit Description

Medium- to massive-bedded, light-gray, gray, and brownish-gray, medium-crystalline limestone and minor dolostone. Weathers light gray. Chert stringers and nodules common; locally fossiliferous; solution breccias in uppermost part. Prominent ridge-forming unit. Conformable with underlying Lodgepole Limestone. Thickness about 240 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ml

Unit Name: Lodgepole Limestone (Lower Mississippian)

Map Unit Description

Thin- to medium-bedded, gray to brownish-gray, finely crystalline limestone that commonly grades into silty limestone interbeds several centimeters thick. Locally cherty; upper half is profusely fossiliferous. Conformable with underlying Three Forks Formation (erroneously described as unconformable above the Three Forks in Kellogg, 1992, 1993a). Thickness about 180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: MDtj

Unit Name: Three Forks Formation (Mississippian? and Upper Devonian) and Jefferson Dolostone (Upper Devonian), undivided

Map Unit Description

Three Forks formation - Mostly thin-bedded, yellowish-orange to yellowish-tan siltstone and silty limestone containing a few thin interbeds of brick-red-weathering siltstone. Weathers light yellowish tan. Contains a medium-gray, irregularly bedded, approximately 12-m-thick, rough-weathering limestone about 25 m above base of unit (Logan Gulch Member). Formation poorly exposed; forms slopes and swales. Unconformably overlies Jefferson Dolostone. Thickness 40-60 m.

Jefferson Formation - Thin- to thick-bedded, black, brown, dark-gray, and light-gray, petroliferous, medium-crystalline to coarsely crystalline dolostone; colors vary considerably over short stratigraphic intervals. Weathers mostly brown and outcrops are typically knobby and irregular; forms conspicuous brown hoodoos. At least upper 15 m is thick- to massive-bedded, gray dolostone solution breccia (Birdbear Member). Unconformably overlies Bighorn Dolomite(?) in northern Madison Range. Thickness about 110 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: OCrm

Unit Name: Bighorn Dolomite(?) (Ordovician), Red Lion Formation (Upper Cambrian), Pilgrim Formation (Upper Cambrian), and Park Shale (Middle Cambrian), undivided

Map Unit Description

Bighorn Dolomite(?) - Medium-gray, sugary dolostone in 0.2- to 1.0-m-thick beds; weathers very light gray. Tentatively placed in Bighorn Dolomite by Hanson (1952) along ridge in NE 1/4, sec. 22 and NW 1/4, sec. 23, T. 5 S., R. 1 E in northwestern Madison Range; not recognized south of this location. Unconformably overlies Red Lion Formation. Thickness about 3 m at location noted above.

Red Lion Formation - Thin-bedded, medium-gray to tan, siliceous dolostone containing conspicuous orange-tan to reddish-tan, cherty stringers as thick as 2 cm; lower 7 m contains intraformational clasts as large as 5 mm. Along west side of Gallatin Range, contains a lower greenish-gray, locally quartzitic shale sequence as thick as 10 m (Dry

Pilgrim Dolomite - Gray, light-gray, and brownish-gray, medium- to massive-bedded, locally oolitic, medium-crystalline dolostone. Weathers light gray and contains irregularly shaped darker gray mottles. Conformably overlies Park Shale. Forms conspicuous crags. Thicknesses about 30 m in northern Madison Range (Kellogg, 1992), about 60 m in the south-central part of the quadrangle (Tysdal, 1990); as much as 120 m in the Gravelly Range, although is missing along east side of range (Hadley, 1969b), and as much as 75 m in the northern Gallatin Range (McMannis and Chadwick, 1964).

Park Shale - Greenish-gray to tan, fissile shale. Poorly exposed, slope-forming unit conformably overlies Meagher Limestone. Thickness about 30-50 m in the Madison Range and Gravelly Range, although is missing along eastern side of Gravelly Range (Hadley, 1969b); thickness 50-75 m in northern Gallatin Range (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Cu

Unit Name: Red Lion Formation and Pilgrim Dolomite, undivided (Upper Cambrian)

Map Unit Description

Mapped east of Gallatin River and north of Spanish Peaks fault (McMannis and Chadwick, 1964)

Red Lion Formation - Thin-bedded, medium-gray to tan, siliceous dolostone containing conspicuous orange-tan to reddish-tan, cherty stringers as thick as 2 cm; lower 7 m contains intraformational clasts as large as 5 mm. Along west side of Gallatin Range, contains a lower greenish-gray, locally quartzitic shale sequence as thick as 10 m (Dry Creek Shale Member) (McMannis and Chadwick, 1964). Unconformably overlies Pilgrim Formation. Thickness about 40-60 m.

Pilgrim Dolomite - Gray, light-gray, and brownish-gray, medium- to massive-bedded, locally oolitic, medium-crystalline dolostone. Weathers light gray and contains irregularly shaped darker gray mottles. Conformably overlies Park Shale. Forms conspicuous crags. Thicknesses about 30 m in northern Madison Range (Kellogg, 1992), about 60 m in the south-central part of the quadrangle (Tysdal, 1990); as much as 120 m in the Gravelly Range, although is missing along east side of range (Hadley, 1969b), and as much as 75 m in the northern Gallatin Range (McMannis and Chadwick, 1964).

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Crp

Unit Name: Red Lion Formation (Upper Cambrian), Pilgrim Dolomite (Upper Cambrian), and Park Shale (Middle Cambrian), undivided

Map Unit Description

Mapped south of Cedar Creek and east of Madison Valley (Tysdal, 1990; Kellogg, 1992)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Cmi

Unit Name: Park Shale, Meagher Limestone, Wolsey Formation and Flathead Sandstone, undivided (Middle Cambrian)

Map Unit Description

Mapped east of Gallatin River and north of Spanish Peaks fault (McMannis and Chadwick, 1964)

Park Shale - Greenish-gray to tan, fissile shale. Poorly exposed, slope-forming unit conformably overlies Meagher Limestone. Thickness about 30-50 m in the Madison Range and Gravelly Range, although is missing along eastern side of Gravelly Range (Hadley, 1969b); thickness 50-75 m in northern Gallatin Range (McMannis and Chadwick, 1964).

Wolsey Shale - Mostly thin-bedded, greenish-gray, olive-drab, gray, and grayish-brown micaceous sandstone, siltstone, and shale. Sandstone beds are wavy and bioturbated, contain green and gray- and green-mottled shale interbeds, and generally weather brown; animal trails common; locally glauconitic. Near middle of unit is a 10- to 15-m-thick section of thin-bedded, dark-gray, brown-weathering argillaceous limestone interbedded with lesser amount of sandstone and shale. Upper 5 m is interbedded wavy-laminated, thin-bedded, gray limestone and gray, micaceous siltstone. Conformable with underlying Flathead Sandstone. Forms slopes and swales. Thickness 30-65 m.

Flathead Sandstone - Thin- to medium-bedded, medium- to coarse-grained, reddish-brown, tan, and purplish-tan, quartz-rich, feldspathic sandstone; locally weathers to rusty red. Two thin zones of fine-grained, micaceous, greenish-gray argillaceous sandstone near top of formation. Basal part of formation contains rounded pebbles of metamorphic rock. Unconformably overlies Archean crystalline rock. Thickness variable, from 15 to 75 m.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Cm

Unit Name: Meagher Limestone (Middle Cambrian)

Map Unit Description

Thin- to massive-bedded, light-gray to brownish-gray, finely crystalline limestone. Locally oolitic, especially in upper part. Upper 30 m is thin-bedded, gray limestone that contains conspicuous orange mottles; upper few meters contain fissile gray-green shale. Middle 50 m is medium- to massive-bedded limestone, locally mottled tan, and containing small silicic limestone stringers. Lower 30 m is thin- to medium-bedded, tan-mottled, gray limestone that contains a few intercalated micaceous shale beds in lower part. Forms cliffs. Conformably overlies Wolsey Shale. About 100-150 m thick in the Madison Range (Tysdal, 1990; Kellogg, 1992), 100-110 m thick in the Gravelly Range (Hadley, 1980), but only about 50 m thick in northern Gallatin Range (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Cwf

Unit Name: Wolsey Shale and Flathead Sandstone, undivided (Middle Cambrian).

Map Unit Description

Wolsey Shale-Mostly thin-bedded, greenish-gray, olive-drab, gray, and grayish-brown micaceous sandstone, siltstone, and shale. Sandstone beds are wavy and bioturbated, contain green and gray- and green-mottled shale interbeds, and generally weather brown; animal trails common; locally glauconitic. Near middle of unit is a 10- to 15-m-thick section of thin-bedded, dark-gray, brown-weathering argillaceous limestone interbedded with lesser amount of sandstone and shale. Upper 5 m is interbedded wavy-laminated, thin-bedded, gray limestone and gray, micaceous siltstone. Conformable with underlying Flathead Sandstone. Forms slopes and swales. Thickness 30-65 m.

Flathead Sandstone-Thin- to medium-bedded, medium- to coarse-grained, reddish-brown, tan, and purplish-tan, quartz-rich, feldspathic sandstone; locally weathers to rusty red. Two thin zones of fine-grained, micaceous, greenish-gray argillaceous sandstone near top of formation. Basal part of formation contains rounded pebbles of metamorphic rock. Unconformably overlies Archean crystalline rock. Thickness variable, from 15 to 75 m

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_di

Unit Name: Diabase dike (Proterozoic)

Map Unit Description

Black to dark-greenish-gray, fine- to medium-grained, equigranular, well-indurated diabase in steep, northwest-striking dikes as wide as 30 m (most are considerably thinner). Contains about 30-50 percent euhedral labradorite, 30-60 percent augite, 0-30 percent hornblende (inverted from augite), 0-10 percent potassium feldspar, 5-8 percent opaque minerals, 1-3 percent apatite, 0-5 percent biotite, 0-3 percent quartz, and from trace to 1 percent epidote. Emplaced during two periods: 1455 Ma and 750-780 Ma (Harlan and others, 1990).

Low-grade metamorphic rocks of the Ruby Creek area, eastern Gravelly Range (Proterozoic or Archean):
Metamorphic grade of rocks in this area is as low as chlorite facies (quartz-albite-epidote-biotite subfacies of Turner and Verhoogen, 1960), but increases in grade southward to almandine-amphibolite facies. The Ruby Creek assemblage is bounded on the north by a north-dipping thrust, which places marble in the hanging wall above the lower grade rocks of the Ruby Creek area. The age of the assemblage is unknown, but may be as young as Proterozoic (J.M. O’Neill, personal commun., 1995). The geology for this area is modified from Vargo (1990) and Hadley (1969a,b).

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Amd

Unit Name: Metadiorite

Map Unit Description

Mapped by Hadley (1969a, b) but not described in detail

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Ass

Unit Name: Epidote-actinolite metasediment

Map Unit Description

Green metamorphosed fine-grained clastic sedimentary rocks, locally showing good cross-bedding and graded beds. Contains quartz, plagioclase, actinolite, and epidote. Weathers to blocky outcrops

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Abs

Unit Name: Biotite-chlorite schist

Map Unit Description

Dark brown-gray to black, well-foliated schist containing quartz, plagioclase, biotite, chlorite, magnetite, and muscovite; porphyroblasts of plagioclase abundant

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Aph

Unit Name: Phyllite

Map Unit Description

Greenish-gray, greenish-red, gray-red, and dark gray phyllite containing quartz, biotite, chlorite, muscovite, hematite, magnetite, and rare garnet. Contains thin layers of micaceous and actinolite-bearing quartzite and lenticular amphibolite bodies (not shown)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Ams

Unit Name: Mylonitic schist

Map Unit Description

Well foliated chlorite-actinolite schist that contains abundant shear-bounded bodies of metagabbro, metadiorite, and amphibolite. Interpreted as sheared amphibolite (J.M. O’Neill, personal commun., 1995) and may be approximately equivalent to biotite chlorite schist (unit P_Abs). Includes a thin staurolite-sillimanite mylonite that bounds southern contact of unit

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Abg

Unit Name: Biotite gneiss, quartzite, and hornblende gneiss

Map Unit Description

Approximately as mapped by Hadley (1969b); part of quartz-feldspar gneiss and pegmatite unit of Vargo (1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Agg

Unit Name: Granite, migmatite,pegmatite, and granitic orthogneiss

Map Unit Description

Approximately as mapped by Hadley (1969b), who did not describe unit in detail. Not known if unit is intrusive into adjacent units or forms older basement

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: P_Aif

Unit Name: Iron-formation

Map Unit Description

Alternating layers, typically 2-10 cm thick, of reddish-brown to black magnetite-quartz and quartzite. Contains minor hydrobiotite and magnetite locally oxidized to hematite and goethite. Layers commonly tightly folded

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Agp

Unit Name: Granite porphyry of Hellroaring Creek

Map Unit Description

Pink, coarse-grained, massive to slightly foliated biotite monzogranite porphyry. Contains about 20 percent conspicuous euhedral to subhedral potassium-feldspar phenocrysts as long as 1.5 cm; matrix contains about 30 percent quartz, 35 percent plagioclase, 15 percent potassium feldspar, and about 20 percent biotite. Locally sheared, forming well-developed pinkish-gray augen gneiss, as on Indian Ridge in Spanish Peaks.

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Agg

Unit Name: Granitic orthogneiss

Map Unit Description

Light-gray to light pinkish gray, generally tan-weathering, medium-grained, hypidiomorphic, weakly to moderately foliated orthogneiss generally ranging in composition from tonalite to monzogranite. Mafic mineral almost exclusively biotite (trace to 15 percent); may contain as much as 5 percent almandine and, rarely, 5 percent hornblende, 2 percent augite, and 2 percent muscovite; also contains traces of zircon, epidote, allanite, and opaque minerals. One unusual occurrence is a pluton near Summit Lake in the Spanish Peaks, the pluton is a discordant body composed of massive to weakly foliated, very-light-gray biotite tonalite

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Amb

Unit Name: Metabasite intrusive

Map Unit Description

Black (commonly speckled with white feldspar and pink garnet), fine-grained, equigranular, granoblastic, weakly foliated to massive hornblende-augite-almandine metabasite. Composition variable; contains 15-45 percent plagioclase (mostly andesine), 10-60 percent yellowish-green to brown hornblende, 2-20 percent augite, 0-20 percent almandine, 0-5 percent reddish-brown biotite, 1-3 percent opaque minerals, and trace of apatite. In some places relict porphyritic texture is preserved as white clusters of fine-grained plagioclase as long as 1 cm. Mostly occurs as sills as wide as about 40 m concordant to foliation; in some places sills show pinch-and-swell structure and boudinage. Commonly enveloped in medium-grained amphibolite margin as wide as 10 m, indicating post-emplacement metasomatism at amphibolite grade. Equivalent to orthoamphibolite of Vitaliano and Cordua (1979) in Tobacco Root Mountains

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Agb

Unit Name: Metagabbro

Map Unit Description

Dark gray, medium-grained, inequigranular, massive gabbro. Typically contains about 40 percent calcic plagioclase, 30-40 percent augite, 10-15 percent hornblende, 2-5 percent biotite, and 1-2 percent opaque minerals

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ags

Unit Name: Hornblende-biotite granodiorite orthogneiss of Summit Lake

Map Unit Description

Light- to medium-gray, medium-grained, hypidiomorphic, poorly to well foliated hornblende-biotite granodiorite orthogneiss. Contains 30-40 percent plagioclase, 10-20 percent potassium-feldspar, 15-25 percent quartz, 10-20 percent hornblende, and about 10 percent biotite. Most rock is highly strained, forming well-developed foliation; in such places, mafic minerals are concentrated in ribbony layers 2-5 mm thick. Contains numerous, thin (3-10 mm) K-feldspar-quartz migmatitic layers. Cut by at least three periods of sill and dike intrusion; sills and dikes locally so closely spaced that they form an agmatite. Cut by granitic orthogneiss of Summit Lake pluton

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aum

Unit Name: Meta-ultramafic rocks

Map Unit Description

Black to dark-greenish-gray, fine- to medium-grained, well foliated to massive, variably serpentinized ultramafic rocks of wide-ranging composition; includes olivine websterite, lherzolite, and olivine clinopyroxenite. Accessory minerals include olive-green spinel, magnetite, and apatite. Commonly contains secondary amphibole (anthophyllite or actinolite) serpentine, talc, dolomite, magnesite, and (or) mica. Occurs in lenses, pods, and small irregularly shaped masses, rarely more than 10 m in diameter. Probably tectonically incorporated into country rock

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aqf

Unit Name: Quartzofeldspathic gneiss

Map Unit Description

Mapped where rocks are heterogeneous, generally layered, light- to medium-gray microcline-plagioclase-quartz-biotite gneiss. Commonly migmatitic and blastomylonitic. Some areas not mapped in detail, such as south of Sphinx Mountain in the Madison Range and east of the Gallatin River in the Gallatin Range, which may contain many of the other gneissic rock units

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Agn

Unit Name: Garnetiferous gneiss of the Tobacco Root Mountains

Map Unit Description

Includes biotite-garnet schist, sillimanite-garnet schist, garnetiferous quartzite, quartzite, highly garnetiferous quartzofeldspathic gneiss, corundum gneiss, gedrite schist, cummingtonite schist, and garnetiferous amphibolite (Vitaliano and Cordua, 1979). May represent refractory component ("restite") after removal of partial melts

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aam

Unit Name: Hornblende-plagioclase gneiss and amphibolite

Map Unit Description

Most is gray to black, medium-grained, hypidiomorphic equigranular, moderately-foliated to well-foliated hornblende-plagioclase gneiss and amphibolite; contains as much as 5 percent quartz and traces of zircon, opaque minerals, and apatite; locally garnetiferous. Plagioclase typically An30 and weathers white. Commonly contains white, migmatitic leucosomes of anorthosite as thick as 10 cm. Similar unit in Tobacco Root Mountains interpreted to be either metamorphosed clay-rich dolomite or mafic-extrusive origin (Vitaliano and Cordua, 1979). Amphibolite envelopes around some metabasite intrusive bodies indicate at least some amphibolite was derived from intrusive rocks. Unit may include minor amounts of other Archean units

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Abs

Unit Name: Biotite schist

Map Unit Description

Black, dark gray, and gray, fine to medium grained biotite-plagioclase-quartz-±hornblende-±microcline schist. Interpreted to be sheared mafic rock that equilibrated at lower amphibolite facies; not studied in detail. Crops out in the Gallatin Canyon-Hellroaring Lake (Spanish Peaks) area

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Agd

Unit Name: Gedrite and Cummingtonite gneiss

Map Unit Description

Cummingtonite gneiss is light gray, medium grained, strongly lineated, and vitreous. Contains as much as 90 percent cummingtonite, and variable amounts of quartz, almandine, muscovite, rutile, and opaque minerals. Grades into metaquartzite. Gedrite gneiss is brown to grayish brown, moderately well foliated gneiss that contains as much as 70 percent clove-brown gedrite, in addition to quartz, plagioclase, ±sillimanite, ±biotite, ±cordierite, and traces of magnetite and rutile. Both rock types occur as small lenses and concordant layers in other Archean rocks

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Abh

Unit Name: Biotite-hornblende gneiss of Beartrap Canyon

Map Unit Description

White, light-gray, dark-gray, and black, medium-grained, well-foliated and well-layered gneiss. Leucosomes contain plagioclase, quartz, biotite, ±potassium feldspar, ±garnet, and a trace of opaque minerals. Melasomes contain biotite, hornblende, plagioclase, quartz, ±garnet, and trace of opaque minerals. Contains rare quartzite layers and sillimanite-bearing gneiss. Commonly migmatitic. Layers typically 1-20 cm thick. Injected by numerous sills of metabasite. Crops out extensively in Bear Trap Canyon of the Madison River. Similar rocks, also mapped as unit Abh, occur at several other less extensive localities

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: At

Unit Name: Mylonite of the Crooked Creek shear zone

Map Unit Description

Light- to medium-gray mottled mylonite with a well-developed L-S tectonite fabric and a fine-grained recrystallized (granoblastic) texture. Composition variable, and ranges from that of quartzofeldspathic gneiss to amphibolite. The mylonite equilibrated at near-peak (lower granulite) metamorphic conditions and forms anastomosing, concordant zones in the northern Madison Range (Kellogg and Mogk, 1991). The margins of the unit are concordant with and grade into relatively unmylonitized gneiss

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aag

Unit Name: Aluminous gneiss and schist

Map Unit Description

Gray to dark-brownish-gray, medium-grained, inequigranular, generally well-foliated, commonly micaceous gneiss and schist containing aluminosilicate (mostly sillimanite and rarer kyanite). Unit contains 5-90 percent anhedral quartz having undulatory extinction, 0-30 percent microcline, 0-35 percent plagioclase, 0-30 percent almandine, 0-20 percent muscovite, trace to 15 percent sillimanite or kyanite, 0-10 percent reddish-brown biotite, 0-2 percent opaque minerals, including graphite, and trace of zircon. Commonly rich in quartz and locally grades into quartzite. Several kyanite prospects are on east side of Gravelly Range, in Sec. 6, T. 8 S., R. 1 W. (Nordstrom, 1947)

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Abm

Unit Name: Biotite-muscovite gneiss

Map Unit Description

Light- to medium-gray, medium-grained, poorly to well foliated quartz-feldspar gneiss that contains abundant thin schistose layers with both biotite and muscovite. Aluminosilicate-bearing lenses are common and one prominent 20-50-m-thick schistose horizon contains as much as 50 percent coarse-grained biotite, about 20 percent quartz, 0-10 percent gedrite, 5 percent plagioclase, 5 percent sillimanite, 3 percent kyanite (as large blue blades), 3 percent garnet, and 3 percent muscovite. Mapped on north side of Hellroaring Creek valley in Spanish Peaks

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aq

Unit Name: Quartzite

Map Unit Description

White, medium- to coarse-grained, inequigranular, moderately foliated to massive quartzite; locally bright green where trace amounts of chromium-bearing mica (fuchsite) present. In most places, unit is composed entirely of anhedral quartz grains having undulatory extinction, but locally contains as much as 30 percent microcline, 20 percent muscovite, 15 percent sillimanite, 10 percent cummingtonite, 8 percent almandine, 2 percent actinolite, and trace of zircon and opaque minerals. Commonly forms prominent ridges, especially in northwestern Madison Range, where the core of a plunging, nearly isoclinal antiform is composed almost entirely of quartzite. Unit is interlayered in most places with mafic amphibolite

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Ama

Unit Name: Marble

Map Unit Description

White, coarse-grained, massive to moderately well foliated dolomitic marble that contains as much as 3 percent quartz grains. Weathers orange- brown. Locally hydrothermally altered to commercial deposits of talc on east side of Gravelly Range. A few thin layers of calcitic marble, containing as much as 30 percent serpentine, mapped in northern Madison Range. Extensive, commercially exploited talc deposits occur in hydrothermally altered zones in large marble body on eastern side of the Gravelly Range

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30' x 60' Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Aif

Unit Name: Iron Formation

Map Unit Description

Alternating layers of reddish-brown to black magnetite-quartz and quartzite, typically 2-10 cm thick. Contains minor hydrobiotite and magnetite locally oxidized to hematite and goethite. Layers commonly tightly folded. Mapped on eastern side of Gravelly Range by Vargo (1990).

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_OF97_851_rect

Map Title

Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana

Map name: Ennis 100K

Map Unit Symbol: Tls

Unit Name: Old landslide deposits (Pliocene and Miocene)

Map Unit Description

Map Citation

Kellogg, K.S. and Williams, V.S., 1998, Geologic map of the Ennis 30’ x 60’ Quadrangle, Gallatin and Madison Counties, Montana: U.S. Geological Survey Open-File Report 97-851, 36 p., 1 sheet.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qal

Unit Name: Alluvium (Holocene)

Map Unit Description

Unconsolidated silt-to boulder-size, moderately sorted to well-sorted sediments in modern flood plains, including overbank deposits. Larger clasts are moderately rounded to well rounded. Maximum thickness greater than 5 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qs

Unit Name: Swamp deposits (Holocene)

Map Unit Description

Black to dark-brown, organic-rich clay, silt, and sand in grassy or willow-covered, flat outcops. Mostly represents eutrophication of shallow lakes

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qcl

Unit Name: Colluvium and loess (Holocene and upper Pleistocene)

Map Unit Description

Unconsolidated to slightly indurated, mostly massive, dark-brown to light-gray-brown deposits that mantle gently to moderately sloping surfaces; sediment types are intermixed by downslope movement. Colluvium contains cobbles and pebbles derived from weathering of bedrock; loess is very fine grained sand, silt, and minor clay. Commonly contains poorly to moderately developed soil profile in upper part. Includes alluvium in small channels and sheetwash on steeper hillsides. Some small areas (as in Tobacco Root Mountains) underlain by till in valleys above about 2,000 m elevation. Unmapped in many areas, particularly where deposit is thin and forms discontinuous veneer. Maximum thickness probably less than 10 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qt

Unit Name: Talus deposits (Holocene and upper Pleistocene?)

Map Unit Description

Angular and subangular cobbles and boulders at base of steep valley walls or cliffs. Boulders generally as large as 2 m, although in places as large as 10 m. Locally includes minor alluvial deposits and rock-glacier deposits. Maximum thickness greater than 20 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ql

Unit Name: Landslide deposits (Holocene and upper Pleistocene)

Map Unit Description

Ranges from chaotically oriented debris to almost intact slump blocks of bedrock. About 10 m to greater than 50 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qr

Unit Name: Rock glacier deposits (Holocene and upper Pleistocene?)

Map Unit Description

Hummocky, lobate deposits of angular boulders having a frontal slope near the angle of repose; locally active. In places, grade into and include some talus deposits (unit Qt). About 20 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qf

Unit Name: Fan deposits (Holocene and upper Pleistocene)

Map Unit Description

Moderately well sorted pebble- to boulder-size gravel in fan-shaped deposits at base of mountain fronts. Includes piedmont-slope deposits and debris-flow deposits

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qfc

Unit Name: Fan deposits of the Cedar Creek alluvial fan (Holocene and upper Pleistocene)

Map Unit Description

Moderately well sorted cobble and boulder gravel that forms a prominent alluvial fan at mouth of Cedar Creek in Madison Valley. Clasts rounded to sub-rounded. Surface is characterized by braided stream pattern. Locally mantled by loess less than 1 m thick. Fan formed mainly during Pinedale (about 20–14 ka) and Bull Lake (about 140–100 ka) glaciations; deposits of both ages exposed at surface (Ritter and others, 1990); minor proximal fan development during Holocene. Modern channel of Cedar Creek incised about 10 m into fan deposits near mouth of creek, indicating that proximal fan deposits are presently eroding. As much as 150 m thick. Unit shown separately from other fan deposits due to its prominent size and detailed studies (Ritter and others, 1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qti

Unit Name: Till (upper Pleistocene)

Map Unit Description

Unsorted, un-stratified, unconsolidated, subangular to subrounded boulders in an unsorted matrix as fine as silt. Most till deposited during Pinedale (about 20–14 ka) and Bull Lake (about 140– 100 ka) glaciations. Pinedale-age till preserved in hummocky deposits that contain numerous closed depressions and have a thin or non-existent soil profile; deposits of Bull Lake–age till have more rounded topography, are more dissected, and generally exhibit a well-developed soil profile. As much as about 50 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qd

Unit Name: Diamicton (upper? Pleistocene)

Map Unit Description

Unsorted, unstratified, non-consolidated deposit composed of angular to subangular clasts of Archean gneiss as large as 2 m across. Believed to be mostly debris-flow deposits, but may include some till and landslide deposits. Mapped only in Jack Creek area. Maximum thickness greater than 20 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qg

Unit Name: Terrace-gravel deposits (upper Pleistocene)

Map Unit Description

Moderately sorted, moderately rounded to well-rounded sand and gravel. Underlies about 12 recognized terrace surfaces in Madison Valley. Bearzi (1987) recognized 11 geomorphic surfaces along Jack Creek. In Madison Valley, east of Madison River, includes all but the highest (and oldest) terrace-gravel deposit, which is shown separately (unit Qgc). Mantled by less than 2 m of loess at most places, although loess on many higher surfaces is thick enough to support cultivation. Mostly less than 10 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Qgc

Unit Name: Terrace-gravel deposits of the Cameron bench (Pleistocene)

Map Unit Description

Moderately sorted, moderately rounded to well-rounded sand and gravel underlying topographically highest (and oldest) terrace deposits in Madison Valley. Formed during Bull Lake glaciation (about 140–100 ka) (Schneider and Ritter, 1987). Mantled by less than 2 m of loess in most places

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: QTbf

Unit Name: Basin-fill deposit (Pleistocene and Pliocene?)

Map Unit Description

Interbedded, moderately sorted, poorly consolidated to unconsolidated, well-bedded to massive silt, sand, and well-rounded cobbles that are exposed in slopes adjacent to, and below, terraces in Madison Valley. Exposed basin-fill deposits are interpreted to be no older than Pliocene, although they overlie buried basin-fill deposits, as thick as 4,500 m, that may be as old as Eocene in the Madison Valley (Rasmussen and Fields, 1983)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tht

Unit Name: Huckleberry Ridge Tuff (Pliocene)

Map Unit Description

Light-brown to gray, massive welded tuff that contains sparse phenocrysts of sanidine, quartz, and plagioclase. Matrix is mostly devitrified glass shards, opaque minerals, and aphanitic minerals. Contains sparse pumice fragments. Lithophysae and vesicles not observed in quadrangle. Forms prominent cap to many ridges and buttes. Age of unit is 2.0 Ma, and source is from Yellowstone caldera (Christiansen and Blank, 1972), the northern edge of which is about 30 km south of quadrangle ’s southeastern corner. Thickness increases to south, and maximum thickness in quadrangle is about 50 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tls

Unit Name: Old landslide deposits (Pliocene and Miocene)

Map Unit Description

Mapped at several localities in northern Madison River Valley where significant erosion and dissection has transpired since landslide events (Kellogg, 1992, 1993b)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ts

Unit Name: Limestone, sandstone, conglomerate, and ash deposits (Miocene?)

Map Unit Description

White, light gray, and light-brownish-gray, moderately indurated to well-indurated, locally vuggy limestone, limy sandstone, ash-bearing sandstone, pebbly sandstone, and pebble conglomerate. Interlayered ash deposits are common, especially in association with limestone. Limestone may be either lacustrine deposits or carbonate paleosols (Hanneman and others, 1991). Mapped along Madison River, east of Ennis Lake, and in Spanish Creek basin. One maximum 40Ar/Ar age on sanidine from just east of Ennis Lake in Madison Valley (NE¼, Sec. 6, T. 5 S, R. 1 E.), is 16.2±0.19 Ma (K.K. Kellogg and S.S. Harlan, unpub. data, 1990). Deposits in Spanish Creek basin are undated, but probably Miocene. Maximum thickness greater than 1,000 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tl

Unit Name: Freshwater limestone (Miocene)

Map Unit Description

Light-brownish-gray to yellowish-gray, locally vuggy, well-bedded, fine-grained limestone. Similar to thin limestone beds associated with ash-bearing sediments in unit Ts, although much thicker, so is considered to be Miocene in age; maximum thickness greater than 20 m. Mapped along west side of Madison Valley (Hadley, 1969a,b)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tvd

Unit Name: Volcanic rocks of Virginia City volcanic field, Diatreme (Oligocene?)

Map Unit Description

Probably basaltic, contains fragments of clay and basalt (Wier, 1982). Intrudes both volcanic rocks and Archean gneiss. One oval outcrop mapped, about 200 m in diameter, just south of Virginia City

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tvv

Unit Name: Volcanic rocks of Virginia City volcanic field, Andesite and basalt flows (Oligocene and Eocene)

Map Unit Description

Mostly dense to scoriaceous basalt and andesite flows, volcanic agglomerates, sandy tuff, and interbedded basaltic cinder deposits. Flows are black and dark brown and contain small phenocrysts of calcic plagioclase, olivine, augite, opaque minerals, and, in places, potassium feldspar and biotite (Hadley, 1980). At least one silicic (latitic?) plagioclase-pyrric flow occurs near base of unit, 4 km southeast of Virginia City. Three localities gave the following potassium-argon (K-Ar) dates: (1) 49.3±2.5 and 51.1±1.9 Ma (biotite) and 51.0±3.8 Ma (plagioclase); this flow is just north of Virginia City and overlies Archean basement; (2) 34.4±3.0 Ma (whole rock); and (3) 32.7±1.4 Ma (whole rock) (Marvin and others, 1974). Unit greater than 200 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tvr

Unit Name: Volcanic rocks of Virginia City volcanic field, Rhyolite flows (Oligocene or Eocene)

Map Unit Description

Dark-gray to black aphanitic rhyolite flows north and northwest of Ennis Lake (Kellogg, 1993b; Vitaliano and Cordua, 1979). Cut by many faults; local steep dips. Correlated with volcanic rocks of Virginia City volcanic field

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tvt

Unit Name: Volcanic rocks of Virginia City volcanic field, Felsic tuff (Eocene)

Map Unit Description

Pale-gray to white rhyolitic air-fall ash, tuffaceous sandstone, and sparse gravel lenses. Poorly exposed in most places and occurs locally at base of sequence of volcanic rocks of Virginia City volcanic field. Large areas mapped by Hadley (1969b) as felsic tuff are underlain mostly by chaotic, locally tuffaceous landslide deposits. Thickness as great as about 40 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tg

Unit Name: Volcaniclastic sandstone and gravel deposits (Eocene)

Map Unit Description

Coarse-grained, well-bedded, cross-bedded volcaniclastic sandstone, pebbly sandstone, and pebble and cobble conglomerate that in places underlie the rocks of the Virginia City volcanic field (Hadley, 1969b, 1980)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tv

Unit Name: Volcanic rocks of undetermined affinity, Andesite and basalt flows

Map Unit Description

In Madison Valley in southern part of quadrangle (Hadley, 1969b); may be outlier of volcanic rocks of Virginia City volcanic field

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ti

Unit Name: Dacite porphyry sills and stocks (Eocene)

Map Unit Description

Light- to medium-gray and brownish-gray, dense, porphyritic dacite. Phenocrysts are euhedral plagioclase, hornblende, and biotite. Petrographically very similar to dacite porphyry of Fan and Lone Mountains, but at least some stocks intrudes Eocene volcanic rocks; other nearby rocks of similar composition intrude Cambrian strata and Archean gneiss. One potassium-argon biotite date of 49.5±1.5 Ma (Chadwick, 1969)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tai

Unit Name: Absaroka Volcanic Supergroup (Eocene) Intrusive rocks

Map Unit Description

Dark-gray, very fine grained basalt or andesite intrusive breccia containing sparse, small phenocrysts of plagioclase. Forms two small necks in upper Porcupine Creek, east of Gallatin River Valley. Intrudes Eocene volcanic rocks and Archean gneiss. Not included in Absaroka Volcanic Supergroup by Simons and others (1985), but unit probably formed feeder vents for younger rocks of Supergroup

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tam

Unit Name: Mt. Wallace Formation

Map Unit Description

Shown where proportion of mostly andesitic and basaltic flows predominate over volcaniclastic rocks, as mapped by the U.S. Geological Survey (1972). Compositions similar to those in Sepulcher Formation, described below. Conformably overlies rocks of Sepulcher Formation

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tas

Unit Name: Sepulcher Formation

Map Unit Description

Mafic and intermediate-composition volcaniclastic rocks, flow breccias, and lava flows. Contains sparse beds of light-reddish-brown welded tuffs. Includes Fortress Mountain and Daly Creek Members (Smedes and Prostka, 1972), and Hyalite Peak Volcanics (Chadwick, 1969; Hiza, 1994). Most of unit composed of dark-grayish-brown, laharic breccias, volcaniclastic conglomerate, and light- to medium-gray volcaniclastic sandstone. Both laharic deposits (vent facies) and conglomeratic deposits (alluvial facies) are greater than 100 m thick in places, crudely stratified, and well indurated. Laharic deposits composed of unsorted, angular to subrounded volcanic debris containing clasts as large as 3 m across. Both lahars and conglomerates contain much silicified wood, commonly as large trunks as thick as 3 m, in growth positions. Lavas are mostly medium-gray to dark-gray, fine-grained to sparsely porphyritic pyroxene or olivine-pyroxene andesite and basalt. Flows having compositions as silicic as latite or trachyandesite occur in upper part of section (as on Steamboat Mountain). Proportion of flows appears to increase upward in section. Basal Daly Creek Member of Sepulcher Formation commonly mapped on basis of lighter color and preponderance of alluvial-facies material. However, except for a gradual increase upward in percentage of flows, no distinct difference was noted between lower and upper parts of Sepulcher Formation

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Tc

Unit Name: Basal conglomerate and siltstone (lower Eocene)

Map Unit Description

Cobbles and boulders predominantly of Archean rocks, with subordinate clasts of Paleozoic carbonate and Tertiary volcanic rocks, mapped near Garnet Mountain in northeastern part of quadrangle (McMannis and Chadwick, 1964). Conglomerate is locally overlain by a thin, discontinuous siltstone of late early Eocene age. Not overlain by volcanic rocks in quadrangle, but similar rocks in adjacent areas occur at the base of volcanic sequences of the Absaroka Volcanic Supergroup

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: TKf

Unit Name: Intrusive felsite (lower Tertiary or Upper Cretaceous)

Map Unit Description

Greenish-gray to pinkish-gray, sparsely porphyritic, massive, siliceous dacite or rhyolite. Most phenocrysts consist of as much as 15 percent white, strongly saussurtized plagioclase crystals as long as 3 mm. Rock commonly stained black by manganese oxide. Mainly forms thin sills, dikes, and irregular pods intruding exclusively Archean rocks. Described by Kellogg (1993b). Unit undated, but shares compositional and textural similarities with both Upper Cretaceous dacite porphyry of Fan and Lone Mountains and Eocene rhyolite and rhyodacite plugs near Norris (Kellogg, 1994, 1995), about 10–15 km north of quadrangle

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: TKg

Unit Name: Gabbro sills (Eocene to Late Cretaceous)

Map Unit Description

Black, medium-grained plagioclase-clinopyroxene gabbro that typically weathers into spheroidal blocks. In places completely weathered into grussy orange-brown soil. Several larger sills contain irregular dikes, as wide as 2 m, of fine-grained, pinkish-gray, inequigranular clinopyroxene-biotite syenite, in which the clinopyroxene forms conspicuous rods as long as 1 cm. Syenite, in turn, is intruded by thin aplitic dikes. Unit crops out near Meadow Village at Big Sky and intrudes Upper and Lower Cretaceous rocks

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kd

Unit Name: Dacite porphyry of Fan and Lone Mountains (Late Cretaceous)

Map Unit Description

Gray to greenish-gray porphyritic dacite that weathers to a very light gray or tan. Euhedral to subhedral phenocrysts compose 30–50 percent of the rock; phenocrysts are 70–90 percent zoned plagioclase crystals An25–35) as long as 1 cm, trace to 15 percent green hornblende crystals as long as 6 mm, 0–15 percent biotite flakes as long as 3 mm, and 0–10 percent equant quartz crystals as long as 5 mm. Mafic minerals are com-monly altered to chlorite and epidote; plagioclase is sericitized. Matrix is very fine grained and dense, and contains about 5 percent opaque minerals. Fine-grained chill zone extends inward several centimeters from contacts. Commonly contains mafic autoliths as large as about 0.5 m. Forms sills, some greater than 80 m thick, in two intrusive centers underlying Fan Mountain and Lone Mountain. The sills are thought to form a “Christmas-tree laccolith” complex underlying both mountains (Swanson, 1950), although Kellogg (1992) found no evidence for a central “trunk.” Late Cretaceous beds dip away from the central peaks at both Fan and Lone Mountains. Intrudes rocks that range in age from Middle Cambrian to Late Cretaceous. Where less than about 20 m thick, unit is indicated on map by a single line. Potassium-argon (K-Ar) and Ar/Ar ages from hornblende are about 68–69 Ma (Tysdal and others, 1986; K.S. Kellogg and S.S. Harlan, unpub. data, 1994)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kgd

Unit Name: Granodiorite of Tobacco Root batholith (Late Cretaceous)

Map Unit Description

Gray, coarse-grained, inequigranular to porphyritic, massive hornblende-biotite granodiorite, monzogranite, and monzodiorite (classification of Streckeisen, 1976). Typically contains 50 percent normally zoned oligoclase (An25–An28), 15–25 percent green hornblende, 10–20 percent microcline (slight development of braid perthite) commonly as phenocrysts as long as 3 cm, 0–20 percent quartz, 5 percent biotite, 0–1 percent clinopyroxene cores in some hornblende, trace to 3 percent magnetite, and traces of apatite and conspicuous sphene and zircon; hypidiomorphic texture. Includes minor dark-gray hornblende diorite and granodiorite along border and in satellitic stocks east of main batholith. Weathers light gray, in rounded tors or flat grussy outcrops. K-Ar age of batholith is 71–74 Ma (Vitaliano and Cordua, 1979)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ks

Unit Name: Sphinx Conglomerate (Upper Cretaceous)

Map Unit Description

Reddish-orange conglomerate with sandstone matrix cemented by calcite and hematite. Contains well-rounded cobbles and boulders derived from Paleozoic and Mesozoic strata shed from thrust plates to west; represents an unroofing sequence, the clasts generally increasing in age upwards (DeCelles and others, 1987). Lower contact is conformable with underlying Livingston Formation. Well exposed only on Sphinx Mountain and The Helmet. Minimum thickness about 610 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kb

Unit Name: Beaverhead Group (Upper Cretaceous)

Map Unit Description

Conglomerate and interbedded limestone containing well-rounded clasts of Archean gneiss and Belt Supergroup quartzite. Mapped by Hadley (1969b) in Gravelly Range as two separate units (Sphinx Conglomerate and Tertiary gravel), but both units were reinterpreted on fossil and stratigraphic evidence as Beaverhead Group rocks of Cretaceous age (J.M. O’Neill, oral commun., 1997)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kl

Unit Name: Livingston Formation, undivided (Upper Cretaceous)

Map Unit Description

Livingston Formation exposed on west side of Madison Range, near Sphinx Mountain, and east of Gallatin River, south of the Spanish Peaks fault. Does not crop out west of Madison River valley. Undivided unit shown only in southeastern part of quadrangle. Description after Tysdal (1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Klu

Unit Name: Livingston Formation, Upper member

Map Unit Description

Cobble and boulder conglomerate composed of well- rounded volcanic clasts in matrix of coarse-grained volcaniclastic sandstone; upper part is predominantly sandstone. Lower contact is conformable. Thickness as much as 180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Klm

Unit Name: Livingston Formation, Middle member

Map Unit Description

Brown, maroon, and gray dacite to basalt flows, autoclastic breccia, tuff breccia, and welded tuff; minor interlayered volcaniclastic sandstone. Lower contact is conformable. Thickness estimated 300– 450 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kll

Unit Name: Livingston Formation, Lower member

Map Unit Description

Complexly intertonguing units of dark-green to dark-brown, medium- to coarse-grained, locally pebbly volcaniclastic sandstone, olivine basalt, mudflow breccia, volcaniclastic conglomerate, and mudstone. Conformable with underlying Everts(?) Formation. Thickness ranges from about 60 to 210 m)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ku

Unit Name: Everts Formation, Virgelle Sandstone, Telegraph Creek Formation, Cody Shale, Frontier Formation, and Mowry Shale, undivided (Upper Cretaceous)

Map Unit Description

May locally include Muddy Sandstone and Thermopolis Shale. Mapped in area of Cretaceous outcrops east of Gallatin River

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kev

Unit Name: Everts Formation and Virgelle Sandstone, undivided (Upper Cretaceous)

Map Unit Description

Everts Formation-Thin- to medium-bedded, light-gray to dark-gray, poorly to moderately sorted, quartz-rich sandstone; intercalated with thin-bedded, greenish-gray to dark-gray mudstone and siltstone. Contains a few thin beds of dense limestone, porcellanite, and coal. About equal quantities of sandstone and finer grained sedimentary rocks. Does not crop out west of Madison River valley. Conformably overlies Virgelle Sandstone. About 425 m thick*Virgelle Sandstone-Thin- to thick-bedded, medium- to coarse-grained, light-brown to yellowish-brown, trough-crossbedded quartz sandstone that forms prominent white-weathering ledges. Conformably overlies Telegraph Creek Formation. Does not crop out west of Madison Valley. About 25–50 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ktc

Unit Name: Telegraph Creek Formation (Upper Cretaceous)

Map Unit Description

Light-gray to dark-brown, thin-bedded to medium-bedded, feldspathic, calcite-cemented sandstone and interbedded dark-gray siltstone and mudstone. Middle marker sequence is a 20-m-thick white tuffaceous siltstone and sandstone. Contains thin flaggy sandstone beds in lower part. Conformably overlies Cody Shale. Does not crop out west of Madison River valley. Thickness about 200 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kc

Unit Name: Cody Shale (Upper Cretaceous)

Map Unit Description

Upper part consists of thin-bedded black fissile shale that is interbedded with minor amounts of thin-bedded, brown, commonly bioturbaded calcareous, fine-grained sandstone. Lower part consists of black, fissile shale and minor siltstone that weathers dark gray. Does not crop out west of Madison River valley. Conformably overlies Frontier Formation. Thickness about 300 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kf

Unit Name: Frontier Formation (Upper Cretaceous)

Map Unit Description

Mostly a sequence of alternating black shale and light-gray to yellowish-tan, thin-bedded to very thick bedded, cross-bedded sandstone. In the Madison Range, sandstone ledges are as thick as 3 m; ratio of sandstone to shale is about 1:3. Shale is locally carbonaceous or coaly. Shale sequences are as thick as about 20 m and commonly contain equally spaced 5- to 10-cm-thick sandstone beds, spaced 15–20 cm apart. Contains several white porcellanite beds; one prominent porcellanite bed in the Madison Range, about 6 m thick, is about 15 m above base of sequence and displays well-developed ball-and-pillow structures. Conformable with underlying Mowry Shale. Formation thickens greatly to the west; thickness in Madison Range about 140–180 m while that in Gravelly Range is greater than 1,500 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kmo

Unit Name: Mowry Shale (Upper Cretaceous)

Map Unit Description

Mostly brownish-gray and greenish-gray tuffaceous mudstone and shale and, in upper part, contains abundant thin sandstone beds. Lower Vaughn Member consists of conspicuous gray, green, yellow, brown, orange, pink, and cream-colored bentonitic mudstone, porcellanite, siltstone, and minor interbedded quartz sandstone, although strikingly varicolored units are missing in northern Madison Range. Poorly exposed in most places. Unconformable with under-lying Muddy Formation. Thickness 90–180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kmt

Unit Name: Muddy Sandstone and Thermopolis Shale, undivided (Lower Cretaceous)

Map Unit Description

Muddy Sandstone-Thin- to medium-bedded, medium- to coarse-grained, brown to brownish-gray, poorly to moderately indurated, clayey, ledge-forming salt-and-pepper sandstone; locally contains mud chips as long as 1 cm. In northern Madison Range, formation typically exposed as upper and lower sandstone sequence interrupted by central, poorly exposed shaly sequence. Thickness varies widely; in the northern Madison Range it is about 20–45 m thick; farther south in the Madison Range it is as great as 107 m (Tysdal, 1990); in the Gravelly Range it is about 15 m thick (Hadley, 1969b, 1980)*Thermopolis Shale—Composed of an upper sequence (three-quarters of the total thickness) that is black to dark-gray, locally carbonaceous, fissile shale and poorly indurated, thin-bedded, silty brown sandstone. Lower one-quarter of unit is thin- to medium-bedded, fine-grained, white to tan quartz arenite that contains black shale interbeds; ripple marks and Liesegang bands are common in sandstone beds. Unconformable contact with underlying Kootenai Formation. Thickness throughout quadrangle about 70–80 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Upper 10–15 m is medium-bedded light-gray, micritic, oolitic limestone that contains abundant gastropod fossils in uppermost part. Middle part is variegated red, purple, yellow, and gray shale, mudstone, siltstone, sandstone, and locally nodular freshwater limestone. Formation typically weathers to a reddish soil. Lower 10–40 m is medium- to coarse-grained, gray, well-indurated, ledge-forming salt-and-pepper sandstone that contains a basal chert-pebble conglomerate as thick as 1 m. Lower contact is unconformable. Total thickness in the northern Madison Range is about 90 m (Kellogg, 1992, 1993a); in the Gravelly Range it is as thick as 170 m (Hadley, 1980), and in the southeastern part of the map area it as much as about 130 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: J_u

Unit Name: Morrison Formation (Upper Jurassic), Ellis Group (Upper and Middle Jurassic), and Woodside Siltstone and Dinwoody Formation (Lower Triassic), undivided

Map Unit Description

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Jm

Unit Name: Morrison Formation (Upper Jurassic)

Map Unit Description

Upper 20–30 m is mostly black and locally purple shale that contains minor intercalated thin- to medium-bedded, rusty-brown and gray quartz sandstone that is lensoidal in places. Lower, thicker part of the Morrison is composed of thin-bedded, gray, yellow, orange, red, and green shale and siltstone interbedded with lesser amounts of gray quartz arenite and thin-bedded, brown limestone. Unconformable with underlying unit. About 75–100 m thick

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: J_ed

Unit Name: Swift Sandstone, Rierdon Limestone, and Sawtooth Formation of Ellis Group (Upper and Middle Jurassic), Woodside Siltstone (Lower Triassic), and Dinwoody Formation (Lower Triassic), undivided

Map Unit Description

In most places this combined unit is poorly exposed. Total thickness about 185 m*Swift Sandstone—Brown, medium- to coarse-grained glauconitic sandstone, locally containing abundant chert pebbles, and minor olive-green shale; glauconite commonly weathered to orange limonitic clots. More calcareous in eastern part of map area (Tysdal, 1990). Unconformably overlies Rierdon Limestone. Less than 12 m thick*Rierdon Limestone—Thin- to thick-bedded, yellowish-gray to brownish-gray, fine-grained, oolitic limestone; contains a few limy siltstone interbeds. Bivalves Camptonectes sp. and Gryphaea sp. locally abundant. Forms prominent cliffs near Shell Creek in western Madison Range. Thickness about 8–30 m*Sawtooth Formation—Interbedded limestone and shale; weathers yellowish brown and is very poorly exposed. Sawtooth unconformably overlies Dinwoody Formation. Thickness 25–55 m*Woodside Siltstone—Brick-red to orange-red, thin-bedded siltstone and mudstone, interbedded with gypsum and scattered thin beds of gray lime-stone. Mostly poorly exposed, although forms prominent red soil. Thickness increases markedly to southeast; nonexistent north of Porcupine Creek in Gallatin Range (Simons and others, 1985) and only a “feather edge” may exist in the northernmost Gravelly Range (Hadley, 1980). Unit previously mapped as Chugwater Formation in southeastern part of quadrangle (Simons and others, 1985). Thickness 0 to about 220 m (Tysdal, 1990)*Dinwoody Formation—Brown silty sandstone, siltstone, and thin-bedded, brown limestone. Small brachiopods locally abundant. Weathers light yellowish brown and is poorly exposed. Dinwoody unconformably overlies Shedhorn Sandstone. Thickness ranges between about 20 and 80 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Pmu

Unit Name: Shedhorn Sandstone (Lower Permian), Quadrant Sandstone (Pennsylvanian), and Amsden Group (Lower Pennsylvanian and Upper Mississippian), undivided

Map Unit Description

Mapped in Garnet Mountain quadrangle by McMannis and Chadwick (1964), who used the term “ Phosphoria Formation” instead of “Shedhorn Sandstone.” Units described below

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ps

Unit Name: Shedhorn Sandstone (Lower Permian)

Map Unit Description

Mostly medium- to massive-bedded, gray, fine- to coarse-grained, very well indurated quartz-rich sandstone that contains white cherty stringers and nodules. Thin, shaly phosphorite beds in middle of formation are rarely exposed. Dolomitic near base. In Gravelly Range, chert is locally massive and filled with voids, so that chert outcrops commonly have a rubbly appearance. Conformably overlies Quadrant Sandstone. Formation about 35–70 m thick, though is about 50 m thick in northern Madison Range

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Mqa

Unit Name: Quadrant Sandstone (Pennsylvanian), Amsden Group (Lower Pennsylvanian and Upper Mississippian), and Snowcrest Range Group (Upper Mississippian), undivided

Map Unit Description

Quadrant Sandstone—Medium- to thick-bedded, white to yellowish-tan, well-sorted, fine- to medium-grained, dolomite-cemented quartz arenite; cross-beds common. Lower half and at least upper 15 m of formation contain a few medium-bedded, light-yellowish-tan dolostone beds. Crops out prominently. Conformable contact with underlying Amsden Group. Thickness about 75 m*Amsden Group—Varies widely, both in stratigraphy and thickness. In central and southern Madison Range, and in Gravelly Range east of Greenhorn thrust, unit consists of about 12–50 m of brick-red, reddish-brown, and pink calcareous siltstone, silty shale, shale, sandstone, and light-gray limestone and yellowish-gray dolomite. Along western Madison Range, upper part contains medium- to thin-bedded, gray to grayish-tan dolostone, locally quartzitic, that grades downward into gray limestone beds (correlated by Kellogg, 1992, with Middle and Lower Pennsylvanian Devils Pocket Formation and Alaska Bench Limestone of Wardlaw and Pecora, 1985); this sequence overlies maroon siltstone and shale that contain a few thin beds of gray limestone and dolostone (correlated with Lower Pennsylvanian Tyler Formation of Wardlaw and Pecora, 1985). Total thickness of Amsden Group in western Madison Range is 88 m*Snowcrest Range Group—Mapped only in western Madison Range (Kellogg, 1992), although rocks of the group may have been either unrecognized elsewhere or placed in Amsden Group. Upper 57 m of Snowcrest Range Group (Upper Mississippian Lombard Limestone) is mostly thin- to medium-bedded, gray limestone that becomes more dolomitic and shaly toward base. The Lombard overlies Kibbey Sandstone, which consists of about 75 m of thin-to medium-bedded, yellowish-gray to maroon, friable dolomitic sandstone, sandy dolostone, and siltstone

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Mbs

Unit Name: Big Snowy Group (Upper Mississippian)

Map Unit Description

Mapped only west of Greenhorn thrust in Gravelly Range (Hadley, 1969b, 1980); upper, thicker part consists of thin- to thick-bedded, pale olive gray, locally very fossiliferous limestone and minor dark-greenish or olive-gray mudstone and shale. Lower 60 m or so consists of red and greenish-gray shale and calcareous sandstone and minor greenish-gray cherty limestone; sandstone and red color increase downward in sequence. Detailed description of Big Snowy Group is given by Hadley (1980). Total thickness 135–275 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Mm

Unit Name: Madison Group, undivided (Upper and Lower Mississippian)

Map Unit Description

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Mmc

Unit Name: Mission Canyon Limestone (Upper and Lower Mississippian)

Map Unit Description

Medium- to massive-bedded, light-gray, gray, and brownish-gray, medium-crystalline limestone and minor dolostone. Weathers light gray. Chert stringers and nodules are common; locally fossiliferous; solution breccias in uppermost part. Prominent ridge-forming unit. Conformable with underlying Lodgepole Limestone. Thickness about 240 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ml

Unit Name: Lodgepole Limestone (Lower Mississippian)

Map Unit Description

Thin- to medium-bedded, gray to brownish-gray, finely crystalline limestone that commonly grades into silty limestone interbeds several centimeters thick. Locally cherty; upper half is profusely fossiliferous. Conformable with underlying Three Forks Formation (erroneously described as unconformable above the Three Forks in Kellogg, 1992, 1993a). Thickness about 180 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: MDtj

Unit Name: Three Forks Formation (Lower Mississippian and Upper Devonian) and Jefferson Formation (Upper Devonian), undivided

Map Unit Description

Three Forks Formation-Mostly thin-bedded, yellowish-orange to yellowish-tan siltstone and silty limestone containing a few thin interbeds of brick-red-weathering siltstone. Weathers light yellowish tan. Contains a medium-gray, irregularly bedded, approximately 12-m-thick, rough-weathering limestone about 25 m above base of unit (Logan Gulch Member). Formation poorly exposed; forms slopes and swales. Unconformably overlies Jefferson Formation. Thickness 40–60 m*Jefferson Formation—Thin- to thick-bedded, black, brown, dark-gray, and light-gray, petroliferous, medium-crystalline to coarsely crystalline dolostone; colors vary considerably over short stratigraphic intervals. Weathers mostly brown, and outcrops are typically knobby and irregular; forms conspicuous brown hoodoos. At least upper 15 m is thick- to massive-bedded, gray dolostone solution breccia (Birdbear Member). Unconformably overlies Bighorn Dolomite (?) in northern Madison Range. Thickness about 110 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: O_rm

Unit Name: Bighorn Dolostone(?) (Ordovician), Red Lion Formation (Upper Cambrian), Pilgrim Dolostone (Upper Cambrian), and Park Shale (Middle Cambrian), undivided

Map Unit Description

Bighorn Dolostone(?)-Medium-gray, sugary dolostone in 0.2- to 1.0-m-thick beds; weathers very light gray. Tentatively placed in Bighorn Dolomite by Hanson (1952) along ridge in NE¼, sec. 22 and NW¼, sec. 23, T. 5 S., R. 1 E. in northwestern Madison Range; not recognized south of this location. Unconformably overlies Red Lion Formation. Thickness about 3 m at location noted above*Red Lion Formation—Thin-bedded, medium-gray to tan, siliceous dolostone containing conspicuous orange-tan to reddish-tan, cherty stringers as thick as 2 cm; lower 7 m contains intraformational clasts as large as 5 mm. Along west side of Gallatin Range, contains a lower greenish-gray, locally quartzitic shale sequence as thick as 10 m (Dry Creek Shale Member) (McMannis and Chadwick, 1964). Unconformably overlies Pilgrim Formation. Thickness about 40–60 m*Pilgrim Dolostone—Gray, light-gray, and brownish-gray, medium- to massive-bedded, locally oolitic, medium-crystalline dolostone. Weathers light gray and contains irregularly shaped darker gray mottles. Conformably overlies Park Shale. Forms conspicuous crags. Thicknesses about 30 m in northern Madison Range (Kellogg, 1992), about 60 m in the south-central part of the quadrangle (Tysdal, 1990); as much as 120 m in the Gravelly Range, although is missing along east side of range (Hadley, 1969b), and as much as 75 m in the northern Gallatin Range (McMannis and Chadwick, 1964)*Park Shale—Greenish-gray to tan, fissile shale. Poorly exposed, slope-forming unit conformably overlies Meagher Limestone. Thickness about 30–50 m in Madison Range and Gravelly Range, although is missing along eastern side of Gravelly Range (Hadley, 1969b); thickness 50–75 m in northern Gallatin Range (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _u

Unit Name: Red Lion Formation and Pilgrim Dolostone, undivided (Upper Cambrian)

Map Unit Description

Mapped east of Gallatin River and north of Spanish Peaks fault (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _rp

Unit Name: Red Lion Formation (Upper Cambrian), Pilgrim Dolostone (Upper Cambrian), and Park Shale (Middle Cambrian), undivided

Map Unit Description

Mapped south of Cedar Creek and east of Madison Valley (Tysdal, 1990; Kellogg, 1992)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _mi

Unit Name: Park Shale, Meagher Limestone, Wolsey Formation, and Flathead Sandstone, undivided (Middle Cambrian)

Map Unit Description

Mapped east of Gallatin River and north of Spanish Peaks fault (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _m

Unit Name: Meagher Limestone (Middle Cambrian)

Map Unit Description

Thin- to massive-bedded, light-gray to brownish-gray, finely crystalline limestone. Locally oolitic, especially in upper part. Upper 30 m is thin-bedded, gray limestone that contains conspicuous orange mottles; upper few meters contains fissile gray-green shale. Middle 50 m is medium- to massive-bedded limestone, locally mottled tan, and containing small silicic limestone stringers. Lower 30 m is thin- to medium-bedded, tan-mottled, gray limestone that contains a few inter-calated micaceous shale beds in lower part. Forms cliffs. Conformably overlies Wolsey Shale. About 100– 150 m thick in Madison Range (Tysdal, 1990; Kellogg, 1992), 100– 110 m thick in Gravelly Range (Hadley, 1980), but only about 50 m thick in northern Gallatin Range (McMannis and Chadwick, 1964)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _wf

Unit Name: Wolsey Shale and Flathead Sandstone, undivided (Middle Cambrian)

Map Unit Description

Wolsey Shale-Mostly thin-bedded, greenish-gray, olive-drab, gray, and grayish-brown micaceous sandstone, siltstone, and shale. Sandstone beds are wavy and bioturbated, contain green and gray-and green-mottled shale interbeds, and generally weather brown; animal trails are common; locally glauconitic. Near middle of unit is a 10- to 15-m-thick section of thin-bedded, dark-gray, brown-weathering argillaceous limestone interbedded with lesser amount of sandstone and shale. Upper 5 m is interbedded wavy-laminated, thin-bedded, gray limestone and gray, micaceous siltstone. Conformable with underlying Flathead Sandstone. Forms slopes and swales. Thickness 30–65 m*Flathead Sandstone—Thin- to medium-bedded, medium-to coarse-grained, reddish-brown, tan, and purplish-tan, quartz-rich, feldspathic sandstone; locally weathers to rusty red. Two thin zones of fine-grained, micaceous, greenish-gray argillaceous sandstone near top of formation. Basal part of formation contains rounded pebbles of metamorphic rock. Unconformably overlies Archean crystalline rock. Thickness variable, from 15 to 75 m

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _di

Unit Name: Diabase dike (Proterozoic)

Map Unit Description

Black to dark-greenish-gray, fine- to medium-grained, equigranular, well-indurated diabase in steep, northwest-striking dikes as wide as 30 m (most are considerably thinner). Contains about 30–50 percent euhedral labradorite, 30–60 percent augite, 0–30 percent hornblende (inverted from augite), 0–10 percent potassium feldspar, 5–8 percent opaque minerals, 1–3 percent apatite, 0–5 percent biotite, 0–3 percent quartz, and from trace to 1 percent epidote. Emplaced during two periods: about 1,455 Ma and 750–780 Ma (Harlan and others, 1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Amd

Unit Name: Metadiorite

Map Unit Description

Mapped by Hadley (1969a,b) but not described in detail

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Ass

Unit Name: Epidote-actinolite metasediment

Map Unit Description

Green, metamorphosed, fine-grained clastic sedimentary rocks, locally showing good cross-bedding and graded beds. Contains quartz, plagioclase, actinolite, and epidote. Weathers to blocky outcrops

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Abs

Unit Name: Biotite-chlorite schist

Map Unit Description

Dark-brownish-gray to black, well-foliated schist containing quartz, plagioclase, biotite, chlorite, magnetite, and muscovite; porphyroblasts of plagioclase abundant

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name Ennis I-2690

Map Unit Symbol _Aph

Unit Name Phyllite

Map Unit Description

Greenish-gray, greenish-red, gray-red, and dark-gray phyllite containing quartz, biotite, chlorite, muscovite, hematite, magnetite, and rare garnet. Contains thin layers of micaceous and actinolite-bearing quartzite and lenticular amphibolite bodies (not shown)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Ams

Unit Name: Mylonitic schist

Map Unit Description

Well-foliated chlorite-actinolite schist that contains abundant shear-bounded bodies of metagabbro, metadiorite, and amphibolite. Interpreted as sheared amphibolite (J.M. O’Neill, oral commun., 1995) and may be approximately equivalent to biotite-chlorite schist (unit _Abs). Includes a thin staurolite-sillimanite mylonite that bounds southern contact of unit

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Abg

Unit Name: Biotite gneiss, quartzite, and hornblende gneiss

Map Unit Description

Approximately as mapped by Hadley (1969b); part of quartz-feldspar gneiss and pegmatite unit of Vargo (1990)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Agg

Unit Name: Granite, migmatite, pegmatite, and granitic orthogneiss

Map Unit Description

Approximately as mapped by Hadley (1969b), who did not describe unit in detail. Not known if unit is intrusive into adjacent units or forms older basement

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: _Aif

Unit Name: Iron-formation

Map Unit Description

Alternating layers, typically 2–10 cm thick, of reddish-brown to black magnetite-quartz and quartzite. Contains minor hydro-biotite and magnetite locally oxidized to hematite and goethite. Layers are commonly tightly folded

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Agp

Unit Name: Granite porphyry of Hell Roaring Creek

Map Unit Description

Pink, coarse-grained, massive to slightly foliated biotite monzogranite porphyry. Contains about 20 percent conspicuous euhedral to subhedral potassium-feldspar phenocrysts as long as 1.5 cm; matrix contains about 30 percent quartz, 35 percent plagioclase, 15 percent potassium feldspar, and about 20 percent biotite. Locally sheared, forming well-developed pinkish-gray augen gneiss, as on Indian Ridge in the Spanish Peaks

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Agg

Unit Name: Granitic orthogneiss

Map Unit Description

Light-gray to light pinkish gray, generally tan-weathering, medium-grained, hypidiomorphic, weakly to moderately foliated orthogneiss generally ranging in composition from tonalite to monzogranite. Mafic mineral almost exclusively biotite (trace to 15 percent); may contain as much as 5 percent almandine and, rarely, 5 percent hornblende, 2 percent augite, and 2 percent muscovite; also contains traces of zircon, epidote, allanite, and opaque minerals. One unusual occurrence is a pluton near Summit Lake in the Spanish Peaks; the pluton is a discordant body composed of massive to weakly foliated, very light gray biotite tonalite

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Amb

Unit Name: Metabasite

Map Unit Description

Black (commonly speckled with white feldspar and pink garnet), fine-grained, equigranular, granoblastic, weakly foliated to massive hornblende-augite-almandine metabasite. Composition variable; contains 15–45 percent plagioclase (mostly andesine), 10–60 percent yellowish-green to brown hornblende, 2–20 percent augite, 0–20 percent almandine, 0–5 percent reddish-brown biotite, 1–3 percent opaque minerals, and trace of apatite. In some places relict porphyritic texture is preserved as white clusters of fine-grained plagioclase crystals as long as 1 cm. Mostly occurs as sills as wide as about 40 m concordant to foliation; in some places sills show pinch-and-swell structure and boudinage. Commonly enveloped in medium-grained amphibolite margin as wide as 10 m, indicating post-emplacement metasomatism at amphibolite grade. Equivalent to orthoamphibolite of Vitaliano and Cordua (1979) in Tobacco Root Mountains.

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ags

Unit Name: Hornblende-biotite granodiorite ortho-gneiss of Summit Lake

Map Unit Description

Light- to medium-gray, medium-grained, hypidiomorphic, poorly to well foliated hornblende-biotite granodiorite orthogneiss. Contains 30–40 percent plagioclase, 10–20 percent potassium-feldspar, 15–25 percent quartz, 10–20 percent hornblende, and about 10 percent biotite. Most rock is highly strained, forming well developed foliation; in such places, mafic minerals are concentrated in ribbony layers 2–5 mm thick. Contains numerous, thin (3–10 mm) feldspar-quartz migmatitic layers. Cut by at least three periods of sill and dike intrusion; sills and dikes locally so closely spaced that they form an agmatite. Cut by granitic orthogneiss of Summit Lake pluton

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aum

Unit Name: Meta-ultramafic rocks

Map Unit Description

Black to dark-greenish-gray, fine- to medium-grained, well-foliated to massive, variably serpentinized ultramafic rocks of wide-ranging composition; includes olivine websterite, lherzolite, and olivine clinopyroxenite. Accessory minerals include olive-green spinel, magnetite, and apatite. Commonly contains secondary amphibole (anthophyllite or actinolite) serpentine, talc, dolomite, magnesite, and (or) mica. Occurs in lenses, pods, and small irregularly shaped masses, rarely more than 10 m in diameter. Probably tectonically incorporated into country rock

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aqf

Unit Name: Quartzofeldspathic gneiss

Map Unit Description

Mapped where rocks are heterogeneous, generally layered, light- to medium-gray microcline-plagioclase-quartz-biotite gneiss. Commonly migmatitic and blastomylonitic. Some areas not mapped in detail, such as south of Sphinx Mountain in Madison Range and east of Gallatin River in Gallatin Range, which may contain many of the other gneissic rock units

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Agn

Unit Name: Garnetiferous gneiss of the Tobacco Root Mountains

Map Unit Description

Includes biotite-garnet schist, sillimanite-garnet schist, garnetiferous quartzite, quartzite, highly garnetiferous quartzofeldspathic gneiss, corundum gneiss, gedrite schist, cummingtonite schist, and garnetiferous amphibolite (Vitaliano and Cordua, 1979). May represent refractory component (“restite”) remaining after removal of partial melts

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aam

Unit Name: Hornblende-plagioclase gneiss and amphibolite

Map Unit Description

Most is gray to black, medium-grained, hypidiomorphic equigranular, moderately foliated to well-foliated hornblende-plagioclase gneiss and amphibolite; contains as much as 5 percent quartz and traces of zircon, opaque minerals, and apatite; locally garnetiferous. Plagioclase is typically An30 and weathers white. Commonly contains white, migmatitic leucosomes of anorthosite as thick as 10 cm. Similar unit in Tobacco Root Mountains interpreted to be either metamorphosed, clay-rich dolomite or mafic-extrusive rock (Vitaliano and Cordua, 1979). Amphibolite envelopes around some metabasite intrusive bodies indicate at least some amphibolite was derived from intrusive rocks. Unit may include minor amounts of other Archean units

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Abs

Unit Name: Biotite schist

Map Unit Description

Black, dark-gray, and gray, fine- to medium-grained biotite-plagioclase-quartz, ±hornblende, ±microcline schist. Interpreted to be sheared mafic rock that equilibrated at lower amphibolite facies; not studied in detail. Crops out in Gallatin Canyon–Hell Roaring Lake (Spanish Peaks) area

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Agd

Unit Name: Gedrite and cummingtonite gneiss

Map Unit Description

Cummingtonite gneiss is light gray, medium grained, strongly lineated, and vitreous. Contains as much as 90 percent cummingtonite, and variable amounts of quartz, almandine, muscovite, rutile, and opaque minerals. Grades into metaquartzite. Gedrite gneiss is brown to grayish-brown, moderately well foliated gneiss that contains as much as 70 percent clove-brown gedrite, in addition to quartz, plagioclase, ±sillimanite, ±biotite, ±cordierite, and traces of magnetite and rutile. Both rock types occur as small lenses and concordant layers in other Archean rocks

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Abh

Unit Name: Biotite-hornblende gneiss of Beartrap Canyon

Map Unit Description

White, light-gray, dark-gray, and black, medium-grained, well-foliated and well-layered gneiss. Leucosomes contain plagioclase, quartz, biotite, ± potassium feldspar, ± garnet, and a trace of opaque minerals. Melasomes contain biotite, hornblende, plagioclase, quartz, ± garnet, and trace of opaque minerals. Contains rare quartzite layers and sillimanite-bearing gneiss. Commonly migmatitic. Layers are typically 1–20 cm thick. Injected by numerous sills of metabasite. Crops out extensively in Bear Trap Canyon of Madison River. Similar rocks, also mapped as unit Abh, occur at several other less extensive localities

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: At

Unit Name: Mylonite of the Crooked Creek shear zone

Map Unit Description

Light- to medium-gray, mottled mylonite that has a well-developed L-S tectonite fabric and a fine-grained recrystallized (granoblastic) texture. Composition variable, ranging from that of quartzofeldspathic gneiss to amphibolite. The mylonite equilibrated at near-peak (lower granulite) metamorphic conditions and forms anastomosing, concordant zones in northern Madison Range (Kellogg, 1993a; Kellogg and Mogk, 1991). Margins of unit are concordant with, and grade, into relatively unmylonitized gneiss

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aag

Unit Name: Aluminous gneiss and schist

Map Unit Description

Gray to dark-brownish-gray, medium-grained, inequigranular, generally well foliated, commonly micaceous gneiss and schist containing aluminosilicate (mostly sillimanite and rarer kyanite). Unit contains 5–90 percent anhedral quartz having undulatory extinction, 0–30 percent microcline, 0–35 percent plagioclase, 0–30 percent almandine, 0–20 percent muscovite, trace to 15 percent sillimanite or kyanite, 0–10 percent reddish-brown biotite, 0–2 percent opaque minerals, including graphite, and trace of zircon. Commonly rich in quartz and locally grades into quartzite. Several kyanite prospects are on east side of Gravelly Range, in sec. 6, T. 8 S., R. 1 W. (Nordstrom, 1947)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Abm

Unit Name: Biotite-muscovite gneiss

Map Unit Description

Light- to medium-gray, medium-grained, poorly foliated to well-foliated quartz-feldspar gneiss that contains abundant thin schistose layers containing both biotite and muscovite. Aluminosilicate-bearing lenses are common, and one prominent 20- to 50-m-thick schistose horizon contains as much as 50 percent coarse-grained biotite, about 20 percent quartz, 0–10 percent gedrite, 5 percent plagioclase, 5 percent sillimanite, 3 percent kyanite (as large blue blades), 3 percent garnet, and 3 percent muscovite. Mapped on north side of Hell Roaring Creek valley in Spanish Peaks

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aq

Unit Name: Quartzite

Map Unit Description

White, medium- to course-grained, inequigranular, moderately foliated to massive quartzite; locally bright green where trace amounts of chromium-bearing mica (fuchsite) are present. In most places unit is composed entirely of anhedral quartz grains having undulatory extinction, but locally contains as much as 30 percent microcline, 20 percent muscovite, 15 percent sillimanite, 10 percent cummingtonite, 8 percent almandine, 2 percent actinolite, and trace of zircon and opaque minerals. Commonly forms prominent ridges, especially in northwestern part of Madison Range, where core of a plunging, nearly isoclinal antiform is composed almost entirely of quartzite. Unit is interlayered in most places with mafic amphibolite

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Ama

Unit Name: Marble

Map Unit Description

White, coarse-grained, massive to moderately well foliated dolomitic marble that contains as much as 3 percent quartz grains. Weathers orange-brown. Locally hydrothermally altered to commercial deposits of talc on east side of Gravelly Range. A few thin layers of calcitic marble, containing as much as 30 percent serpentine, mapped in northern part of Madison Range. Extensive, commercially exploited talc deposits occur in hydrothermally altered zones in large marble body on eastern side of Gravelly Range

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): Ennis_I2690_rect

Map Title

Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming

Map name: Ennis I-2690

Map Unit Symbol: Aif

Unit Name: Iron-formation

Map Unit Description

Magnetite-bearing schist and gneiss, grunerite-magnetite schist, and garnet-quartz rock. Mapped in Tobacco Root Mountains (Vitaliano and Cordua, 1979)

Map Citation

Kellogg, K.S. and Williams, V.S., 2000, Geologic map of the Ennis 30’ x 60’ quadrangle, Madison and Gallatin counties, Montana and Park County, Wyoming (version 1.0): U.S. Geological Survey Geologic Investigations Map I-2690, 16 p., 1 sheet, scale 1:100000, http://pubs.usgs.gov/imap/i-2690/.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Qal

Unit Name: Alluvium (Holocene and upper Pleistocene)

Map Unit Description

Sand and gravel deposits locally containing thin lenses of silt. Includes channel and overbank deposits in modern floodplains, as well as alluvial fan and terrace deposits. Unit consists mainly of rounded and subrounded clasts of Belt Supergroup rocks. Thickness 1-10 m

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Qc

Unit Name: Colluvium (Holocene and upper Pleistocene)

Map Unit Description

Locally derived slope deposits consisting of unsorted, angular, gravel-size clasts in a matrix of unsorted sand, silt, and clay. Unit locally includes small areas of till, talus, rock-avalanche, and debris-flow deposits. Commonly 1-5 m thick

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Qls

Unit Name: Landslide deposits (Holocene and upper Pleistocene)

Map Unit Description

Includes large slumps, block slides, and earth flows. Slumps are common in east side of park in areas underlain by Cretaceous sedimentary rocks. Block slides are present, although not common, in areas underlain by Belt Supergroup rocks. Block slides and earth flows are common in west side of park in areas underlain by sedimentary rocks of the Kishenehn Formation. Some of the larger landslide deposits in park exceed 50 m in thickness and cover several square kilometers. Unit locally includes small areas of till, rock glaciers, talus, and colluvium

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Qg

Unit Name: Till (Holocene and upper Pleistocene)

Map Unit Description

Unsorted, subrounded to subangular bouldery rubble, consisting mainly of Belt Supergroup rocks, and lesser amounts of sand, silt, and clay. Striated rocks common. In valleys of the North and Middle Forks Flathead River, unit deposited as a thick (locally >30 m) blanket of ground moraine by large trunk glaciers that filled these valleys. On valley floors in mountainous areas, unit deposited by local mountain glaciers as ground moraine usually 1-3 m thick. In front of many of the glaciers and snowfields in higher regions of park, unit forms moraines 3-50 m high. On Boulder, Cut Bank, and Swiftcurrent Ridges, unit also includes "pre-Wisconsin glacial drift" of Alden (1912), which in places is as much as 60 m thick. Unit also locally includes small areas of bedrock and colluvium

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Tku

Unit Name: Kishenehn Formation, undivided (Oligocene and Eocene)

Map Unit Description

Generally divisible into two parts.

Upper part is a sequence of brick-red, red-brown, and vermillion mudstone, sandstone, and conglomerate and interbedded gray, calcareous, sandy pebble and cobble conglomerate. Mudstone beds have yielded fossil gastropods, mammals, and palynomorphs. Maximum thickness is about 1,500 m.

Lower part consists of light-gray to gray-green sandstone, siltstone, mudstone, lignite, oil shale, marlstone, and sandy pebble and cobble conglomerate. Gastropod fossils prevalent throughout lower part. Maximum thickness at least 3,500 m

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Tkp

Unit Name: Kishenehn Formation-Conglomerate member of Pinchot Creek (Eocene)

Map Unit Description

Brick-red, red-brown, and maroon, intercalated mudstone, sandstone, and conglomerate. Locally, calcareous sandy mudstone and siltstone grade to muddy sandstone; muddy sandstone is composed of varicolored, angular to subrounded, sand- and pebble-size clasts. Pebble and boulder conglomerate beds are gray and sandy and contain abundant mudstone and sandstone matrix material; rounded and subrounded lithic clasts in pebble and boulder conglomerate beds consist entirely of angular to subrounded Belt Supergroup rocks that attain a maximum size of 2.5 m. Vertebrate fossils in some mudstone units. Conglomerate member rests conformably on the lacustrine member of Coal Creek. Maximum estimated thickness 700 m

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Tkcc

Unit Name: Lacustrine member of Coal Creek (Eocene)

Map Unit Description

Predominantly a light-gray, heterogeneous assemblage of sandstone, siltstone, mudstone, claystone, coal, oil shale, marlstone, and pebble and boulder conglomerate. Lacustrine member is informally divided into three parts, each bounded by gradational contacts. Total thickness about 1,150 m.

Upper part consists typically of an interbedded sequence of marlstone, litharenite, siltstone, conglomerate, mudstone, claystone, and coal, Variegated maroon, red-brown, and gray-green color of sandy mudstone beds gives outcrops of upper part a distinctive pink cast, in contrast to the predominantly light-gray to gray color of lower and middle parts of member. Fossil gastropods and Eocene-age mammals common in mudstone beds. Thickness about 100 m.*Middle part is interbedded oil shale, marlstone, litharenite, and siltstone, and lesser amounts of lignite, sapropelic coal, tuff, claystone, and mudstone. Gastropod fossils extremely abundant; plants and plant fragments, fish, insects, and mollusks also common in middle part. Fission track analysis of zircon from a tuff bed suggests an Eocene age of 43.5±4.9 Ma (analysis by Charles Naeser, written commun., 1990). Thickness about 500 m.

Lower part consists primarily of (1) interbedded carbonaceous siltstone, (2) silty to coarse-grained litharenite that displays climbing-ripple and even, parallel lamination, and (3) light-bluish-gray-weathering oil shale. Lignite, mudstone, claystone, marlstone, conglomerate, and devitrified tuff beds present to a lesser extent. Eocene-age fossil leaves of Macginitea augustiloba present in beds of litharenite. About 550 m thick

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Km

Unit Name: Marias River Shale (Upper Cretaceous)

Map Unit Description

Dark-gray, marine mudstone and lesser amounts of interbedded sandstone, limestone, and arenaceous shale. Ranges from 365 to 395 m thick (Mudge and Earhart, 1983)

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Kb

Unit Name: Blackleaf Formation (Upper(?) and Lower Cretaceous)

Map Unit Description

Gray, marine mudstone and interbedded sandstone. About 260 m thick (Mudge and Earhart, 1983)

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Gray-green and maroon, non-marine mudstone and abundant lenticular beds of poorly sorted, greenish-gray sandstone that are locally cross-bedded and contain lenticular interbeds of conglomerate. Brown to brownish-gray limestone and thin to thick lenses of coquina containing pelecypods and gastropods near top of formation. Brown iron-stained limestone nodules common in mudstone beds. Thickness ranges from 198 to more than 305 m (Mudge and Earhart, 1983)

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Kbk

Unit Name: Blackleaf and Kootenai Formations, undivided (Upper(?) and Lower Cretaceous)

Map Unit Description

Unit shown where parts of both formations present but too thin to map separately

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ku

Unit Name: Sedimentary rocks, undivided (Cretaceous)

Map Unit Description

Lithostratigraphic units not identified or mapped separately

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: KJm

Unit Name: Mount Pablo Formation (Lower Cretaceous), Morrison Formation (Upper Jurassic), and Ellis Group (Upper and Middle Jurassic), undivided

Map Unit Description

Units not mapped separately. See Mudge and Earhart (1983) for detailed descriptions

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Zd

Unit Name: Diorite, diabase, and gabbro sills and dikes (Late Proterozoic?)

Map Unit Description

Dark gray to greenish black, metamorphosed, fine to medium grained, equigranular. Abundant chlorite replaces amphibole and pyroxene; commonly pyritic. Laterally continuous sill in Helena Formation cuts up and down section locally, ranges in thickness from 16 to 90 m, and is commonly flanked by bleached zones of hornfels. Sills (0.5-65 m thick) also occur locally in Grinnell, Empire, and Snowslip Formations. Dikes intrude the Appekunny and Altyn Formations on east side of Glacier National Park and intrude the Purcell Lava and overlying strata near Granite Park (McGimsey, 1985); dikes are 3-6 m thick (Ross, 1959). Sills and dikes closely resemble Late Proterozoic intrusive rocks in west-central Montana reported to be 750±25 Ma (potassium-argon age method, Mudge and others, 1968)

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ym

Unit Name: McNamara Formation

Map Unit Description

Grayish-green siltite and argillite, commonly interlaminated as wavy, nonparallel fining-upward couplets. Contains abundant beds of mud-chip breccia; locally, some breccia clasts and thin discontinuous laminae of argillite are silicified. Calcareous and quartzose arenite beds near base. Some calcareous siltite beds also present in lower part. Ripple marks and subaqueous shrinkage cracks common; salt casts rare. Top of formation not exposed; base of formation placed on top of uppermost red feldspathic arenite and siltite of the Bonner Quartzite. Present in southern part of park east of Mount Shields (600 m exposed) and near mouth of Coal Creek (450 m exposed)

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ybo

Unit Name: Bonner Quartzite

Map Unit Description

Pinkish-gray to pale-red, very fine grained to medium-grained feldspathic arenite and lesser amounts of interbedded siltite and dark-red argillite. Rhythmic fining-upward successions as much as 3 m thick. Large-scale channels, cross bedding, and ripple cross-lamination common. Lower contact placed at base of lowermost green feldspathic arenite bed. Exposed east of Mount Shields and near mouth of Coal Creek; thickness 250-280 m

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation

Map Unit Description

At type section near Mount Shields in southern part of park, the Mount Shields Formation is informally subdivided into five members designated 1 through 5 in ascending order. Members are not mapped separately but can be recognized throughout exposures in park. Maximum thickness is about 850 m.

Member 5 is characterized by very thinly laminated, blackish-green argillite and some thin, lenticular beds of arenaceous siltite that are more abundant near top of member. This distinctive succession of blackish-green argillite is locally calcareous and sharply overlain by pale-green, coarse-grained, poorly sorted feldspathic arenite of the Bonner Quartzite; lower contact placed at base of lowermost interval of thinly laminated blackish-green argillite and siltite. Thickness is about 9 m.

Member 4 consists mostly of grayish-green, fining-upward couplets of siltite and argillite and contains carbonate mostly as cement in siltite, Salt casts common, particularly in lower part. Lower contact is placed on top of uppermost noncalcareous, pale-purple siltite and argillite interval of member 3. About 17 m thick at type section but appears to thicken and contain more carbonate beds northward in park.

Member 3 is mostly couplets of siltite and argillite. Siltite laminae in couplets successively change color upward from brick red in lower part of member to purplish gray in middle part to dark grayish green near top; argillite laminae in couplets remain dark red to pale purple throughout member. Salt casts and ripple marks are common, but salt casts become less abundant downward as arenite beds increase and argillite beds decrease. Lower part contains pale-purple to brick-red, very fine-grained arenite similar to that in member 2 but in equal proportion to siltite and argillite. Base of member 3 is placed on top of uppermost bed of stromatolitic limestone of member 2. Member 3 is thickest (450 m) member of formation throughout park.

Member 2 consists mostly of thin, fining-upward successions of brick-red, very fine grained arenite and coarse-grained siltite capped locally by dark-red argillite; member 2 contains more arenite than other members. Ripple cross-lamination and some even, parallel lamination are common in lower part of successions. Pink to cream limestone beds at top of member contain oolites and small stromatolite heads; this zone is recognized throughout northern part of Belt basin (Don Winston, University of Montana, oral commun., 1982). Base of member 2 is placed at base of lowermost succession of brick-red arenite and siltite. About 270 m thick.

Member 1 consists of thinly laminated, maroon to pale-purple argillite, brick-red siltite, and some interbedded arenaceous siltite and thin intervals of greenish-gray siltite and argillite. Lower contact placed on top of uppermost sequence of dolomitic siltite of Shepard Formation. Near northern boundary of park, member 1 encloses basaltic lava (shown by black symbol), and because the lava is only about 10.5 m thick and near the base of member 1, it is shown at contact between Mount Shields and underlying Shepard Formation. Member 1 is about 30 m thick

Map Citation

Geologic map unit descriptions

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ysh

Unit Name: Shepard Formation

Map Unit Description

Typically consists of yellowish-gray to greenish-gray dolomitic and pyritic siltite and argillite and a few thin beds of coarse grained calcarenite, quartz arenite, limestone, and dolomite. A succession of very thinly laminated, olive-green argillite beds about 53 m thick occurs in lower part of formation near Mount Shields at southern edge of park but is not present near U.S.-Canada boundary. Thin beds of stromatolitic limestone are common in southern exposures but are rare in northern parts of park. Lamination is generally wavy, nonparallel and composed of fining-upward couplets. Fluid-escape structures, shrinkage cracks, ripple marks, miniature molar-tooth structures, and mud-chip breccias are common. Because of the carbonate and pyrite content of strata, most exposures weather tan to dusky orange. Lower contact placed at base of lowermost bed of dolomitic siltite or dolomite. Thickness about 400 m in southern part of park; thins northward to 165 m at Hole-in-the-Wall and westward to 210 m in Apgar Mountains

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ypb

Unit Name: Purcell Lava

Map Unit Description

Grayish-green to dark-greenish-gray mafic lava flow(s) (which can be subdivided into three facies) and a hypabyssal sill. In the park, the Purcell occurs within strata of the upper part of the Snowslip Formation as defined here. Because of map scale and position of lava in the uppermost part of the Snowslip, the Purcell is shown on map at contact between the Snowslip and Shepard Formation in northern part of park. Maximum total thickness of the Purcell is 92 m in northernmost exposure at Hole-in-the-Wall; thins southward to 19 m at Granite Park and pinches out at Huckleberry Mountain.

Upper facies of subaerially emplaced pahoehoe ranges in thickness from 0 to 54 m, is a compound flow sequence of multiple flow units (0.1-6 m thick), and overlies a lower pillow-lava facies; ropy flow structures are common on upper flow surfaces. Lower pillow-lava facies is 9-15 m thick and consists of interconnected pillows, which range in diameter from 20 cm to 2 m, and associated hyaloclastite breccia. Locally, a third facies of vent rock is confined to north-central exposures in park; it forms a lens-shaped, chaotic breccia (maximum thickness 10 m) containing randomly distributed, angular to subrounded, equidimensional cognate blocks (5-35 cm) and lapilli intermixed with accidental, deformed and undeformed blocks of Snowslip strata (as much as 2 m long) in a devitrified, oxidized matrix. Vent facies is within pillow-lava facies and is overlain by pahoehoe flow units.

A hypabyssal diabase sill, spatially correlative with vent facies but interpreted to be from a younger igneous event (McGimsey, 1985), is 18-21 m thick and generally enclosed by the Snowslip Formation about 5 m below base of pillow-lava facies

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ysn

Unit Name: Snowslip Formation

Map Unit Description

At type section at Snowslip Mountain in southern part of park, the Snowslip is informally subdivided into six members designated 1 through 6 in ascending order (Whipple and Johnson, 1988). Members are not mapped separately but can be recognized in exposures throughout park. Contact with underlying Helena Formation is sharp, apparently disconformable, and placed at base of first occurrence of red lithic arenite that overlies gray limestone or dolomite of the Helena. The Snowslip ranges from about 360 m thick (including 95 m of Purcell Lava) at reference section on west wall of Hole-in-the-Wall cirque (Whipple and Johnson, 1988) to 635 m thick in Apgar Mountains (including 32.5 m of Purcell Lava); thickness about 490 m at type section.

Member 6 consists of interbedded noncalcareous, grayish-green and pale-maroon, fine-grained arenite, siltite, and minor argillite at type section. In northern part of park, member 6 conformably encloses the Purcell Lava and consists mostly of grayish-green siltite and argillite beneath the lava and alternating beds of pale-maroon and grayish-green, very fine grained arenite, siltite, and argillite above the lava. Where the Purcell is present, thin, discontinuous beds of pink and gray stromatolitic limestone occur in lower part of member 6. Base of member is placed on top of uppermost red, fining-upward succession of arenite and argillite of member 5. Thickness ranges from 8 to 130 m.

Member 5 is composed of rhythmic, fining-upward successions as much as 8 m thick, but typically 2-3 m thick, of very fine grained to medium-grained, white to pink quartz arenite and subfeldspathic arenite, fining upward to siltite in middle of succession and dark-red argillite at top. Base of each succession is erosional and forms a sharp contact with dark-red argillite at top of underlying succession. Sedimentary structures include abundant ripple marks, desiccation cracks, mud-chip breccias, and fluid-escape structures. Lower contact is placed at base of lowermost fining-upward succession that rests on calcareous strata of member 4. Thickness ranges from 35 to 145 m.

Member 4 is predominantly wavy, nonparallel-laminated, grayish-green and yellowish-gray calcareous siltite and argillite. A few interbeds of very fine grained arenite and several thin, conspicuous beds of pink stromatolitic limestone are present, particularly in lower part of member. Lower contact is placed at base of lowermost sequence of calcareous grayish-green strata. Thickness ranges from about 85 to 140 m.

Member 3 is similar to member 5 but the rhythmic, fining-upward successions from arenite to argillite are not as regular as in member 5. For example, a succession could have arenite at base and argillite at top, but no siltite in middle, or a succession could be all siltite, coarse grained at base and very fine grained at top. Successions are as much as 3 m thick. At type section, rhythmic successions show a more regular change in grain size, grading from arenite to argillite and are thicker than elsewhere in park. Thickness ranges from about 15 to 65 m.

Member 2 is nearly identical to member 4; it includes a few interbeds of arenite and several thin beds of pink stromatolitic limestone, particularly in lower part of member. Thickness ranges from about 70 to

150 m.

Member 1 is characterized by alternating pale-maroon and grayish-green sequences of calcareous siltite, argillite, and oolitic arenite. Arenite grains are fine to very coarse, moderately too poorly sorted, subrounded to rounded; arenite beds are thin and commonly cross-laminated. Siltite and argillite laminae are commonly arranged as wavy, nonparallel, fining-upward couplets that contain abundant mud-chip intraclasts, subaqueous shrinkage cracks, and fluid-escape structures. Thickness ranges from 25 to 90 m.

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yh

Unit Name: Helena Formation

Map Unit Description

Generally subdivisible into three parts at most exposures in park. Lower contact of the Helena is placed on top of a 1.8-m-thick interval of green argillite of the Empire Formation. Thickness ranges from 750 m in most of park to a maximum of about 1,030 m in southwestern part. The following description is from a measured section along Going-to-the-Sun Road between Logan Pass and The Loop on west side of park.

Upper part consists primarily of interbedded stromatolitic limestone, dolomite, oolitic limestone, and quartz arenite. At base of upper part, an interval of stromatolitic limestone about 30 m thick, known as the Conophyton zone (Rezak, 1957), is composed of Baicalia-Conophyton stromatolite cycles (Horodyski, 1983, p. 407). Massive character of Conophyton zone (shown by blue symbol) causes it to stand in relief in most exposures of the Helena Formation in park. A 40-m-thick diorite sill (unit Zd) intrudes the Helena in this part of measured section just above Conophyton zone. This sill, which is present throughout park, changes stratigraphic position from near the base of the Helena in southeastern part of park to the lower part of the Snowslip in northernmost part of park. Upper part is 235 m thick at measured section.

Middle part is predominantly dolomitic molar-tooth beds, some as much as 30 m thick. A few thin beds of quartz arenite and stromatolitic limestone are present in the middle part of the Helena. Thickness 360 m at measured section.

Lower part consists of thick, smoky-gray limestone beds near top, thin beds of horizontally laminated and molar-tooth dolomite in middle, and interbedded quartz arenite and thin-bedded dolomite near base. Thickness 180 m at measured section

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ye

Unit Name: Empire Formation

Map Unit Description

Consists primarily of argillite, siltite, and lesser amounts of arenite and dolomite. Upper part is composed primarily of olive-green and a few purplish-red argillite and siltite beds that range in thickness from a few centimeters to 1.5 m. Thin dolomite beds are present near middle of the Empire and increase in number and thickness upward. Lower part of the Empire is composed largely of white to buff quartz arenite beds that range in thickness from 13 cm to 3.5 m and contain minor carbonate cement and pyrite; most arenite is well sorted, however, within some beds grain size ranges from fine to coarse. Locally, arenite beds have well-developed cross-bedding, load structures, and asymmetrical ripple marks. Arenite beds decrease in number and thickness from bottom to top of the Empire. Lower contact is placed at base of lowermost bed of white quartz arenite that overlies the uppermost sequence of red argillite of the Grinnell Formation. Thickness ranges from 158 m on Scalplock Mountain to 122 m near Grinnell Glacier

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ygl

Unit Name: Grinnell Formation

Map Unit Description

Mostly quartz arenite on east side of park and interlaminated siltite and argillite on west side. Contact between the Grinnell and underlying Appekunny Formation is placed where red argillite and siltite of the Grinnell change to green argillite of the Appekunny. Thickness ranges from 530 to 790 m.

In southeastern most part of park, the Grinnell averages 60 percent quartz arenite, and its upper part is nearly 100 percent quartz arenite or quartz conglomerate. Quartz arenite beds in eastern exposures are typically white, medium to coarse grained, lenticular, ripple marked, and prominently cross-bedded, and, in general, become more common upward in the Grinnell. Basal scours and red argillite chips, pellets, and cobbles are common. Red or purplish-red laminated siltite, silty argillite, and argillite are commonly interbedded; lamination ranges from even parallel to wavy nonparallel and locally includes ripple cross-lamination; mud cracks and fluid-escape structures commonly disrupt bedding in these red beds. Greenish-gray siltite and argillite are locally present in the upper and lower transition zones with adjacent formations.

Interbedded quartz arenite and red argillite in the eastern exposures changes northwestward to a lithofacies that contains less quartz arenite and instead is composed mainly of pale, grayish-green and grayish-purple siltite and argillite. In northwestern part of park, the Grinnell can be subdivided into two parts. Upper part is 425 m thick and is similar to the lower part except that it contains more lenses of rippled, white quartz arenite (locally as much as 20 percent of the section). Lower part is 365 m thick and is predominantly interbedded blocky siltite and evenly laminated argillite that contains a few thin lenses of ripple-marked, white quartz arenite. Bedding is disrupted by abundant shrinkage cracks, fluid-escape structures, and interlayers of mud-chip breccia

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yap

Unit Name: Appekunny Formation

Map Unit Description

At Apikuni Mountain in northeastern part of park, the Appekunny is informally subdivided into five members designated 1 through 5 in ascending order; members are not mapped separately. On west side of park only parts of members 5, 4, and 3 are present and are mapped along with the disconformably underlying Prichard Formation as unit Yapp. On east side of park, the Appekunny disconformably overlies the Altyn Formation (see fig. 1): the contact between the two is placed on top of the uppermost dolomite bed of the Altyn and locally shows as much as 2 m of erosional relief. Thickness on east side of park ranges from 530 to 690 m. Member thicknesses are from measured section near Apikuni Mountain.

Member 5 consists of bright-green argillite and lesser amounts of siltite. Lamination is wavy, nonparallel, fining-upward couplets. Mud-chip breccias, fluid-escape structures, and dolomite-filled subaqueous shrinkage cracks common. About 60 m thick.

Member 4 contrasts sharply with member 5 and is poorly exposed because outcrops are mostly cleaved and easily weathered. Member consists of thin to very thin laminae of olive siltite and thin lenticular beds of rusty-brown arenite. Commonly stained by iron and manganese oxides. Notably cleaved, folded, and faulted near thrust faults. Lower contact placed at base of lowermost sequence of thinly laminated siltite. About 135 m thick.

Member 3 is characterized by interlaminated and interbedded grayish-green siltite, yellowish-brown arenite, and lesser amounts of grayish-green argillite; subaqueous shrinkage cracks, load structures, and mud-chip breccia common. Lamination is wavy nonparallel; arenite beds typically contain pyrite. Lower contact placed at base of lowermost bed of pyritic arenite, where pyritic arenite and overlying beds are wavy laminated and contain numerous shallow-water sedimentary structures. About 165 m thick.

Member 2 consists mostly of interlaminated siltite and some argillite. Thin arenite beds, 2.5-7.5 cm thick, common in lower part. Bed lamination is even parallel to nonparallel and curved nonparallel; some beds show broad, low-angle hummocky cross-lamination and small-scale, scour-and-fill structures. Lower contact is placed on top of uppermost maroon sequence of member 1 and generally coincides with an increase in thickness of siltite laminae in member 2. In areas where maroon beds are absent, contact between members 1 and 2 may be indistinguishable. About 165 m thick.

Member 1 closely resembles member 2 except for the presence of maroon beds and consists of alternating successions of pale-maroon and grayish-green siltite and minor argillite. Laminae are generally thinner in member 1 than in member 2. A quartz arenite interval forms a key marker about 55 m above base of member 1. This interval thins gradually northward from about 25 m at Elk Mountain (at south end of park) to 15 m at Bear Mountain (near U.S.-Canada boundary). About 135 m thick

Map Citation

Geologic map unit descriptions

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yapp

Unit Name: Appekunny and Prichard Formations, undivided

Map Unit Description

Present only on west side of park where unit is divisible into three parts, but parts are not differentiated on map. Upper part is the Appekunny Formation; middle and lower parts are subdivisions of the Prichard Formation. Base not exposed. Minimum thickness ranges from 1,608 to 2,165 m.

Upper part of map unit is partial sections of members 5, 4, or 3, or of all three members of the Appekunny that appear to rest disconformably on the Prichard. Upper part ranges in thickness from 63 m in west-central part of park where it consists only of member 5, to about 500 m near the U.S.-Canada boundary where it consists of members 5, 4, and 3.

Middle part of map unit is the upper part of the Prichard and consists of wavy, nonparallel laminae of greenish-gray to medium-gray calcareous siltite. Locally, middle part contains thin lenticular beds of white quartz arenite and discontinuous beds of fragmental limestone or breccia and stromatolitic limestone. Equivalent to the transition zone of the Prichard as described by Cressman (1989). Thickness ranges from 245 to 365 m.

Lower part of map unit is characterized by thin, even, parallel laminae of rusty-weathering, blackish-gray argillite and light-gray siltite that contain disseminated pyrite and pyrrhotite. Some small-scale cross-lamination is present in siltite laminae. Carbonate occurs locally near top of lower part as cement in thin siltite laminae and as pods and nodules of black manganiferous limestone. About 1,300 m thick

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ya

Unit Name: Altyn Formation

Map Unit Description

Occurs only on eastside of park; completely exposed at Yellow Mountain and northward in northeastern part of park. In exposures south of Yellow Mountain, base is not exposed and formation is truncated by Lewis thrust fault. In Yellow Mountain area, the Altyn can be informally subdivided into three members designated 1 through 3 in ascending order (Jardine, 1985); members not mapped separately. Locally where map scale permits, the Altyn and an eastern facies are differentiated and mapped separately. At Yellow Mountain, the Altyn ranges in thickness from 238 to 255 m.

Member 3 is interbedded and interlaminated, light-gray to brownish-yellow dolomite, dolarenite, and arenite. Dolomite beds are 2-20 cm thick; arenite beds are medium to coarse grained and commonly cross-bedded, some herringbone lamination. Stromatolites and styolites common. Thickness 55-62 m.

Member 2 is massive, medium- to thick-bedded, white to gray dolomite. Some medium- to coarse-grained, poorly sorted arenite beds in upper part. Stromatolites and dark-orange dolomite blebs occur locally in lower part. Contains black asphaltic veinlets near Lewis thrust fault. Thickness 58-68 m.

Member 1 is yellow- to orange-weathering, dark-gray to black dolomite in thin to thick (2 m) beds, and thin, lenticular interbeds of fine-grained arenite. Stromatolites common in lower part. About 125 m thick

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yae

Unit Name: Eastern facies

Map Unit Description

Similar to main body of Altyn except middle member (member 2) is mostly thick beds of brownish-weathering, coarse-grained quartzite (Hill and Mountjoy, 1984). Low-angle cross--lamination common. Minor interbedded argillaceous gray dolomite. Partially exposed in thrust-fault plates in Divide Mountain area

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Yapa

Unit Name: Appekunny and Altyn Formations, undivided

Map Unit Description

Undivided in areas adjacent to southern part of Lewis thrust fault where map scale and complex structure preclude differentiation

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_bed_rect

Map Title

Geologic map of Glacier National Park, Montana

Map name: Glacier National Park bedrock

Map Unit Symbol: Ywt

Unit Name: Waterton Formation

Map Unit Description

Present only in northeastern part of park, where base is not exposed and Waterton is truncated by Lewis thrust fault. In Yellow Mountain area, Waterton is informally subdivided into five members designated 1 through 5 in ascending order (Jardine, 1985); members not mapped separately. At Yellow Mountain, Waterton ranges in thickness from 170 to 229 m; becomes thicker northward as Lewis thrust fault cuts down section.

Member 5 consists of silty dolomite, dolomitic siltite, and dolomitic sandstone. Most strata are rusty reddish brown, some are maroon, orange, and green. Bed thickness usually thin to medium but sometimes thick. Cross-bedding and stromatolites are common locally. Thickness ranges from 22 to 46 m.

Member 4 is orangish-yellow and light-brown, fine-grained dolomite. Usually medium bedded but some thin or thick beds. Thickness 18-28 m.

Member 3 is dark-gray and bluish-gray limestone and minor light-tan dolomite. Bedding is generally thin to medium, thickens downward, and has a striped appearance because of discontinuous 1- to 3-cm-thick mottled dolomite layers within 7- to 10-cm-thick limestone and limestone breccia beds. Breccia composed of rip-up clasts of fine-grained dolomite. Stromatolites, thin cherty layers, pisolites, and soft-sediment deformation are present. Thickness ranges from 15 to 30 m.

Member 2 consists of yellowish-gray and light-gray, fine-grained, medium- to thin-bedded dolomite. A 1-m-thick dolomite bed contains chert nodules 5-10 m from top. Thickness 15-25 m.

Member 1 is mostly dolomite that contains chert nodules and cherty beds. Color is generally tan to gray with a light-yellow tint, but locally some beds are grayish brown and yellowish white. Most beds are 0.3-1 m thick. Bedding is usually weakly defined by discontinuous, black calcareous beds, 2-4 cm thick, that are commonly dolomitic and have a concretionary form. Chert nodules, chert "blebs," and siliceous laminae are common. Chert is black when fresh and weathers rusty orange. Chert nodules are usually less than 5 cm in diameter. Stromatolites as much as 30 cm in diameter are common and sometimes have cherty tops and bottoms. Small-scale cross-bedding is present locally. Asphaltic material fills veinlets adjacent to Lewis thrust fault. Member is truncated by Lewis thrust fault but is at least 100 m thick

Map Citation

Whipple, J. W., 1992, Geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-F, 1:100,000.

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: al

Unit Name: Alluvium (Holocene)

Map Unit Description

Sand and gravel deposits and minor amounts of silt; in places silt forms thin lenses. Includes channel and overbank deposits in modern floodplain. In narrow mountain valleys locally includes small areas of colluvium. Unit consists mainly of rounded and subrounded clasts of Belt Supergroup rocks; other rock types, chiefly coarse-grained granites, are also present in minor amounts along the North Fork Flathead River. Thickness 1-5 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: af

Unit Name: Alluvial-fan deposit (Holocene and late Pleistocene)

Map Unit Description

Fan-shaped deposits of fluvial sand and gravel. In places unit contains thin lenses of silt. Unit consists chiefly of rounded and subrounded clasts of Belt Supergroup rocks. Locally includes debris-flow deposits. Thickness 2-50 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: ac

Unit Name: Alluvial and colluvial deposit (Holocene and late Pleistocene)

Map Unit Description

Locally derived deposits of silt and sand on Flattop Mountain. Unit locally includes sandy and silty sheetwash deposits. Thickness 0.5-2 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: tg

Unit Name: Terrace deposit (late Pleistocene)

Map Unit Description

Sand and gravel deposits underlying terraces along the North and Middle Forks Flathead River and the mouths of Ole and Park Creeks. Unit consists mainly of rounded and subrounded clasts of Belt Supergroup rocks. Locally contains thin lenses of silt. Terraces range from 3 to 20 m above present stream levels. Thickness 2-10 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: es

Unit Name: Esker deposit (late Pleistocene)

Map Unit Description

Identified in two areas: (1) along north side of Lake McDonald in the Fish Creek campground area, where deposit consists of well-sorted silty sand and gravel composed of Belt Supergroup rocks; (2) in the Railroad Creek area in southeastern corner of park, where deposit consists of sand, silt, and clay derived from the local bedrock. In both areas these deposits form sinuous ridges 0.5-1 km long and about 10-20 in high

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: t1

Unit Name: Till (late Holocene)

Map Unit Description

Unsorted subrounded to subangular bouldery rubble, consisting of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Striated rocks are common. Unit forms steep, rubbly moraines 10-50 m high in front of many of the glaciers and snowfields in the park. Unit is unweathered and supports little vegetation. Many of these moraines were deposited by glacial advances during the mid-19th century (Carrara and McGimsey, 1981, 1988; Carrara, 1987)

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: t2

Unit Name: Till (late Pleistocene)

Map Unit Description

Unsorted subrounded to subangular bouldery rubble, consisting of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Unit commonly forms subdued, vegetated moraines 3-10 m high immediately downvalley from t1 deposits. Unit supports thin soil, which in places contains Mazama ash (Osborn, 1985; Carrara, 1987; Carrara and McGimsey, 1988) dated at about 6,845 B.P. (Bacon, 1983). Unit is thought to date from about 10,000 B.P. or slightly earlier (Carrara, 1987)

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: at

Unit Name: Ablation till (late Pleistocene)

Map Unit Description

Unsorted subrounded to subangular bouldery rubble, consisting mainly of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Striated rocks are common. This unit, deposited by stagnating mountain glaciers, forms hummocky, poorly drained deposits in valleys tributary to the valley of the North Fork Flathead River. In places this unit overlies t3 deposits, yet it is also older than some t3 deposits that lie upvalley. Thickness exceeds 40 m at some localities. This unit is in places overlain by the Glacier Peak G ash, which has been dated at about 11,200 B.P. (Mehringer and others, 1984)

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: t3

Unit Name: Till (late Pleistocene)

Map Unit Description

Unsorted subrounded to subangular bouldery rubble, consisting mainly of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Striated rocks are common. Found on valley floors within mountainous areas where it was deposited as ground moraine by local mountain glaciers; here, its thickness is usually 1-3 m. Also found in the valleys of the North and Middle Forks Flathead River where it was deposited as a thick blanket of ground moraine by the large trunk glaciers that filled these valleys; here, its thickness exceeds 30 m in places. Locally includes small areas of bedrock and colluvium. This unit is in places also overlain by the Glacier Peak G ash

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: rg

Unit Name: Rock-glacier deposit (Holocene and late Pleistocene)

Map Unit Description

Lobate masses of unsorted angular blocky rubble; interstices filled with unsorted sand, silt, clay, and ice. Unit occurs at the head of some cirques. Thickness 10-30 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: ta

Unit Name: Talus deposit (Holocene and late Pleistocene)

Map Unit Description

Unsorted and mainly unvegetated, angular, bouldery rubble in a matrix of sand, silt, and clay at bases of steep valley walls or cliffs. Some of the larger deposits exceed 30 m in thickness

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: ls

Unit Name: Landslide deposit (Holocene and late Pleistocene)

Map Unit Description

Unit includes large rock slumps, slump-earth flows, and rock block slides (Varnes, 1978). The size and the kind of clasts and the grain size of the matrix vary according to the bedrock units involved in the landslide. Rock slumps are common in the eastern side of the park in those areas underlain by Cretaceous sedimentary rocks. Rock block slides, although not common, are present in areas underlain by Belt Supergroup rocks. Rock slumps and slump-earth flows are common in areas in the western side of the park underlain by the soft sedimentary rocks of the late Paleogene Kishenehn Formation. Some of the larger landslides exceed 50 m in thickness and cover several square kilometers. Locally includes small areas of till and colluvium

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: co

Unit Name: Colluvial deposit (Holocene and late Pleistocene)

Map Unit Description

Mainly locally derived slope deposits consisting of unsorted angular gravel-size clasts in a matrix of unsorted sand, silt, and clay. Unit locally includes some small areas of bedrock and till as well as talus, rock avalanche, and debris-flow deposits. Commonly 1-5 m thick

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: so

Unit Name: Solifluction and related deposit (Holocene and Pleistocene)

Map Unit Description

Includes solifluction lobes, sorted polygons, and sorted stone stripes. Unit found mainly in unglaciated upland areas. Locally includes other mass-wasting deposits. Thickness 0.5-2 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: fr

Unit Name: Frost rubble (Holocene and Pleistocene)

Map Unit Description

Unsorted veneer of angular pebbles, cobbles, and boulders derived from the underlying bedrock by frost action. Unit found in unglaciated upland areas. Thickness commonly less than 1 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: or

Unit Name: Organic deposit (Holocene and late Pleistocene)

Map Unit Description

Peat and organic muds. Common in the valley of the North Fork Flathead River. Thickness 2-5 m

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: di

Unit Name: Diamicton (early Pleistocene or Pliocene?)

Map Unit Description

Unsorted subrounded to subangular bouldery rubble, consisting of Belt Supergroup rocks, and minor amounts of sand, silt, and clay. Unit occurs beneath Boulder, Cut Bank, and Swiftcurrent Ridges. Striated rocks are common. In places, unit is weakly cemented by calcium carbonate. Locally, unit is as much as 60 m thick. This unit is equivalent to the "pre-Wisconsin glacial drift" of Alden (1912)

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): GlacierNP_sur_rect

Map Title

Surficial geologic map of Glacier National Park, Montana

Map name: Glacier National Park surface

Map Unit Symbol: BR

Unit Name: Bedrock (late Paleogene, Cretaceous, and Proterozoic)

Map Unit Description

Includes: (1) late Paleogene sedimentary rocks of the Kishenehn Formation, consisting of lacustrine and fluvial sediments in west side of park (Constenius, 1981); (2) Cretaceous sedimentary rocks, consisting predominantly of the Upper Cretaceous Marias River Shale, a dark-gray marine mudstone, in east side of park (Mudge and Earhart, 1983); and (3) Proterozoic rocks of the Belt Supergroup, consisting mainly of siltites and argillites and subordinate amounts of igneous rocks that occur as sills, dikes, and flows in central mountainous region of park (McGimsey, 1985; Ross, 1959; Raup and others, 1983; Whipple and others, 1984). In places, unit is mantled by small, thin patches of surficial material

Map Citation

Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1508-D, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Qu

Unit Name: Quaternary terrane

Map Unit Description

Sedimentary and volcanic deposits, undivided.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Tv

Unit Name: Miocene and Pliocene volcanic rocks

Map Unit Description

All Miocene and Pliocene volcanic and sedimentary rocks including rocks of the Magic Mountain eruptive center, the Banbury Basalt and coeval rocks, the Idavada Volcanics, the tuff of Cannonball Mountain, and the Payette Formation.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Tcv

Unit Name: Eocene rocks

Map Unit Description

Eocene extrusive volcanic rocks, volcaniclastic sedimentary rocks, and smaller hypabyssal bodies of the Challis Volcanic Group.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Tri

Unit Name: Rhyolite

Map Unit Description

Mostly hypabyssal bodies, many of which are too small to show.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Tg

Unit Name: Granite

Map Unit Description

Pink to light-gray granite in the Sawtooth, Trinity, and Soldier batholiths and many smaller plutons.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Tdc

Unit Name: Diorite complex

Map Unit Description

Diorite, granodiorite, dacite porphyry, latite, quartz monzonite, and hornblende gabbro in the border areas of major batholiths and many smaller plutons.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Kg

Unit Name: Granite

Map Unit Description

Granite and leucogranite

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Kgd

Unit Name: Granodiorite

Map Unit Description

Major phases of the Idaho batholith

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Kt

Unit Name: Tonalite

Map Unit Description

Potassium-rich granodiorite and quartz diorite, mainly in the southwestern border areas of the Idaho batholith.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pza

Unit Name: Argillaceous and arenaceous rocks

Map Unit Description

Includes the Eagle Creek and Hailey Members of the Wood River Formation and equivalent parts of the Dollarhide and Grand Prize Formations.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pzs

Unit Name: Primarily argillaceous rocks

Map Unit Description

Includes the Wilson Creek Member of the Wood River Formation and equivalent parts of the Dollarhide and Grand Prize Formations, the Milligen Formation, unnamed Devonian and Silurian rocks, and the Trail Creek and Phi Kappa Formations.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Mf

Unit Name: Flysch

Map Unit Description

Mainly carbonate and sandstone turbidite. Includes the McGowan Creek and Copper Basin Formations.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Md

Unit Name: Drummond Mine Member of the Copper Basin Formation

Map Unit Description

Shown separately because of its importance in control of mineralization.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pzp

Unit Name: Primarily carbonate rocks

Map Unit Description

Includes the Snaky Canyon, Bluebird Mountain, Arco Hills, and Saturday Mountain Formations and the Ella Marble.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pzc

Unit Name: Carbonate rocks

Map Unit Description

Includes the White Knob Limestone, the Surrett Canyon, South Creek, Scott Peak, Middle Canyon, and Jefferson Formations, and the Laketown and Fish Haven Dolostones.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pzr

Unit Name: Quartzite and other rocks

Map Unit Description

Includes the Clayton Mine Quartzite and the Wilbert Formation. The Wilbert Formation is included with sedimentary rock terranes although its age is considered Early Cambrian and Late Proterozoic (?).

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: Pzq

Unit Name: Quartzite

Map Unit Description

Includes the Kinnikinic Quartzite and the Summerhouse Formation.

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: m

Unit Name: Metamorphic rock inclusions within Idaho batholith

Map Unit Description

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_IDFalls_rect

Map Title

Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho

Map name: Hailey & part Idaho Falls 250K

Map Unit Symbol: YX

Unit Name: High-grade metamorphic rocks and felsic intrusive rocks in the Pioneer gneiss dome

Map Unit Description

Pioneer core complex

Map Citation

Worl, R.G. and Johnson, K.M., 1995, Map showing geologic terranes of the Hailey 1º x 2º quadrangle and the western part of the Idaho Falls 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-A, plate 1, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qa

Unit Name: ALLUVIUM (HOLOCENE)

Map Unit Description

Gravel, sand, silt, and clay deposited in active stream channels. Locally includes alluvial fans and colluvium

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Ql

Unit Name: LANDSLIDE DEPOSITS (HOLOCENE)

Map Unit Description

Angular blocks and fragments of locally derived bedrock in a matrix of sand and silt, commonly characterized by hummocky topography

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qf

Unit Name: ALLUVIAL FANS (HOLOCENE AND PLEISTOCENE)

Map Unit Description

Sand and gravelly sand of incised alluvial fans derived from local bedrock

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name Hailey 250K

Map Unit Symbol Qt

Unit Name TERRACE GRAVELS (PLEISTOCENE)

Map Unit Description

Fluvial sand and coarse to medium gravel of current drainage system

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qm

Unit Name: GLACIAL DEPOSITS (PLEISTOCENE)

Map Unit Description

Includes till and morainal deposits with minor alluvium, colluvium, and landslide debris

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qhg

Unit Name: HIGH GRAVELS (PLEISTOCENE)

Map Unit Description

Unsorted sand, gravel, and boulders on ridges or well above present streams. May be pre-Pleistocene

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qsb

Unit Name: SNAKE RIVER GROUP, UNDIVIDED (HOLOCENE AND PLEISTOCENE)

Map Unit Description

Basaltic lava flows and associated clastic deposits

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbf

Unit Name: BASALT OF FALL CREEK (HOLOCENE)

Map Unit Description

Basalt flow filling valleys and largely unmodified by surficial deposits

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qby

Unit Name: YOUNG BASALT FLOW (HOLOCENE)

Map Unit Description

Basalt lava flow with irregular rocky surface and no cover of surficial deposits

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qb1-Qb2-Qb3

Unit Name: UNNAMED BASALT FLOWS (HOLOCENE OR PLEISTOCENE)

Map Unit Description

Basalt lava flows largely unmodified by surficial deposits. Consists of three separate flows with well-defined vents

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qmg

Unit Name: MELON GRAVEL (PLEISTOCENE)

Map Unit Description

Boulders, cobbles, and pebbles of basalt in matrix of basaltic sand arranged in giant cross-beds. Deposited during catastrophic Lake Bonneville Flood

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qmk

Unit Name: MCKINNEY BASALT (PLEISTOCENE)

Map Unit Description

Porphyritic plagioclase-olivine basalt

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbsb

Unit Name: BANCROFT SPRINGS BASALT (PLEISTOCENE)

Map Unit Description

Porphyritic plagioclase-olivine basalt partly mantled with eolian material

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qsp

Unit Name: SMITH PRAIRIE BASALT (PLEISTOCENE)

Map Unit Description

Numerous flow units of olivine basalt with interspersed wedges of pillow basalt; minor hyaloclastic material between pillows. Commonly diktytaxitic

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qcg

Unit Name: CROWSNEST GRAVEL (PLEISTOCENE)

Map Unit Description

Pebbles and cobbles of silicic volcanic rocks, quartzite, and porphyry

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qlc

Unit Name: BASALT OF LAVA CREEK (PLEISTOCENE)

Map Unit Description

Microporphyritic to weakly porphyritic olivine basalt with very fine-grained (<0.1mm) matrix; contains small granitic xenoliths near vent

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbb

Unit Name: BASALT FLOWS, UNDIVIDED (PLEISTOCENE)

Map Unit Description

Multiple flows of basalt that form plateaus and fill canyons; locally stained brown and yellow

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbs

Unit Name: LAKE DEPOSITS (PLEISTOCENE)

Map Unit Description

Silt, clay, and diatomite with minor amounts of alluvial silt and sand

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbp

Unit Name: PRIEST BASALT (PLEISTOCENE)

Map Unit Description

Porphyritic olivine basalt with diktytaxitic texture

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qsc

Unit Name: SCHOOLER BASALT (PLEISTOCENE)

Map Unit Description

Vesicular, diktytaxitic, porphyritic olivine basalt

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbm

Unit Name: MACON BASALT (PLEISTOCENE)

Map Unit Description

Vesicular, diktytaxitic, porphyritic olivine basalt

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qtm

Unit Name: TIMBER GULCH BASALT (PLEISTOCENE)

Map Unit Description

Olivine basalt with diktytaxitic texture. Vesicles commonly filled with tannish-cream-colored carbonate. Consists of multiple flows

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Qbw

Unit Name: WIND RIDGE BASALT (PLEISTOCENE)

Map Unit Description

Porphyritic olivine basalt in two distinct flows

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: QTg

Unit Name: LAKE AND STREAM DEPOSITS (PLEISTOCENE AND PLIOCENE)

Map Unit Description

Detrital deposits characterized by abrupt lateral facies changes. Facies includes (1) silt in massive layers marked with faint bedding; (2) sand in evenly layered thick beds cemented locally to flaggy sandstone; (3) thinly bedded clay, silt, and carbonaceous shale; (4) ripple-marked sand and silt; (5) granitic sand and fine pebble gravel; and (6) quartzitic cobble gravel

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: QTgb

Unit Name: BASALT FLOWS, UNDIVIDED (PLEISTOCENE AND PLIOCENE)

Map Unit Description

Mostly subaerial flows of olivine basalt that form sheetlike bodies within the lake and stream deposits. Generally altered to basaltic saprolite with residual spheroids of undecomposed rock

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: QTsc

Unit Name: BASALT OF SMITH GREEK (PLEISTOCENE OR PLIOCENE)

Map Unit Description

Nearly aphyric olivine basalt that weathers to rounded boulders. Contains abundant xenocrysts and xenoliths of granitic rock

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: QTsr

Unit Name: STEAMBOAT ROCK BASALT (PLEISTOCENE OR PLIOCENE)

Map Unit Description

Upper flow units of plagioclase-phyric basalt and diabase and lower flow units of mioroporphyritic basalt

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: QTb

Unit Name: CLAY BANK BASALT (PLEISTOCENE OR PLIOCENE)

Map Unit Description

Porphylitic olivine basalt with diktytaxitic texture

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tmd

Unit Name: YOUNG DOMES (PLIOCENE)

Map Unit Description

Porphyritic high-silica rhyolite domes with phenocrysts of sanidine, quartz, plagioclase, hornblende, and biotite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tmy

Unit Name: YOUNG TUFF (MIOCENE)

Map Unit Description

Crystal-poor lapilli-rich black densely welded to orange nonwelded tuff. Phenocrysts consist of quartz, sanidine, andesine hypersthene, and clinopyroxene. The pyroxenes are largely altered to antgorite-1ike material. Includes Poison Creek tuff of Schmidt (1962)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tmf

Unit Name: FERROLATITE OF SQUARE MOUNTAIN (MIOCENE)

Map Unit Description

Intermediate composition ferrolatite containing phenocrysts of plagioclase, augite, and pigeonite in a hyalopilitic groundmass of dark-brown glass. Includes Square Mountain Basalt of Schmidt (1962)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tmq

Unit Name: QUARTZ LATITE OF MAGIC RESERVOIR (MIOCENE)

Map Unit Description

Coarsely porphyritic quartz latite lava with a highly devitrified matrix. Includes Moonstone Rhyolite of Schmidt (1962)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tb

Unit Name: BASALT FLOWS (MIOCENE)

Map Unit Description

Multiple flows of porphyritic basalt with plagioclase, olivine, and rare clinopyroxene phenocrysts

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Taa

Unit Name: ARKOSE AND ASH (PLIOCENE OR MIOCENE)

Map Unit Description

Poorly consolidated arkose, siltstone, conglomerate and water-laid ash of uncertain age. Preserved in down-dropped blocks within the Idaho batholith

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name Hailey 250K

Map Unit Symbol Tbb

Unit Name BASALT FLOWS, UNDIVIDED (MIOCENE)

Map Unit Description

Mostly thin, vesicular flows of olivine basalt; vesicles commonly filled with zeolites and calcite. Locally includes stream deposits of massive sand and fine gravel as well as basaltic pyroclastic material

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tbs

Unit Name: STREAM AND LAKE DEPOSITS (MIOCENE)

Map Unit Description

Sand and pebble gravel in lenticular channel deposits, and silt, clay, and diatomite in lake deposits

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tbt

Unit Name: BASALTIC TUFF (MIOCENE)

Map Unit Description

Light-brown porous basaltic tuffs and white silicic volcanic ash. Tuffs are generally massive or crudely bedded and contain basaltic scoria and other rock fragments in a palagonite-clay matrix

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tv

Unit Name: IDAVADA VOLCANICS (MIOCENE)

Map Unit Description

Rhyolitic tuffs and lavas, commonly crystal-poor. Characterized by anhydrous mafic phenocryst phases, usually clinopyroxene ± orthopyroxene

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Ttc

Unit Name: TUFF OF CANNONBALL MOUNTAIN (MIOCENE)

Map Unit Description

Light-gray alkali rhyolite (comendite) tuff with phenocrysts of sanidine and quartz in thoroughly devitrified matrix. Contains late alkali amphibole

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name Hailey 250K

Map Unit Symbol Tp

Unit Name PAYETTE FORMATION (MIOCENE)

Map Unit Description

Stratified, tan to gray, loosely consolidated arkosic sandstone and siltstone and interstratified conglomerate and thin-bedded, dark-gray to black shale in which are abundant impressions of upper middle to lower upper Miocene leaves and plant fragments

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tcb

Unit Name: COLUMBIA RIVER BASALT GROUP (MIOCENE)

Map Unit Description

Fine-grained ophitic basalt; consists chiefly of plagioclase laths embedded in augite and scattered crystals of magnetite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tb

Unit Name: BASALTIC DIKES (MIOCENE)

Map Unit Description

Dark-green microporphyritic basaltic andesite and basalt dikes consisting mostly of labradorite and augite. Most probably correlate with the Columbia River Basalt Group, but those in the southernmost part of the Idaho batholith may be younger

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name Hailey 250K

Map Unit Symbol Tcv

Unit Name CHALLIS VOLCANICS, UNDIVIDED

Map Unit Description

Principally intermediate to mafic K-rich lava flows with lesser amounts of volcaniclastic material and tuff

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tcr

Unit Name: RHYOLITE

Map Unit Description

Light-colored rhyolite lava and ash-flow tuff characterized by phenocrysts of plagioclase, biotite, quartz, sanidine, and rare hornblende

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tct

Unit Name: VOLCANICLASTIC SEDIMENTARY ROCKS

Map Unit Description

Includes subaerially and subaqueously deposited, mostly nonwelded but locally pyroclastic flows, mudflows, conglomerates, and volcanic sandstone and mudstone locally containing woody fragments and other organic debris. Generally the unit forms discontinuous outcrops and is poorly exposed. The volcanic component includes hornblende, pyroxene, plagioclase, and biotite; quartz may be present in variable amounts. Unit is primarily confined to the lower part of the Challis section and is intercalated with intermediate to mafic lava flows. Similar to unit Tt as mapped in the Challis quadrangle (Fisher and others, 1983; in press)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tcd

Unit Name: K-RICH DACITE. LATITE, AND TRACHYTE LAVAS

Map Unit Description

Includes a variety of lavas and flow breccias erupted from numerous scattered vents. K-rich dacite dominates this unit and is strongly porphyritic with up to 30% phenocrysts, of plagioclase and hornblende with lesser amounts of biotite and pyroxene; quartz and sanidine are rare. Trachyte lavas are by a relatively high proportion of hornblende and biotite. Proportion and amount of all phenocrysts vary greatly. Equivalent to Td of Challis quadrangle (Fisher and others, 1983; in press)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tca

Unit Name: K-RICH ANDESITE AND SHOSHONITE LAVAS

Map Unit Description

Dark-gray to black, predominantly aphyric to sparsely porphyritic lavas and flow breccias that erupted from fissure vents scattered over the region. Hornblende, pyroxene, and plagioclase are dominant phenocrysts and occur in variable proportions. Unit is similar to Tl of Challis quadrangle (Fisher and others, 1983; in press)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tcc

Unit Name: BASAL-CHALLIS CLASTIC ROCKS

Map Unit Description

Unit grades from coarse alluvial fan and talus deposits composed entirely of Paleozoic sedimentary material to volcanic conglomerates with increasing proportion of volcanic material as clasts and matrix

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tg

Unit Name: GRANITE DIKES

Map Unit Description

Light-colored, fine-grained dikes that are similar in composition to the granite plutons (unit Tg)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tr

Unit Name: RHYOLITE DIKES AND PLUGS

Map Unit Description

Pink, tan, and light-gray, highly to sparsely porphyritic rhyolite with phenocrysts of K-feldspar, quartz, plagioclase, and biotite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Ttr

Unit Name: TRACHYTE DIKES

Map Unit Description

Pink, porphyritic trachyte with phenocrysts of sanidine and lesser amounts of quartz. Age unknown; may be related to Challis or Idavada volcanics

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Trd

Unit Name: RHYODACITE DIKES

Map Unit Description

Pink to gray-green, porphyritic rhyodacite with phenocrysts of plagioclase, hornblende, biotite, and embayed quartz

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tqm

Unit Name: QUARTZ MONZODIORITE DIKES

Map Unit Description

Greenish-gray, highly porphyritic dikes that are similar in composition to the quartz monzodiorite plutons (unit Tqm)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tdp

Unit Name: DACITE PORPHYRY

Map Unit Description

Stocks and dike swarms of gray porphyritic dacite with plagioclase, biotite, and hornblende phenocrysts in a fine-grained groundmass. Hypabyssal equivalent of quartz monzodiorite suite (unit Tqm)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tda

Unit Name: DACITE DIKES

Map Unit Description

Green to gray porphyritic dacite with phenocrysts of plagioclase and hornblende

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Ta

Unit Name: ANDESITE DIKES

Map Unit Description

Dark-green weakly porphyritic to aphyric andesite. Some of these dikes may be Late Cretaceous in age

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tg

Unit Name: GRANITE

Map Unit Description

Pink to light-gray, coarse- to medium-grained, equigranular to porphyritic granite in which perthitic potassium feldspar and dark quartz are the principal components

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tqm

Unit Name: QUARTZ MONZODIORITE

Map Unit Description

Granodiorite grading to quartz monzodiorite and granite. Gray to dark-gray, medium-grained, equigranular to porphyritic rock in which zoned andesine is the principal component; hornblende and sphene are common

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Td

Unit Name: DIORITE

Map Unit Description

Dark-gray, fine- to medium-grained rock containing hornblende and (or) pyroxene. Salt and pepper texture common

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tfgd

Unit Name: FOLIATED HORNBLENDE-BIOTITE GRANODIORITE

Map Unit Description

Strongly foliated to massive, heterogeneous unit which ranges from quartz diorite to granite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Tgb

Unit Name: HORNBLENDE GABBRO

Map Unit Description

Equigranular, medium- to fine-grained hornblende-rich rock

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kg

Unit Name: PEGMATITE DIKES

Map Unit Description

Coarsely crystalline dikes consisting principally of quartz, feldspar, biotite, and muscovite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kap

Unit Name: APLITE/PEGMATITE COMPLEX

Map Unit Description

Aplite and pegmatite dikes cross-cutting subordinate amounts of biotite granodiorite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kapm

Unit Name: APLITE/PEGMATITE COMPLEX WITH METAMORPHIC FRAGMENTS

Map Unit Description

Similar to aplite/pegmatite complex but containing fragments of schist, quartzite, and calc-silicate rocks

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Klg

Unit Name: LEUCOCRATIC GRANITE

Map Unit Description

Light-gray, fine- to medium-grained granite dikes and small stocks with about equal percentages of quartz, potassium feldspar, and oligoclase; distinctive anhedral texture

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kfap

Unit Name: FOLIATED APLITE/PEGMATITE

Map Unit Description

Similar to aplite/pegmatite complex but foliated

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kg

Unit Name: MUSCOVITE-BIOTITE GRANITE

Map Unit Description

Light-gray, medium- to coarse-grained, equigranular to porphyritic granite that contains primary muscovite in books large enough to be identified in hand specimen

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kgd

Unit Name: BIOTITE GRANODIORITE

Map Unit Description

Light-gray, medium- to coarse-grained, equigranular to porphyritic granodiorite in which oligoclase is the chief component. Grades to granite. Hornblende rare to absent; no primary muscovite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kai

Unit Name: ALTERED BIOTITE GRANODIORITE

Map Unit Description

Biotite granodiorite in which feldspars are strongly altered to sericite and clay minerals; commonly moderately to intensely silicified

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kfgd

Unit Name: FOLIATED GRANODIORITE

Map Unit Description

Rock is similar to biotite granodiorite but is foliated and contains inclusions of metasedimentary rock

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kt

Unit Name: TONALITE

Map Unit Description

Gray to dark-gray, medium-grained, equigranular tonalite in which andesine is the principal component. May contain as much as 20% biotite and hornblende. Locally foliated; grades to granodiorite

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kgdk

Unit Name: POTASSIUM-RICH HORNBLENDE-BIOTITE GRANODIORITE

Map Unit Description

Gray, medium- to coarse-grained equigranular to porphyritic hornblende-biotite granodiorite and granite containing conspicuous books of biotite. High K2O content for a given SiO2 relative to biotite granodiorite and tonalite units. Includes Hailey granodiorite of Schmidt (1962)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Kqd

Unit Name: QUARTZ DIORITE

Map Unit Description

Brown, medium-grained, equigranular pyroxene-biotite quartz diorite. Includes Croesus stock and a small unnamed stock in upper Deer Creek

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: P[Pw

Unit Name: WOOD RIVER FORMATION, UNDIVIDED

Map Unit Description

Primarily calcareous sandstone of the Eagle Creek Member, but includes other rock types and members

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Pww

Unit Name: WILSON CREEK MEMBER (LOWER PERMIAN)

Map Unit Description

Calcareous siltstone, silty limestone, cherty limestone, and argillite. Includes unit 7 of Hall and others (1974) and unit 8 of Hall and others (1978) as defined by Mahoney and others (1991)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: P[Pwe

Unit Name: EAGLE CREEK MEMBER (LOWER PERMIAN AND UPPER PENNSYLVANIAN)

Map Unit Description

Calcareous sandstone, sandy and silty limestone, quartz arenite, siltstone and argillite. Includes units 3, 4, 5, and 6 of Hall and others (1974) are defined by Mahoney and others (1991)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: [Pwh

Unit Name: HAILEY MEMBER (MIDDLE PENNSYLVANIAN)

Map Unit Description

Pebble to boulder conglomerate and bioclastic limestone. Conglomerate contains clasts of argillite, chert, and fine-grained quartzite. Conglomerate interfingers with and is overlain by bioclastic and biostromal limestone (unit 2 of Hall and others, 1974). Contact with underlying Milligan Formation is typically sheared. Unit is revised from Hailey Conglomerate Member of Hall and others (1974) by Mahoney and others (1991)

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Pg4

Unit Name: MEMBER 4 (LOWER PERMIAN)

Map Unit Description

Dark-colored and thin-bedded carbonaceous siltstone, sandy limestone, mudstone, and calcareous sandstone

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Pg3

Unit Name: MEMBER 3 (LOWER PERMIAN)

Map Unit Description

Rhythmically banded, light-colored calcareous sandstone, carbonaceous siltstone, and sandy limestone

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: P[Pg2

Unit Name: MEMBER 2 (LOWER PERMIAN AND UPPER PENNSYLVANIAN)

Map Unit Description

Light-colored calcareous sandstone, siliceous sandstone, sandy limestone, and siltstone

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Pdu

Unit Name: UPPER MEMBER (LOWER PERMIAN)

Map Unit Description

Dark-colored and carbonaceous siltstone, silty and sandy limestone, argillite, and minor conglomerate

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Pdm

Unit Name: MIDDLE MEMBER (LOWER PERMIAN)

Map Unit Description

Light-colored calcareous sandstone, siliceous sandstone, sandy limestone, silty argillite, and minor conglomerate. Very similar to sandy parts of the Eagle Creek Member of the Wood River Formation

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: P[Pdl

Unit Name: LOWER MEMBER (LOWER PERMIAN AND MIDDLE AND UPPER PENNSYLVANIAN)

Map Unit Description

Dark-colored and carbonaceous calcareous sandstone, calcareous siltstone, sandy and silty limestone and marble, argillite, and minor granule to boulder conglomerate

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: P[Pdf

Unit Name: FOLIATED LOWER AND MIDDLE MEMBER (LOWER PERMIAN AND MIDDLE AND UPPER PENNSYLVANIAN)

Map Unit Description

Light-colored banded quartzite, calc-silicate, siltite, phyllite, marble, and schist. Represents metamorphosed equivalent of the lower member and is present only near contacts with the Idaho batholith

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Mcb

Unit Name: COPPER BASIN FORMATION, UNDIVIDED

Map Unit Description

Predominantly dark, impure quartzite, grit, and argillite with subordinate granule and pebble conglomerate. Generally strongly deformed

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Mcg

Unit Name: GLIDE MOUNTAIN PLATE

Map Unit Description

Dark-colored and carbonate-poor facies including quartzite, chert- and argillite-pebble conglomerate grit, argillite, and minor silty limestone. Generally tightly folded

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Mcc

Unit Name: COPPER BASIN PLATE

Map Unit Description

Light-colored and carbonate-rich facies including quartzite, argillite, silty micritic limestone, and quartzite- and chert-pebble conglomerate. Characterized by broad folding

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Dj

Unit Name: JEFFERSON FORMATION (DEVONIAN)

Map Unit Description

Cliff-forming, medium- to blue-gray, medium-bedded to massive, finely crystalline dolomitic limestone, dolomite, and calcarenaceous limestone; locally contains intraformational conglomerate

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Dm

Unit Name: MILLIGEN FORMATION (DEVONIAN)

Map Unit Description

Black, well-cleaved argillite and phyllite; black, thinly-bedded chert; gray, massive quartzite; black diamictite and conglomerate; brown to maroon calcareous sandstone and siltstone; black, carbonaceous limestone; gray, sandy limestone; brown, finely laminated dolomite; and green to butterscotch-colored shale. Less competent lithologies are generally well-cleaved and tightly folded, while competent units are typically boudined

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: DSu

Unit Name: UNNAMED DEVONIAN AND SILURIAN ROCKS (DEVONIAN AND SILURIAN)

Map Unit Description

Dark-colored carbonaceous argillite, orange-weathering, bioturbated siltstone, dark-colored fine- to coarse-grained quartz wacke, pebble to boulder conglomerate, and sedimentary breccia

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: DOu

Unit Name: DEVONIAN, SILURIAN, AND ORDOVICIAN ROCKS, UNDIVIDED (DEVONIAN, SILURIAN AND ORDOVICIAN)

Map Unit Description

Includes imbricated sequences of Phi Kappa Formation, Trail Creek Formation, and unnamed Devonian and Silurian rocks juxtaposed by numerous faults in the headwaters of the east fork of Trail Creek, Boulder Mountains. Structural detail mapped by Dover (1983) too complex to show at this scale

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: SOp

Unit Name: PHI KAPPA FORMATION (SILURIAN AND ORDOVICIAN)

Map Unit Description

Black, carbonaceous graptolite-bearing shale and slabby argillite, subordinate pebbly quartzite, and micritic limestone. Complexly folded and imbricated

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Ok

Unit Name: KINNIKINIC QUARTZITE (ORDOVICIAN)

Map Unit Description

White, pink, yellow-brown, or molted-gray vitreous pure quartzite. Locally faintly laminated and rarely contains thin muscovite partings. Where preserved, original texture is fine-grained and well sorted, with subrounded quartz grains.

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Oe

Unit Name: ELLA MARBLE (ORDOVICIAN)

Map Unit Description

Buff-weathering calc-silicate marble. Upper part contains thin- to medium-bedded marble that varies in content of calcite, quartz, and calc-silicate minerals from bed to bed; siliceous parting and quartzite interbeds occur rarely. Lower part is massive, more uniform and more coarsely crystalline and crumbles to a coarse calcite-diopside sand

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Oc

Unit Name: CLAYTON MINE QUARTZITE (ORDOVICIAN)

Map Unit Description

White, vitreous, poorly sorted, thick-bedded to massive, micaceous, and feldspathic gneissose quartzite characterized by well developed thick tabular cross-bedding. Contains some discontinuous layers and lenses of granule and pebble conglomerate with pink- to purplish-gray quartz clasts

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: m

Unit Name: ROOF PENDANTS (PROTEROZOIC OR PALEOZOIC)

Map Unit Description

Garnet-diopside gneiss, quartzite, and biotite-sillimanite schist of uncertain age

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Yu

Unit Name: METASEDIMENTARY ROCKS, UNDIVIDED (MIDDLE PROTEROZOIC)

Map Unit Description

Calc-silicate, gneissose quartzite, pelitic schist, and marble

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Hailey_rect

Map Title

Geologic map of the Hailey 1° x 2° Quadrangle, Idaho

Map name: Hailey 250K

Map Unit Symbol: Xwg

Unit Name: WILDHORSE GNEISS COMPLEX (MIDDLE PROTEROZOIC)

Map Unit Description

Layered quartzofeldspathic, quartzitic, and mafic gneiss, as well as calc-silicate marble

Map Citation

Worl, R. G., Kiilsgaard, T. H., Bennett, E. H., Kink, P. K., Lewis, R. S., Mitchell, V. E., Johnson, K. M., and Snyder, L. D., 1991, Geologic map of the Hailey 1° x 2° Quadrangle, Idaho: U.S. Geological Survey Open-File Report 91-340, 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qfp

Unit Name: Floodplain deposits (Holocene)

Map Unit Description

Sand, silt, and clay deposited in broad, open stream valleys and in confined ephemeral stream channels. Maximum thickness unknown.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qal

Unit Name: Alluvial and fluvial channel deposits (Holocene)

Map Unit Description

Sand, silt, clay, and pebble to cobble gravel deposited in narrow stream channels and on broad alluvial slopes at base of low hills and mountain fronts. Locally includes thin colluvial deposits. Generally less than 5 m thick.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qc

Unit Name: Colluvium (Holocene)

Map Unit Description

Unconsolidated deposits of silt, sand, angular pebbles and cobbles formed by mass movement downslope. Thickness generally less than 2 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qac

Unit Name: Alluvial and colluvial deposits, undivided (Holocene)

Map Unit Description

Sand, silt, clay, and pebble to cobble gravel deposited in narrow stream channels and on broad alluvial slopes at base of low hills and mountain fronts. Locally includes thin colluvial deposits. Generally less than 5 m thick.

Unconsolidated deposits of silt, sand, angular pebbles and cobbles formed by mass movement downslope. Thickness generally less than 2 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qaf

Unit Name: Alluvial fan deposits, undivided (Holocene)

Map Unit Description

Poorly sorted silty sand and gravel deposited in small alluvial fans along valley margins and around hills and mountains. Maximum thickness unknown.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qaf1

Unit Name: Young alluvial fan deposits (Holocene)

Map Unit Description

Active, small to large alluvial fans along valley margins.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qaf2

Unit Name: Old alluvial fan deposits (Holocene)

Map Unit Description

Inactive, generally large alluvial fans, most of which were deposited along the east side of the Madison Valley; fans are weakly dissected and locally cut by Holocene fault scarps.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qe

Unit Name: Eolian deposits (Holocene)

Map Unit Description

Translucent tan to brown, well-sorted, moderately frosted quartz sand grains comprise sand dune field in northern Centennial Valley. Maximum thickness (dune height) about 10 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qta

Unit Name: Talus deposits (Holocene)

Map Unit Description

Unsorted, unstratified angular clasts and slabs as much as 2 m across that accumulate at the base of cliffs and very steep slopes.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qr

Unit Name: Rock glaciers (Holocene)

Map Unit Description

Unconsolidated lobate to elongate deposits of coarse gravel and boulders in glacial cirques or at the base of cliffs above timberline. Older deposits are locally covered by thin soil and vegetation. Thickness generally less than 20 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qbo

Unit Name: Boulder field (Holocene)

Map Unit Description

Unsorted accumulation of angular boulders on steep slopes.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qat

Unit Name: Alluvium of alluvial terrace deposit, undivided (Holocene)

Map Unit Description

Pebble- to boulder-size gravel and sand on low terraces adjacent to major streams. Maximum exposed thickness about 5 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qaty

Unit Name: Alluvium of younger alluvial terraces (Holocene)

Map Unit Description

Unconsolidated gravels deposited on lowest terraces of modern streams.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qato

Unit Name: Alluvium of older alluvial terraces (Holocene)

Map Unit Description

Unconsolidated gravels deposited on terraces above lowest terraces in modern stream valleys.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qls

Unit Name: Earth flow and landslide deposits (Holocene and Pleistocene)

Map Unit Description

Coarse, unconsolidated deposits of locally derived, angular pebbles, cobbles, and boulders associated with fine-grained matrix of silt and sand. On south and east sides of Gravelly Range, huge landslides where length and width are measured in km include large toreva blocks of Huckleberry Ridge Tuff (Thr) deposited on unconsolidated sand and silt of the Neogene Six Mile Creek Formation (Tsc); on the west side of the Gravellys, landslides of similar size reflect massive dip-slip slope failure of clay-rich, tuffaceous, weakly indurated Cretaceous formations. Maximum thickness probably near 60 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qlk

Unit Name: Lacustrine deposits (Holocene and Pleistocene)

Map Unit Description

Light-brown to brown, well-sorted, unconsolidated sand, silt, and clay veneer on undissected surfaces underlain mainly by basin-fill deposits. Marked, in part, by multiple strand lines that outline limit of dwindling glacial lake. Thickness unknown; probably less than 2 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qgo

Unit Name: Glacial outwash deposits (Holocene and Pleistocene)

Map Unit Description

Generally poorly sorted, bouldery, layered sand and gravel deposited by glacial meltwater.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qgt

Unit Name: Glacial till and related deposits (Holocene and Pleistocene)

Map Unit Description

Poorly sorted, unconsolidated deposits of silt, sand, gravel, and boulders in, commonly adjacent to, and locally at the mouths of major alpine valleys. Deposits are both Pinedale and Bull Lake in age; cirque moraines and pretalus ramparts are Holocene in age. Maximum thickness is unknown.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qpg

Unit Name: Pediment deposits (Pleistocene)

Map Unit Description

Weakly dissected deposits of pebbles and cobbles of generally angular to subrounded, unsorted and unconsolidated sedimentary and crystalline rocks in a fine-grained, pale-yellowish-brown matrix. Deposited on gently dipping surfaces related to the development of the Madison Valley. Maximum thickness about 5 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qat3

Unit Name: Alluvium of third youngest terrace level (Pleistocene)

Map Unit Description

Sand and pebble- to boulder-size gravel deposits on terraces along the Ruby River that are about 60-100 m above adjacent stream level.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: QTat

Unit Name: Alluvium of oldest (highest) terrace level (Pleistocene and Pliocene)

Map Unit Description

Isolated sand and pebble- to boulder-size gravel deposits at high elevations in the Gravelly and Centennial Ranges.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tsg

Unit Name: Sand and gravel (Pliocene and Miocene)

Map Unit Description

Thin alluvial and fluvial sand and pebble-size gravel deposits restricted to abandoned stream valleys in the Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qpcu

Unit Name: Plateau Rhyolite, Central Plateau Member, upper part (Pleistocene)

Map Unit Description

Rhyolitic flows erupted from vents in the Yellowstone Caldera; flows contain abundant phenocrysts of mainly quartz and sanidine; plagioclase phenocrysts are conspicuous in their absence. Maximum thickness about 300 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qpcb

Unit Name: Plateau Rhyolite, Central Plateau Member, lower Buffalo Lake flow (Pleistocene)

Map Unit Description

Rhyolitic ash-flow tuff, light-gray, dense, fine-grained to aphanitic with angular to rounded phenocrysts of quartz, sanidine, pyroxene, and olivine that make up as much as 25 percent of volume of rock.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qmr

Unit Name: Madison River Basalt (Pleistocene)

Map Unit Description

Medium- to light-gray, dense basalt that contains moderately abundant plagioclase phenocrysts and rare olivine phenocrysts; occurs as scattered, thin flows in the vicinity of West Yellowstone.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qlcu

Unit Name: Lava Creek Tuff, upper member, informal (Pleistocene)

Map Unit Description

Light-gray, locally pale-red, fine-grained to aphanitic, densely welded ash-flow tuff, with phenocrysts composing as much as 20 percent of rock. Thickness to east of map area ranges from 180 to 300 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qlcl

Unit Name: Lava Creek Tuff, lower member, informal (Pleistocene)

Map Unit Description

Ash-flow tuff lithologically similar to overlying upper member; the two members are separated by a partially welded tuff locally associated with a sorted and bedded crystal ash several cm thick.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Qmb

Unit Name: Mt. Jefferson Rhyolite, Big Bear Lake flow (Pleistocene)

Map Unit Description

Light-gray rhyolite flows conformably underlie Lava Creek Tuff; rhyolite is variable in appearance but contains conspicuous phenocrysts of sanidine, quartz, and plagioclase that make up 30-50 percent of the volume of the rock. Maximum thickness to east of map area is 450 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Thr

Unit Name: Huckleberry Ridge Tuff, undivided (Pliocene)

Map Unit Description

Tuff, mapped in the Gravelly Range, where it thins dramatically to less than 1 m in the north, and in the northern Gallatin Mountains in the northeast part of the quadrangle.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Thru

Unit Name: Huckleberry Ridge Tuff, upper member, informal (Pliocene)

Map Unit Description

Pinkish-gray, gray, to brown welded tuff containing abundant phenocrysts of sanidine and quartz (25 and 10 percent, respectively); uppermost part is locally nonwelded, light pink on weathered surfaces, and contains noncompacted pumice fragments.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Thrl

Unit Name: Huckleberry Ridge Tuff, lower member, informal (Pliocene)

Map Unit Description

Medium- to dark-gray welded tuff with sparse (less than 5 percent) phenocrysts; base of the unit is a vitrophyre overlain by densely welded tuff that becomes only partly welded at the top.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tmv

Unit Name: Mafic volcanic rocks (Miocene and Oligocene)

Map Unit Description

Dark-gray to black, dense, fine-grained flow rock, commonly vesicular or columnar jointed, and containing sparse olivine phenocrysts. Maximum thickness in southern Gravelly Range along the West Fork of the Madison River is near 120 m. In Centennial Range, divided into two similar mafic flow sequences separated by rhyolitic flows (Tfv). Upper flows are basalt to basaltic andesite, sparsely porphyritic, and interlayered with thin, discontinuous beds of mudflow breccia; lower sequence consists of lava flows and flow breccias of dark-gray to brownish-black basalt, basaltic andesite, and gray, brown, and yellowish-brown andesite with fewer mafic flows lowermost in the sequence. All rocks are porphyritic; basaltic rocks contain plagioclase and olivine phenocrysts whereas andesite contains sparse to abundant phenocrysts of plagioclase and at least one mafic mineral in a glassy to aphanitic groundmass. Total thickness about 870 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tfv

Unit Name: Felsic volcanic rocks (Miocene and Oligocene)

Map Unit Description

In Centennial Mountains, consists of two units: upper sequence consists of light-gray, yellowish-gray, and brown porphyritic dacite and rhyodacite flows and flow breccias interlayered with thin, discontinuous beds of mudflow breccia; maximum thickness about 350 m; lower sequence is light- to brownish-gray mudflow breccia and mudstone containing poorly sorted volcanic rock fragments in an ashy matrix; lower sequence ranges in thickness from 0 to 60 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tmi

Unit Name: Mafic intrusive rocks (Miocene and Oligocene)

Map Unit Description

Large to small plugs and sills of basalt and basaltic andesite exposed in western part of map area; largest plug is Black Butte in the Gravelly Range. In eastern part of map area includes sills of dacite porphyry and minor shoshonite.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tav

Unit Name: Absaroka Supergroup volcanic rocks, undivided (Oligocene and Eocene)

Map Unit Description

In Centennial Mountains consists of dark-gray to black, fine-grained to aphanitic pyroxene trachyte porphyry; augite, olivine, and andesine are common phenocrysts. Thickness unknown.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tsc

Unit Name: Six Mile Creek Formation (Miocene)

Map Unit Description

Weakly consolidated. tan to light-orange-brown, laminated, tuffaceous mudstone, siltstone, sandstone, and lithic pebble conglomerate; maximum exposed section along the West Fork of Madison River is about 70 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tre

Unit Name: Renova Formation (Oligocene and Eocene)

Map Unit Description

Weakly consolidated, cream-colored, tuffaceous mudstone commonly containing calcareous concretions, interlayered with lesser amounts of sandy siltstone and granule-pebble conglomerate; maximum exposed thickness at Lion Mountain at the crest of the Gravelly Range, is about 260 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: TKgr

Unit Name: Boulder conglomerate (Paleocene and Upper Cretaceous)

Map Unit Description

Unconsolidated cobbles and boulders of subrounded metamorphic rock in scattered exposures along the crest of the Gravelly Range; maximum preserved thickness about 10 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kbel

Unit Name: Limestone and conglomerate, Beaverhead Group (Upper Cretaceous)

Map Unit Description

Limestone and limestone conglomerate interbedded with varying amounts of siltstone and sandstone. Best exposures are at Red Hill in the Gravelly Range where basal siltstone and limestone conglomerate are interlayered with lenses of well-rounded quartzite gravel in an angular quartz sand matrix; gravel is similar to underlying stream gravel deposits (Kbeg) and may have been derived, in part, from these fluvial deposits. The lacustrine limestone consists of medium- to coarse-crystalline, light-gray limestone locally containing abundant snails, stromatolites, and oncolites; also commonly interlayered with coarse-grained sandstone, siltstone, and intraformational limestone rip-up conglomerate. Many of the conglomerate lenses consist of clasts of locally derived Paleozoic rocks upon which these rocks rest; they are confined to paleovalleys that, in the Gravelly Range, drained from west to east. Maximum thickness is about 20 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kbeg

Unit Name: Gravel and sand, Beaverhead Group (Upper Cretaceous)

Map Unit Description

Unconsolidated, well-rounded pebble- to cobble-size stream deposits composed chiefly of quartzite derived from Mesoproterozoic Lemhi Group and Belt Supergroup exposed to the northwest and west of Gravelly Range, beyond the borders of the Hebgen Lake quadrangle; thickness about 10 m or less.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kbes

Unit Name: Sandstone of Beaverhead Group (Upper Cretaceous)

Map Unit Description

Poorly exposed buff to brown, silty sandstone interlayered with lenses of well-rounded to subrounded cobbles and boulders of metamorphic rock; present in the northern Centennial Valley and southernmost Gravelly Range; thickness may be as much as 725 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kevv

Unit Name: Everts(?) Formation and Virgelle Sandstone (Upper Cretaceous)

Map Unit Description

Everts(?) Formation - Light- to dark-gray, thin- to thick-bedded, fine- to medium-grained, quartz-rich sandstone and interbedded siltstone; includes sparse mudstone, porcellanite, and dark gray limestone. Lower 60-90 m are thinly interbedded mudstone, siltstone, shale, coal, and minor crossbedded sandstone. Formation is about 425 m thick.

Virgelle Sandstone - Thin- to thick-bedded, medium- to coarse-grained, crossbedded sandstone forming prominent white-weathering ledges. Thickness ranges from 23 to 50 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Ktc

Unit Name: Telegraph Creek Formation (Upper Cretaceous)

Map Unit Description

Upper half consists of light-brown-weathering mudstone and siltstone with thin interbeds of light-gray sandstone that locally contain chert-pebble lags and glauconite. Middle 20 m consists of conspicuous white-weathering, finely laminated tuffaceous siltstone. Lower 75 m consists of slope-forming siltstone and mudstone in upper part that overlies lowermost "salt and pepper", ripple-marked sandstone. Total thickness about 206 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kco

Unit Name: Cody Shale (Upper Cretaceous)

Map Unit Description

Dark-gray, thin-bedded, locally micaceous and silty mudstone with thin interbeds of gray-green siltstone and fine-grained sandstone. About 300 m thick.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kf

Unit Name: Frontier Formation (Upper Cretaceous)

Map Unit Description

Interbedded sandstone, siltstone, mudstone, carbonaceous shale and coal seams, and minor limestone. Sandstone is predominantly medium light gray to yellowish or greenish gray, very fine to medium grained and commonly calcareous. Coarse-grained varieties include subangular lithic sand grains of chert, feldspar, and biotite; locally conglomeratic, containing well-rounded pebbles of quartzite and chert. Sandstone beds generally less than 1 m, but occur in layered units as much as 7 m in thickness. Siltstone and mudstone are olive gray and medium to dark gray and are bentonitic and porcellanitic. Limestone is thin-bedded to nodular, light to medium gray, and micritic. Thickness ranges from about 870 m directly north of the Gravelly Range, to 2100 m near the southern part of the Gravellys, and thins to 120 m in the Madison Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Km

Unit Name: Mowry Formation (Lower Cretaceous)

Map Unit Description

Slope-forming dark-gray mudstone and silty mudstone interbedded with minor siltstone, sandstone and bentonite with organic-rich shale in the upper part. Lower part is light colored pink, gray green, green, and orange-cream colored mudstone, bentonitic mudstone, and porcellanite interlayered with welded tuff, mudstone, siltstone, and minor quartz sandstone. Generally poorly exposed because of slumping; in the Gravelly Range the Mowry is the site of pronounced landsliding. Formation is about 150 to 180 m thick.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kmd

Unit Name: Muddy Formation (Lower Cretaceous)

Map Unit Description

Formation consists of three parts: upper part consists of light-gray, thin- to medium-bedded, fine- to coarse-grained quartz sandstone, feldspathic sandstone, and arkose; middle part is dark-gray, thin-bedded siltstone, sandstone, and shale; lower part is greenish-gray to tan, fine- to medium-grained sandstone. The middle member thins to the west and is absent in the Gravelly Range. Thickness ranges from 0 to about 110 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kt

Unit Name: Thermopolis Shale (Lower Cretaceous)

Map Unit Description

Dark-gray to black, fissile, organic-rich shale in the upper part overlies light- to dark-brown-weathering, thin- to medium-bedded, fine- to medium-grained sandstone. Thickness ranges from about 50 to 75 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

Upper 15 m consists of conspicuous, ledge-forming, medium- to thick-bedded, light-gray fresh water limestone that contains abundant gastropods. Middle part is a slope-forming gray, maroon, yellow, red, and purple mudstone with siltstone, sandstone, and, in the lower part, minor limestone. Lower part is thick-bedded, cherty, crossbedded, quartz-rich sandstone and minor, well-rounded chert-pebble conglomerate. Thickness about 125 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Jme

Unit Name: Morrison and Ellis Formations, undivided (Upper and Middle Jurassic)

Map Unit Description

Morrison Formation - Interbedded red, green, gray, and yellowish siltstone, mudstone, and shale locally interlayered with thin beds of dense, fine-grained limestone; in Madison Range the upper part includes yellowish-tan, medium-bedded sandstone lenses as much as 20 m thick; formation is generally poorly exposed and forms reddish-colored slopes. Maximum thickness is about 100 m.

Ellis Group:
Swift Formation - Thin- to medium-bedded, medium- to coarse-grained, calcareous, locally chert-bearing quartz sandstone that contains abundant ooids and shell fragments; lowermost part is olive-green shale and claystone. The Swift is the only formation of the Ellis Group exposed in the western part of the map area. Thickness ranges from about 1 to 30 m.

Rierdon Formation - Light-gray to pale brown, thin- to thick-bedded, dense, oolitic limestone locally containing sparse chert pebbles. Formation is absent in western part of map area; maximum thickness is about 30 m.

Sawtooth Formation - Thin-bedded, light- to dark-gray limestone with local shaly to silty limestone interbeds; locally fossiliferous and oolitic. Formation absent in western part of map area; maximum thickness about 55 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Jm

Unit Name: Morrison Formation (Upper Jurassic)

Map Unit Description

Interbedded red, green, gray, and yellowish siltstone, mudstone, and shale locally interlayered with thin beds of dense, fine-grained limestone; in Madison Range the upper part includes yellowish-tan, medium-bedded sandstone lenses as much as 20 m thick; formation is generally poorly exposed and forms reddish-colored slopes. Maximum thickness is about 100 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Je

Unit Name: Ellis Group (Upper and Middle Jurassic)

Map Unit Description

Swift Formation - Thin- to medium-bedded, medium- to coarse-grained, calcareous, locally chert-bearing quartz sandstone that contains abundant ooids and shell fragments; lowermost part is olive-green shale and claystone. The Swift is the only formation of the Ellis Group exposed in the western part of the map area. Thickness ranges from about 1 to 30 m.

Rierdon Formation - Light-gray to pale brown, thin- to thick-bedded, dense, oolitic limestone locally containing sparse chert pebbles. Formation is absent in western part of map area; maximum thickness is about 30 m.

Sawtooth Formation - Thin-bedded, light- to dark-gray limestone with local shaly to silty limestone interbeds; locally fossiliferous and oolitic. Formation absent in western part of map area; maximum thickness about 55 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Trwd

Unit Name: Woodside and Dinwoody Formations, undivided (Lower Triassic)

Map Unit Description

Woodside Formation - Brick-red to orange-red, thin-bedded siltstone and mudstone interbedded with gypsum and thin, discontinuous limestone beds; uppermost strata are silty and locally crossbedded. Thickness ranges from 0 to about 220 m.

Dinwoody Formation - Tan to pale-brown-weathering, finely laminated, calcareous siltstone in the upper part; grades downward into chocolate-brown-weathering gray to tan limestone, silty limestone and siltstone. Thickness is variable, ranging from about 20 to 80 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Trw

Unit Name: Woodside Formation (Lower Triassic)

Map Unit Description

Brick-red to orange-red, thin-bedded siltstone and mudstone interbedded with gypsum and thin, discontinuous limestone beds; uppermost strata are silty and locally crossbedded. Thickness ranges from 0 to about 220 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Trd

Unit Name: Dinwoody Formation (Lower Triassic)

Map Unit Description

Tan to pale-brown-weathering, finely laminated, calcareous siltstone in the upper part; grades downward into chocolate-brown-weathering gray to tan limestone, silty limestone and siltstone. Thickness is variable, ranging from about 20 to 80 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Psh

Unit Name: Shedhorn Sandstone (Permian)

Map Unit Description

Uppermost medium-bedded, fine- to coarse-grained sandstone with minor chert lenses grades downward into yellowish- to dark-brown, thin-bedded chert with silty, locally phosphatic partings; lower part is brown to gray, thin- to medium-bedded sandstone that grades downward into yellowish-gray, medium-bedded dolomite and sandy dolomite locally containing abundant chert fragments. Equivalent to Phosphoria Formation. Thickness is variable, ranging from about 35 to 70 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Pq

Unit Name: Quadrant Sandstone (Pennsylvanian)

Map Unit Description

White to tan, medium- to thick-bedded, clean, well-sorted quartz sandstone; lower part contains thin interbeds of pale-brown dolomite and gray limestone. Thickness is 60-100 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: PMa

Unit Name: Amsden Formation (Lower Pennsylvanian and Upper Mississippian)

Map Unit Description

Dark-red, gray-red, and pinkish-red, thin-bedded, calcareous siltstone, silty shale, and shale; upper part of formation contains interbeds of medium- to coarse-grained, calcareous sandstone whereas the lower part is interbedded with thin-bedded limestone, limestone-pebble conglomerate, and dolomite. Thickness ranges from about 10 to 50 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Mm

Unit Name: Madison Group, undivided (Upper and Lower Mississippian)

Map Unit Description

Group ranges in thickness from about 400 to 700 m.

Mission Canyon Limestone (Upper and Lower Mississippian) - Commonly cliff-forming, thick-bedded, light-gray-weathering, cherty, fine-grained limestone and minor dolomite; uppermost few meters of formation contain prominent orangish-gray-weathering solution breccia.

Lodgepole Limestone (Lower Mississippian) - Slope- to ledge-forming, thin- to medium-bedded, light-gray, finely crystalline, fossiliferous limestone with brownish silty limestone partings.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: MDt

Unit Name: Three Forks Formation (Lower Mississippian and Upper Devonian)

Map Unit Description

Consists of three members, from top to bottom: Yellowish-tan calcareous siltstone and silty limestone (Sappington Member, maximum thickness 25 m); gray-green, fissile, micaceous shale (Trident Member, maximum thickness 6 m); yellowish-grey vuggy limestone and dolomite underlain by olive-green micaceous shale (Logan Gulch Member, maximum thickness 12 m).

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Dj

Unit Name: Jefferson Formation (Upper Devonian)

Map Unit Description

Light-gray, tan, yellowish-brown, and dark-gray, fine-crystalline to sucrosic dolomite locally interbedded with 1-m-thick silty, shaly, laminated dolomite; in Madison Range, includes uppermost, massive, ledge-forming dolomite breccia (Birdbear Member). Maximum thickness about 100 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: OCs

Unit Name: Bighorn(?) Dolomite, Snowy Range Group, and Pilgrim Limestone, undivided (Ordovician and Upper Cambrian)

Map Unit Description

Bighorn(?) Dolomite (Ordovician) - Light-gray, thin-bedded, dense cryptocrystalline dolomite. About 11 m thick.

Snowy Range Group (Upper Cambrian) - Tan, thin-bedded limestone with reddish mottles underlain by greenish, thin-bedded dolomite and dolomitic mudstone that grades downward into red, calcareous siltstone and green sandy shale. Formation is about 300 m thick.

Pilgrim Limestone (Upper Cambrian) - Light-gray, yellowish-brown to gray-brown, thin- to medium-bedded, glauconitic dolomitic limestone; mud-chip conglomerate and oolitic beds are locally common. Thickness is approximately 60 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cppm

Unit Name: Pilgrim, Park, and Meagher Formations, undivided (Upper Cambrian)

Map Unit Description

Pilgrim Limestone - Light-gray, yellowish-brown to gray-brown, thin- to medium-bedded, glauconitic dolomitic limestone; mud-chip conglomerate and oolitic beds are locally common. Thickness is approximately 60 m.

Park Shale - Greenish-gray to reddish-gray, fissile, locally waxy-looking shale interbedded with minor limestone, limestone-pebble conglomerate, and oolitic limestone. Poorly exposed everywhere and perhaps locally missing in the Gravelly Range. Locally included with the underlying Meagher Formation where too thin to show on map. Thickness 0 to 30 m.

Meagher Formation - Light-gray to brownish-gray, thin to medium-bedded, finely crystalline limestone with thin partings of calcareous shale in upper and lower parts; characteristically contains irregular orange-yellow silty mottles; locally interbedded with cm-thick oolitic limestone. Basal few meters of formation in the Gravelly Range, where it directly overlies Paleoproterozoic metasedimentary rocks, are characterized by calcareous-cemented lag gravel deposits. In Gravelly Range, locally includes thin, unmapped deposits of Wolsey and Flathead Formations. Maximum thickness about 150 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cpi

Unit Name: Pilgrim Limestone (Upper Cambrian)

Map Unit Description

Light-gray, yellowish-brown to gray-brown, thin- to medium-bedded, glauconitic dolomitic limestone; mud-chip conglomerate and oolitic beds are locally common. Thickness is approximately 60 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cp

Unit Name: Park Shale (Middle Cambrian)

Map Unit Description

Greenish-gray to reddish-gray, fissile, locally waxy-looking shale interbedded with minor limestone, limestone-pebble conglomerate, and oolitic limestone. Poorly exposed everywhere and perhaps locally missing in the Gravelly Range. Locally included with the underlying Meagher Formation where too thin to show on map. Thickness 0 to 30 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cm

Unit Name: Meagher Formation (Middle Cambrian)

Map Unit Description

Light-gray to brownish-gray, thin to medium-bedded, finely crystalline limestone with thin partings of calcareous shale in upper and lower parts; characteristically contains irregular orange-yellow silty mottles; locally interbedded with cm-thick oolitic limestone. Basal few meters of formation in the Gravelly Range, where it directly overlies Paleoproterozoic metasedimentary rocks, are characterized by calcareous-cemented lag gravel deposits. In Gravelly Range, locally includes thin, unmapped deposits of Wolsey and Flathead Formations. Maximum thickness about 150 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cwf

Unit Name: Wolsey and Flathead Formations, undivided (Middle Cambrian)

Map Unit Description

Wolsey Formation - Gray-green to dark-gray, fissile, micaceous shale interbedded with minor, thin limestone beds similar to mottled limestone of the overlying Meagher Formation as well as thin, glauconitic, quartzose sandstone similar to underlying Flathead Sandstone. Locally missing in the Gravelly and Centennial Ranges. Thickness 0 to 60 m.

Flathead Sandstone - White, tan to reddish-brown, hematitic, thin-to medium-bedded, fine- to medium-grained quartz to feldspathic sandstone; interlayered with greenish shale in upper part; glauconitic locally. Where unmapped in the Centennial and Gravelly Ranges, formation may be missing or so thin that it is included in the overlying Meagher Formation. Thickness 0 to 30 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cw

Unit Name: Wolsey Formation (Middle Cambrian)

Map Unit Description

Gray-green to dark-gray, fissile, micaceous shale interbedded with minor, thin limestone beds similar to mottled limestone of the overlying Meagher Formation as well as thin, glauconitic, quartzose sandstone similar to underlying Flathead Sandstone. Locally missing in the Gravelly and Centennial Ranges. Thickness 0 to 60 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Cf

Unit Name: Flathead Sandstone (Middle Cambrian)

Map Unit Description

White, tan to reddish-brown, hematitic, thin-to medium-bedded, fine- to medium-grained quartz to feldspathic sandstone; interlayered with greenish shale in upper part; glauconitic locally. Where unmapped in the Centennial and Gravelly Ranges, formation may be missing or so thin that it is included in the overlying Meagher Formation. Thickness 0 to 30 m.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xmy

Unit Name: Mylonite

Map Unit Description

Mylonitization of rocks occurred about 1.8 Ga, coeval with the mylonitic rocks to the east, in the Madison Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xgr

Unit Name: Granite

Map Unit Description

A granitic stock in the north part of the Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xgbc

Unit Name: Gabbro, chloritized

Map Unit Description

Gabbroic intrusive rocks are weakly tectonized and are associated with contact metamorphic aureoles marked by porphyroblasts of andalusite or staurolite or both in pelitic rocks around their perimeters. Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xgb

Unit Name: Gabbro

Map Unit Description

Gabbroic intrusive rocks are weakly tectonized and are associated with contact metamorphic aureoles marked by porphyroblasts of andalusite or staurolite or both in pelitic rocks around their perimeters. Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xq4

Unit Name: Quartzite member 4

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O'Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xph3

Unit Name: Phyllite member 3

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O’Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xph2

Unit Name: Phyllite member 2

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O’Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xq3

Unit Name: Quartzite member 3

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O’Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xks

Unit Name: Knotted mica schist

Map Unit Description

Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xif

Unit Name: Iron formation

Map Unit Description

Sedimentary iron formation occurs in the middle of the sequence of Late Paleoproterozoic tectonites, metasedimentary rocks, and associated igneous rocks and is a marker horizon throughout the Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xph1

Unit Name: Phyllite member 1

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O'Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xq2

Unit Name: Quartzite member 2

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O'Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xqms

Unit Name: Quartz-mica schist

Map Unit Description

Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xq1

Unit Name: Quartzite member 1

Map Unit Description

This is one unit in a weakly metamorphosed rock sequence interpreted to represent a sequence of late Paleoproterozoic clastic foreland basin deposits (O'Neill, 1999) consisting mainly of sandstone and shale. Exposed only in Gravelly Range

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xqfb

Unit Name: Quartz-feldspar-biotite gneiss

Map Unit Description

Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Xpm

Unit Name: Pegmatite and metasedimentary rocks, undivided

Map Unit Description

Exposed only in Gravelly Range.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAgd

Unit Name: Granodioritic gneiss (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Foliated granodiorite occurs as intrusive sills that locally show crosscutting relationships and chilled margins. The rock is equigranular and composed of plagioclase, quartz, microcline, hornblende, and biotite.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAam

Unit Name: Amphibolite (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Amphibolite dikes and sills in the Madison Range range from infolded, disjointed units to tabular sheets with sharp, planar contacts; mapped units were probably originally gabbroic intrusive rock. In the Centennial Range and Horn Mountains, amphibolite is green to greenish brown, schistose to massive, generally fine grained, and locally porphyroblastic; actinolite makes up as much as 50-90 percent of rock.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAm

Unit Name: Marble (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Massive, light-gray to cream-colored dolomitic marble interlayered with thin quartzite bands; schistosity defined by aligned chlorite and phlogopite, and flattened dolomite grains. In thin section, dolomite dominates the marble; calcite is associated with quartzite layers only; quartz is present generally as granular bands within marble.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAq

Unit Name: Quartzite (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Light-green, poorly banded quartzite interfingers with adjacent biotite schist and marble; quartzite has been completely recrystallized and does not show clastic textures or graded bedding.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAms

Unit Name: Mica schist (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Interlayered rusty-yellow-weathering, quartz-rich muscovite schist and thin quartzite; locally contains abundant magnetite, chlorite, biotite, and poikiloblastic garnet.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAcs

Unit Name: Chlorite-biotite schist (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Well-banded chlorite-biotite schist and gneiss containing variable amounts of quartz and epidote are interlayered with green phyllonite, chloritic schist with quartz augen, and granulated amphibolite.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: XAbs

Unit Name: Biotite schist and gneiss (Early Paleoproterozoic(?) - Late Archean)

Map Unit Description

Compositional layering of biotite-rich metamorphic rocks is defined by relative proportions of quartz, biotite, garnet, and muscovite. One- to 3-m-thick beds of biotite-rich metasandstone with well-preserved clastic textures separated by thinner beds of metapelite are common. Biotite schist is also interlayered with marble and is associated with chlorite-quartz schist and well-banded quartzite similar to banded cherts associated with iron formation.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Aum

Unit Name: Ultramafic rock (Middle Archean)

Map Unit Description

Pods and lenses of hornblende-rich rock consisting mainly of, from rim to core, hornblende and biotite, actinolite and biotite, chlorite, talc and carbonate, anthophyllite, and a core of serpentine.

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Ag

Unit Name: Granite and granitic gneiss (Middle Archean)

Map Unit Description

Pink, foliated granitic rocks show weakly to strongly discordant contacts with adjacent rocks. Rock composition and texture is variable, ranging from medium-grained and equigranular with faint layering defined by aligned biotite, to highly folded and contorted leucogranite enclosing granodioritic xenoliths, to mafic, folded granite and granite gneiss. Northernmost exposures of granitic gneiss in Madison Range contain conspicuous elongate feldspar augen.

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Aqfb

Unit Name: Quartz-feldspar-biotite gneiss and migmatite (Middle Archean)

Map Unit Description

Weakly foliated granitic gneiss; locally strongly deformed. Commonly cut by veins of equigranular granite and pegmatite. Similar in texture to granitic gneiss (Ag) but is less mafic and generally concordant.

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Adi

Unit Name: Dioritic gneiss (Middle Archean)

Map Unit Description

White-and-green-spotted, well-foliated plagioclase-hornblende-quartz rock occurs as thin sills and small stocks. Sills typically consist of 60-80 percent plagioclase, hornblende, and minor quartz; stocks are more felsic and include biotite and as much as 30 percent quartz.

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: At

Unit Name: Tonalitic gneiss (Middle Archean)

Map Unit Description

Tonalitic migmatite-gneiss and tonalitic biotite gneiss are highly variable both texturally and compositionally; gneiss includes amphibolitic migmatite breccia, leucotonalite gneiss, and dark-gray tonalitic biotite gneiss with moderate migmatite banding. Locally tonalite gneiss is interlayered with a mixed gneiss composed of green quartzite, biotite-garnet gneiss, amphibolite and garnet amphibolite, and gedrite-cordierite-bearing gneiss. All tonalitic rocks consist of essential plagioclase, quartz, hornblende, and biotite with a granoblastic texture. Also included with these rocks is migmatitic granite gneiss characterized by granite leucosomes containing abundant microcline between thin layers enriched in plagioclase, biotite and, locally, hornblende.

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tv

Unit Name: Volcanic vent (Miocene and Oligocene)

Map Unit Description

Basaltic scoria, flows, and volcanic ejectamenta in a cone-shaped deposit on Lion Mountain.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Aqfp

Unit Name: Pegmatitic quartz-feldspar gneiss (Middle Archean)

Map Unit Description

Well foliated, fine-to medium-grained granitic gneiss cut by abundant, coarse-grained quartz-feldspar pegmatite. Unit is intruded by adjacent granite (Xgr).

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: d

Unit Name: Dike

Map Unit Description

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Tv

Unit Name: Volcanic rocks, undivided (Miocene and Oligocene)

Map Unit Description

Rocks of a volcanic vent, located along north map border in northwest part of map.

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HebgenLake_rect

Map Title

Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho

Map name: Hebgen Lake, MT 100K

Map Unit Symbol: Vqfp

Unit Name: Quartz-feldspar-biotite gneiss and pegmatite

Map Unit Description

Well-foliated, fine- to medium-grained granitic gneiss cut by abundant, coarse-grained quartz-feldspar pegmatite. Intruded by adjacent granite (Xgr).

[Middle Archean amphibolite- to granulite-grade metamorphic tectonites and associated igneous rocks; relative ages uncertain. Middle Archean (>3.1 Ga) age has been confirmed by U-Pb zircon ages from crystalline rocks collected from southern Madison Range (Shuster and others, 1987)]

Map Citation

O'Neill, J.M., and Christiansen, R.L., 2004, Geologic map of the Hebgen Lake quadrangle, Beaverhead, Madison and Gallatin counties, Montana, Park and Teton counties, Wyoming, and Clark and Fremont counties, Idaho [version 1.0 (Feb. 9, 2004)]: U.S. Geological Survey Scientific Investigations Map 2816, scale 1:100000

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qa

Unit Name: Alluvium (Quaternary)

Map Unit Description

Unconsolidated silt, sand, and gravel along modern-day streams

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qc

Unit Name: Colluvium (Quaternary)

Map Unit Description

Unconsolidated deposits consisting mainly of slope wash and talus

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qac

Unit Name: Alluvium and colluvium. undivided (Quaternary)

Map Unit Description

Unconsolidated mantle of alluvium, colluvium, and, near Lake Helena, wind-blown silt

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qls

Unit Name: Landslide deposits (Quaternary)

Map Unit Description

Unconsolidated earthflow deposits that contain a mixture of rock materials ranging from silt to boulders in size

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qg

Unit Name: Glacial deposits, undivided (Quaternary)

Map Unit Description

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Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qgt

Unit Name: Glacial till (Quaternary)

Map Unit Description

Unconsolidated deposits of unsorted and unstratified clay, silt, sand, gravel, and boulders; in general lacks morainal form

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qgo

Unit Name: Glacial outwash deposits (Quaternary)

Map Unit Description

Unconsolidated clay, silt, sand, and gravel deposited from meltwater streams that flowed from glaciers; generally stratified

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Qgs

Unit Name: Glacial-lake deposits (Quaternary)

Map Unit Description

Sand, silt, and clay that is sorted, stratified, and firmly compacted. Present in vicinity of Missouri River

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: QTg

Unit Name: Conglomerate (Quaternary or Tertiary)

Map Unit Description

Unconsolidated gravel and fan deposits, and conglomerate in northern part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ts

Unit Name: Stream and lake deposits, undivided (Tertiary)

Map Unit Description

Sandstone, siltstone, claystone, shale, marl, siliceous sinter, and minor poorly sorted conglomerate; locally carbonaceous and tuffaceous; rare coal and limestone. Volcaniclastic components common.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tbz

Unit Name: Bozeman Group, undivided (Tertiary)

Map Unit Description

In southeastern most part of Big Belt Mountains, interbedded siltstone and tuff. Along central and southwestern most flank of Big Belt Mountains, composed of tuffaceous conglomerate and sandstone, subordinate stream-laid siltstone, freshwater limestone, and volcanic ash.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgs

Unit Name: Golden Spike Formation (Upper Cretaceous)

Map Unit Description

Sandstone and conglomerate that includes both volcaniclastic and non-volcaniclastic units; and lava flows and flow breccias. Present only in westernmost part of Forest.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ket

Unit Name: Slim Sam Formation, Eagle Sandstone, and Telegraph Creek Formation (Upper Cretaceous)

Map Unit Description

Slim Sam Formation lies at top of sequence and is composed of interbedded volcaniclastic sandstone, tuff, and lapilli tuff; present only in Elkhorn Mountains. Eagle Sandstone consists of ledge-forming chert-rich sandstone; in Elkhorn Mountains locally contains fossil marine placers of magnetite. Telegraph Creek Formation consists of marine mudstone, siltstone, and sandstone.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kb

Unit Name: Blackleaf Formation, undivided (Upper and Lower Cretaceous)

Map Unit Description

In descending order, includes Vaughn, Taft Hill, and Flood Members, described below

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kbv

Unit Name: Vaughn Member (Upper Cretaceous)

Map Unit Description

Upper part is dark siliceous sandstone and interbedded siliceous shale and siltstone; light gray porcellanite and lapilli tuff. Middle part is lenticular conglomerate of quartzite and chert clasts in matrix of sandstone. Lower part is sandstone interbedded with shale, bentonitic mudstone, and siltstone; some interbeds of limestone and limestone concretions. Present in western part of Forest

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kbtf

Unit Name: Taft Hill and Flood Members (Lower Cretaceous)

Map Unit Description

Taft Hill consists of sandstone and dark shale, mudstone, and siltstone. Flood consists of sandstone in upper part and dark gray fissile shale and minor interbedded siltstone in lower part. Present in western part of Forest

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kc

Unit Name: Colorado Group (Upper and Lower Cretaceous)

Map Unit Description

In descending order, includes Cody Shale (Upper Cretaceous), Frontier Formation (Upper Cretaceous), Mowry Shale (Upper Cretaceous), and Thermopolis Formation (Lower Cretaceous). Cody consists of dark gray mudstone, and minor interbedded siltstone and sandstone. Frontier consists of light-gray sandstone, siltstone, and lesser interbedded mudstone. Mowry consists of sandstone, siltstone, tuffaceous siltstone, mudstone. and tuffaceous mudstone. Thermopolis consists of dark-gray fissile shale in upper part and rusty-brown quartz-rich sandstone and interbedded siltstone in lower part. Present in Elkhorn Mountains and southern part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kk

Unit Name: Kootenai Formation (Lower Cretaceous)

Map Unit Description

In Elkhorn Mountains and southern part of Big Belt Mountains. upper part is light-gray freshwater limestone, medial part is reddish orange mudstone and interbedded siltstone, and lower part is gray chert-rich sandstone and conglomeratic sandstone. In remainder of Forest, uppermost part in interbedded red to green shale, mudstone, siltstone, and light-gray sandstone; light-gray freshwater limestone and dolomite, and minor interbedded shale, siltstone, and sandstone; medial part is reddish orange mudstone, siltstone, shale, and light-gray sandstone; dark-gray shale and interbedded sandstone and siltstone; basal part is light-gray vitreous quartzite

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: KJu

Unit Name: Mesozoic rocks, undivided (Cretaceous and Jurassic)

Map Unit Description

Includes the following map units, described above and below. Blackleaf Formation; Kootenai Formation; Jurassic rocks, undivided. Present only in northern part of Big Belt Mountains and directly west of Helena

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ju

Unit Name: Jurassic rocks, undivided (Upper and Middle Jurassic)

Map Unit Description

In descending order, includes Morrison Formation (Upper Jurassic), Swift Formation (Upper and Middle Jurassic), Rierdon Formation (Middle Jurassic), and Sawtooth Formation (Middle Jurassic). Morrison consists of gray to reddish purple and orange mudstone, shale, siltstone, and sandstone. Swift consists of gray calcareous sandstone and conglomeratic sandstone, and minor interbeds of siltstone and shale. Rierdon consists of gray calcareous shale and siltstone and interbedded limestone. Sawtooth consists of gray calcareous sandstone and siltstone, and lesser amounts of shale and limestone

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: [PPu

Unit Name: Upper Paleozoic rocks, undivided (Permian, Pennsylvanian, and Mississippian)

Map Unit Description

Includes the following map units, described below. Phosphoria Formation and Quadrant Formation, undivided; Amsden Formation and Big Snowy Group, undivided. Present only in northern part of Big Belt Mountains

Phosphoria consists of gray phosphorite, phosphatic and calcareous sandstone, siltstone, shale, black phosphatic chert, and limestone.   In Big Belt and Elkhorn Mountains and near Helena, in southern part of Big Belt Mountains, consists of chert, phosphatic sandstone, limestone, and quartzose sandstone; in northern part of Big Belt Mountains, consists of chert and cherty sandstone; in Elkhorn Mountains and near Helena, consists mainly of chert and quartzitic sandstone, but locally contains one to two thin beds of phosphatic rock.

Quadrant consists of light-gray tightly cemented quartz-rich sandstone, locally with interbeds of siltstone and dolomite at base

Amsden consists of reddish orange mudstone, shale, sandstone, and gray limestone and dolomite; present only in Big Belt Mountains and Elkhorn Mountains.

Big Snowy Group, in descending order, comprised of Heath, Otter, and Kibbey Formations. Heath consists of gray limestone, petroliferous limestone and shale, and calcareous sandstone. Otter consists of varicolored shale, limestone, and siltstone. Kibbey consists of gray shale, siltstone, limestone, and calcareous sandstone. Big Snowy Group present only in Big Belt Mountains.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: [PPq

Unit Name: Shedhorn Sandstone, Phosphoria Formation, and Park City Formation (Permian), Quadrant Formation (Pennsylvanian), and Snowcrest Range Group (Lower Pennsylvanian and Upper Mississippian), undivided

Map Unit Description

Shedhorn consists of gray siliceous sandstone. Phosphoria consists of gray phosphorite, phosphatic and calcareous sandstone, siltstone, shale, black phosphatic chert, and limestone. Park City consists of gray limestone, cherty limestone, calcareous siltstone, and sandstone. Snowcrest Range Group, in descending order, consists of lateral equivalents of Conover Ranch Formation (Lower Pennsylvanian and Upper Mississippian), Lombard Limestone (Upper Mississippian), and Kibbey Sandstone (Upper Mississippian) Conover Ranch and its lateral equivalents consists of reddish brown to reddish purple calcareous shale and siltstone. Lombard consists of gray limestone and dolomite. Kibbey consists of gray to red calcareous shale, siltstone, and sandstone.

In Big Belt and Elkhorn Mountains and near Helena:

Phosphoria: in southern part of Big Belt Mountains, consists of chert, phosphatic sandstone, limestone, and quartzose sandstone; in northern part of Big Belt Mountains, consists of chert and cherty sandstone; in Elkhorn Mountains and near Helena, consists mainly of chert and quartzitic sandstone, but locally contains one to two thin beds of phosphatic rock.

Throughout Forest:

Quadrant consists of light-gray tightly cemented quartz-rich sandstone, locally with interbeds of siltstone and dolomite at base

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: [PMa

Unit Name: Amsden Formation (Pennsylvanian and Mississippian), Tyler Formation (Mississippian), and Big Snowy Group (Upper Mississippian)

Map Unit Description

Amsden consists of reddish orange mudstone, shale, sandstone, and gray limestone and dolomite; present only in Big Belt Mountains and Elkhorn Mountains. Tyler Formation consists of pale brown sandstone; present only in Dry Range area, northeast of Big Belt Mountains. Big Snowy Group, in descending order, comprised of Heath, Otter, and Kibbey Formations. Heath consists of gray limestone, petroliferous limestone and shale, and calcareous sandstone. Otter consists of varicolored shale, limestone, and siltstone. Kibbey consists of gray shale, siltstone, limestone, and calcareous sandstone. Big Snowy Group present only in Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Mm

Unit Name: Madison Group (Upper and Lower Mississippian)

Map Unit Description

Includes Mission Canyon Formation (Upper and Lower Mississippian) and Lodgepole Formation (Lower Mississippian); and in Choteau quadrangle, Castle Reef Dolomite (Upper and Lower Mississippian) and Allan Mountain Limestone (Lower Mississippian). All units are composed of limestone and (or) dolomite; local chert

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: MDCu

Unit Name: Lower Paleozoic rocks, undivided (Mississippian, Devonian, and Cambrian)

Map Unit Description

Includes the following map units, described above and below. Madison Group; Three Forks Formation and Jefferson Formation, undivided; Cambrian formations, undivided. Present only in northern part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: MDu

Unit Name: Three Forks Formation (Lower Mississippian and Upper Devonian), Jefferson Formation (Upper Devonian), and Maywood Formation (Lower Devonian)

Map Unit Description

Three Forks consists of varicolored shale. siltstone, limestone, and locally minor thin beds of sandstone. Jefferson consists of gray to brown dolomite, limestone, limestone breccia, and dark-gray fetid dolomite; minor siltstone and shale. Maywood consists of reddish and yellowish gray siltstone and interbedded limestone and dolomite; sandstone present locally. Maywood in southern part of Big Belt Mountains is included with Cambrian formations, undivided, below

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Cu

Unit Name: Cambrian Formations, undivided (Middle Cambrian)

Map Unit Description

Includes Upper Snowy Range Formation (Upper Cambrian), Pilgrim Limestone (Upper Cambrian), Park Shale (Middle Cambrian), Meagher Limestone (Middle Cambrian), Wolsey Shale (middle Cambrian), and Flathead Sandstone (Middle Cambrian). Also includes Maywood Formation (Lower Devonian), described above, in southern part of Big Belt Mountains. Snowy Range consists of limestone and dolomite, including pebble conglomerate, and intervals of micaceous shale and siltstone. Pilgrim consists of yellowish gray to brown limestone and dolomite; green clay shale in lower part. Park consists of green fissile clay shale and minor interbeds of siltstone and limestone; local limestone pebble conglomerate. Meagher consists of light gray limestone and dolomite. Wolsey consists of greenish gray micaceous shale and glauconitic siltstone, and minor limestone and quartzite. Flathead consists of gray to maroon quartz sandstone, locally conglomeratic. Map unit present only east of 112º longitude

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Crh

Unit Name: Red Lion and Hasmark Formations (Upper Cambrian)

Map Unit Description

Red Lion consists of gray limestone and discontinuous bands of siliceous dolomite, and interbedded gray limestone and varicolored shale. Hasmark consists of gray dolomite and limestone, minor local interbeds of green shale and siltstone. Map unit present only west of 112º longitude

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Cmu

Unit Name: Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone, undivided (Middle Cambrian)

Map Unit Description

Formations described above. Map unit present only west of 112º longitude

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Cmw

Unit Name: Silver Hill Formation and Flathead Sandstone (Middle Cambrian)

Map Unit Description

Silver Hill consists of green clay shale, medium-gray limestone, and, in lower part, minor interbedded siltstone, sandstone, and shale. Flathead described above. Present only in vicinity of Elliston

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ym

Unit Name: McNamara Formation (Middle Proterozoic)

Map Unit Description

Varicolored argillite, siltite, and metasandstone that ranges from feldspathic to quartz-rich; locally contains glauconite and chert

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ybo

Unit Name: Bonner Formation (Middle Proterozoic)

Map Unit Description

Pale pink to light brown fine- to coarse-grained feldspathic metasandstone; sparse dark-red argillite and siltite; commonly cross-laminated, local ripples

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation (Middle Proterozoic)

Map Unit Description

North of St. Mary’s fault, western part of Forest: Brown, red, and gray-green interbedded feldspathic metasandstone, siltite, and argillite. Thin interbeds of pale-green to light-gray quartzite. Contains ripples, desiccation cracks, raindrop impressions, salt casts, and cross-laminated beds. Formation divided into three members, in descending order:
Yms3-Member 3-Gray siltite, argillite, and quartz-rich metasandstone and feldspar-quartz metasandstone

Yms2-Member 2-Varicolored quartzite and feldspar-quartz metasandstone

Yms1-Member 1-Varicolored argillite, siltite, feldspathic metasandstone.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yms3

Unit Name: Member 3

Map Unit Description

Gray siltite, argillite, and quartz-rich metasandstone and feldspar-quartz metasandstone

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yms2

Unit Name: Member 2

Map Unit Description

Varicolored quartzite and feldspar-quartz metasandstone

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yms1

Unit Name: Member 1

Map Unit Description

Varicolored argillite, siltite, feldspathic metasandstone

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ysh

Unit Name: Shepard Formation (Middle Proterozoic)

Map Unit Description

Green, white, and yellowish-gray calcareous and dolomitic argillite and siltite; argillaceous limestone and dolomite, locally stromatolitic; local beds of quartzite that contain rounded quartz grains. Ripples, fluid-escape structures, desiccation cracks, mud-chip rip-up clasts, and cross-lamination common

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ysn

Unit Name: Snowslip Formation (Middle Proterozoic)-

Map Unit Description

North of St. Mary’s fault, in western part of Forest: On Hoadley thrust plate, interbedded red-brown siltite, gray-green siltite, and dark-red argillite. Red-purple feldspathic metasandstone at base.

South of St. Marys fault, in western part of forest:

Grayish red quartzite and feldspathic metasandstone, and interbedded zones of siltite and silty argillite. Zones of green beds of siltite, argillite, and fine-grained metasandstone, locally calcareous or dolomitic, distributed unevenly through formation. White to light-gray lenticular quartzite distributed throughout formation

On Hoadley thrust plate, interbedded red-brown siltite, gray-green siltite, and dark-red argillite. Red-purple feldspathic metasandstone at base.

South of St. Marys fault, in western part of forest:

Grayish red quartzite and feldspathic metasandstone, and interbedded zones of siltite and silty argillite. Zones of green beds of siltite, argillite, and fine-grained metasandstone, locally calcareous or dolomitic, distributed unevenly through formation. White to light-gray lenticular quartzite distributed throughout formation.

On Eldorado thrust plate in Big Belt Mountains:

Interbedded gray-green sandy siltite, dark-green argillite, and in basal part coarse-grained metasandstone. Ripple and rip-up clasts common; local stromatolitic beds.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yh

Unit Name: Helena Formation (Middle Proterozoic)

Map Unit Description

Dark-gray dolomitic limestone, calcareous siltite, and argillite, commonly cyclically interbedded; local light-gray fine-grained metasandstone. Stromatolite beds common in upper and lower parts of formation. Common sedimentary structures include ripples, syneresis cracks, scour-and-fill structures, and fluid-escape structures

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ye

Unit Name: Empire Formation (Middle Proterozoic)

Map Unit Description

Interlaminated gray-green dolomitic siltite and pale-green argillite. Light-gray fine-grained quartzite beds present in lower part of formation. Sedimentary structures include syneresis cracks, water-expulsion structures, and ripple cross-lamination

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ys

Unit Name: Spokane Formation (Middle Proterozoic)

Map Unit Description

Interbedded grayish red purple argillite and siltite, and lesser gray-green siltite; middle part, and to lesser extent lower part contains light-gray feldspathic metasandstone. Local dolomitic limestone. Common sedimentary structures include load casts, rip-up clasts, fluid-escape structures, ball-and-pillow structures, syneresis cracks, and ripple cross-lamination

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yes

Unit Name: Empire and Spokane Formations, undivided (Middle Proterozoic)

Map Unit Description

Interlaminated gray-green dolomitic siltite and pale-green argillite. Light-gray fine-grained quartzite beds present in lower part of formation. Sedimentary structures include syneresis cracks, water-expulsion structures, and ripple cross-lamination

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yu

Unit Name: Lower Belt Supergroup, undivided (Middle Proterozoic)

Map Unit Description

Includes the Spokane, Greyson, and Newland Formations, described above and below. Present only in northern part of Big Belt Mountains. Interbedded grayish red purple argillite and siltite, and lesser gray-green siltite; middle part, and to lesser extent lower part contains light-gray feldspathic metasandstone. Local dolomitic limestone. Common sedimentary structures include load casts, rip-up clasts, fluid-escape structures, ball-and-pillow structures, syneresis cracks, and ripple cross-lamination

Spokane Fm: Interbedded grayish red purple argillite and siltite, and lesser gray-green siltite; middle part, and to lesser extent lower part contains light-gray feldspathic metasandstone. Local dolomitic limestone. Common sedimentary structures include load casts, rip-up clasts, fluid-escape structures, ball-and-pillow structures, syneresis cracks, and ripple cross-lamination

Greyson Fm: In northwestern part of Forest: Interbedded dark greenish gray siltite and argillite, a few beds of lenticular quartzose metasandstone, and dolomitic siltite that contains algal laminations.

In Big Belt Mountains: Upper member consists chiefly of argillite in lower part that grades upward into siltite; local gray fine-grained feldspathic metasandstone. Minor limestone and calcareous siltite and metasandstone present in upper part. Lower member consists of interbedded gray fine- to coarse-grained feldspathic metasandstone and, locally, quartzite; some beds ripple cross-laminated; conglomeratic beds, locally graded from small boulders in lower part to pebbles in upper part; medium-gray feldspathic siltite; local yellowish brown finely laminated (porcellanitic?) siltite; and gray finely laminated argillite

Newland Fm: Upper member consists of interbedded units of medium-gray limestone, some beds mottled dark gray with algal-like structures; calcareous and noncalcareous finely laminated siltite, and locally ripple cross-laminated siltite; locally light-gray, yellowish-orange-weathering porcellanitic argillite; minor feldspathic metasandstone and, locally, quartzite. Lower member consists of medium-gray, light-brown-weathering argillite and dolomitic argillite that is finely laminated. Minor interbeds of gray fine-to medium-grained feldspathic metasandstone beds a few inches thick. Formation exposed only in Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yg

Unit Name: Grayson Formation Middle Proterozoic)

Map Unit Description

In northwestern part of Forest: Interbedded dark greenish gray siltite and argillite, a few beds of lenticular quartzose metasandstone, and dolomitic siltite that contains algal laminations.

In Big Belt Mountains: Upper member consists chiefly of argillite in lower part that grades upward into siltite; local gray fine-grained feldspathic metasandstone. Minor limestone and calcareous siltite and metasandstone present in upper part. Lower member consists of interbedded gray fine- to coarse-grained feldspathic metasandstone and, locally, quartzite; some beds ripple cross-laminated; conglomeratic beds, locally graded from small boulders in lower part to pebbles in upper part; medium-gray feldspathic siltite; local yellowish brown finely laminated (porcellanitic?) siltite; and gray finely laminated argillite

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Yn

Unit Name: Newland Formation (Middle Proterozoic)

Map Unit Description

Upper member consists of interbedded units of medium-gray limestone, some beds mottled dark gray with algal-like structures; calcareous and noncalcareous finely laminated siltite, and locally ripple cross-laminated siltite; locally light-gray, yellowish-orange-weathering porcellanitic argillite; minor feldspathic metasandstone and, locally, quartzite. Lower member consists of medium-gray, light-brown-weathering argillite and dolomitic argillite that is finely laminated. Minor interbeds of gray fine-to medium-grained feldspathic metasandstone beds a few inches thick. Formation exposed only in Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tb

Unit Name: Basalt (Tertiary)

Map Unit Description

Basalt flows, flow breccia, and plugs

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ta

Unit Name: Andesite (Tertiary)

Map Unit Description

Andesite flows, flow breccia, and plugs

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tr

Unit Name: Rhyolite (Tertiary)

Map Unit Description

Flows, porphyry plugs, breccia plugs, dikes, tuff, and welded tuff; includes minor andesite and latite flows and plugs

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tvg

Unit Name: Volcanic rocks, undivided (Tertiary)

Map Unit Description

Volcanic flows and dikes of basaltic, andesitic, and latitic composition; present only west of 112o longitude

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tlv

Unit Name: Lowland Creek Volcanics (Eocene)

Map Unit Description

Volcanic rocks ranging from rhyolite to quartz latite to dacite in composition; includes plugs, dikes, stock, diatreme, flows, welded tuff, and air-fall tuff, locally volcaniclastic rocks. Present in Elkhorn Mountains and to west, south of U.S. Highway 12

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: TKbv

Unit Name: Basaltic and andesitic volcanic rocks (Paleocene or Late Cretaceous)

Map Unit Description

Lava flows, breccia, plugs, tuff, and volcaniclastic sedimentary rocks. Present only in southwesternmost part of Forest, south of Elliston.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Klp

Unit Name: Lamprophyre (Cretaceous?)

Map Unit Description

Dark gray dike of highly altered igneous rock composed chiefly of mafic minerals; present along west flank of middle part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kl

Unit Name: Quartz latite (Cretaceous?)

Map Unit Description

Light gray intrusions of porphyritic latite to quartz latite. Present along west flank of central part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kev

Unit Name: Elkhorn Mountains Volcanics, undivided (Late Cretaceous)

Map Unit Description

Medium to dark gray lava flows, flow-breccia, air-fall tuff, and ash-flow tuff; composition ranges from rhyolitic to andesitic, and locally basaltic. Unit also includes related intrusive rocks (described below) where they are areally too small to show separately at this scale. Volcaniclastic sedimentary rocks, derived from debris of volcanic rocks, include conglomerate, sandstone, and mudstone. Present only in Elkhorn Mountains and area to west

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ki

Unit Name: Intrusive rocks related to Elkhorn Mountains Volcanics, undivided (Late Cretaceous)

Map Unit Description

Dacite to andesite sills, dikes, and irregularly shaped intrusions. Shown only in Elkhorn Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kv

Unit Name: Volcanic and volcaniclastic rocks, undivided (Late Cretaceous)

Map Unit Description

Welded tuff and lava flows ranging from rhyolite to dacite in composition; dikes of andesitic composition; and volcaniclastic conglomerate, sandstone, siltstone, and mudstone. Unit present only in central and southern part of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Td

Unit Name: Dacite (Eocene)

Map Unit Description

Porphyritic dacite plug of Knopf (1963). Present northwest of Helena

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tgb

Unit Name: Gabbro (Tertiary)

Map Unit Description

Dark-gray gabbro pluton. Present only east of Elliston

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tqmd

Unit Name: Quartz monzodiorite (Early Tertiary)

Map Unit Description

Gray granitic intrusion of monzodiorite composition. Present only southeast of Lincoln

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Tmp

Unit Name: Monzonite porphyry (Eocene and Paleocene)

Map Unit Description

Light-gray monzonite in stocks, dikes, and sills; present only in northwesternmost part Forest

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kqma

Unit Name: Aegerine-augite quartz monzonite (Late Cretaceous)

Map Unit Description

Light-gray aegirine-augite-bearing granitic intrusions of monzodiorite composition. Present only in Boulder Baldy-Boulder Mountains area of Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kqmd

Unit Name: Quartz monzodiorite (Late Cretaceous)

Map Unit Description

Light-gray quartz monzodiorite intrusions. Present only in Big Belt Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kqm

Unit Name: Quartz monzonite and granite (Late Cretaceous)

Map Unit Description

Light- to medium-gray quartz monzonite intrusion. Present only in eastern part of Elkhorn Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kmg

Unit Name: Monzogranite and monzonite porphyry (Cretaceous)

Map Unit Description

Light-gray monzogranitic intrusion. Present only south of Lincoln.

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kdi

Unit Name: Diorite and diorite porphyry (Late(?) Cretaceous)

Map Unit Description

Dark-gray dioritic rocks that form small stocks, dikes, and sills. Present in area between Helena and Elliston in western part of Forest

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgd

Unit Name: Granodiorite and related rocks (Late Cretaceous)

Map Unit Description

Medium-gray granodiorite stocks and plugs

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgdm

Unit Name: Granodiorite of Marysville stock (Late Cretaceous)

Map Unit Description

Medium-gray granodiorite stock near Marysville, northwest of Helena

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgdo

Unit Name: Granodiorite of Ogden Mountain stock (Late Cretaceous)

Map Unit Description

Medium-gray granodiorite stock near Ogden Mountain, southwest of Lincoln

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgdb

Unit Name: Granodiorite of Blackfoot City (Late Cretaceous)

Map Unit Description

Medium-gray intrusion granodiorite stock near Blackfoot City, northwest of Elliston

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgdd

Unit Name: Granodiorite of Dalton Mountain stock (Late Cretaceous)

Map Unit Description

Medium-gray granodiorite stock near Dalton Mountain, south of Lincoln

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgdu

Unit Name: Unionville granodiorite of Knopf (1963) (Late Cretaceous)

Map Unit Description

Dark-gray granodiorite pluton along the northern margin of the Boulder batholith. Present south of Helena and in northwestern part of Elkhorn Mountains

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kmgd

Unit Name: Butte quartz monzonite (Late Cretaceous)

Map Unit Description

Light- to medium-gray granitic intrusions with many separate phases; composition ranges from monzogranite to granodiorite. Includes small areas of aplite (described below) too small to show separately. Forms the major rock type of the Boulder batholith in Elkhorn Mountains and in area south of U.S. Highway 12

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kpl

Unit Name: Priest Pass leucomonzonite of Knopf (1963) (Late Cretaceous)

Map Unit Description

Light-gray, small leucomonzonite plutonic masses; present only west of Helena, north of U.S. Highway 12

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Kgra

Unit Name: Granophyre of Knopf (1963) (Late Cretaceous)

Map Unit Description

Dark-gray monzogabbro of plagioclase and clinopyroxene phenocrysts in groundmass of micropegmatite; present only south of Helena along northern margin of the Boulder batholith

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ka

Unit Name: Aplite, alaskite, and pegmatite (Late Cretaceous)

Map Unit Description

Light-gray to white rock of feldspar and quartz. Forms sheets, pods, dikes, and irregularly shaped masses within Butte quartz monzonite. Only larger bodies are shown. Present only in Elkhorn Mountains and in area south of U.S. Highway 12

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Zd

Unit Name: Diorite, gabbro, and microgabbro (Late Proterozoic)

Map Unit Description

Dark-gray to gray-green sills and dikes

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): HelenaNF_E_rect, HelenaNF_W_rect

Map Title

Geologic setting of the Helena National Forest study area

Map name: Helena National Forest

Map Unit Symbol: Ydi

Unit Name: Andesite, basaltic andesite, and dacite (Middle Proterozoic)

Map Unit Description

Dark gray-green mafic sills; present only in northwestern part of Forest

Map Citation

Tysdal, R.G., 1996, Geologic setting of the Helena National Forest study area, in Tysdal, R.G., Ludington, Steve, and McCafferty, A.E., eds., Mineral and energy assessment of the Helena National Forest, west-central Montana: U.S. Geological Survey Open-File Report 96-683A, p. 11-26, 1 plate, scale 1:126720

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Qal

Unit Name: Alluvial deposits (Holocene)

Map Unit Description

Gravel, sand, silt, and clay in flood plains and low terraces along present drainages

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Qs

Unit Name: Landslide deposits (Holocene)

Map Unit Description

Angular blocks of bedrock in finer grained matrix; mixed at places with glacial debris

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Qg

Unit Name: Glacial and fluvioglacial deposits (Pleistocene)

Map Unit Description

Includes till (ground and end moraines), outwash, and other fluvioglacial deposits. Dune sands are common in a few places. Locally includes lake sediments where not mapped separately as unit Ql

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ql

Unit Name: Lake sediments (Pleistocene)

Map Unit Description

Buff, laminated clay and silt containing a few lenses of gravel and scattered dropstones. Tends to form vertical cliffs along present stream courses; topographic surfaces are gently rolling. Sediments represent bottom deposits of various glacial lakes

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Tk

Unit Name: Kishenehn Formation (Oligocene)

Map Unit Description

Conglomerate, sandstone, siltstone, marlstone, oil shale, and coal representing fill in Kishenehn basin; presently restricted to the valley along the North Fork of the Flathead River in northeastern part of map area. As much as 11,000 ft thick (Constenius, 1988)

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Td

Unit Name: Dikes (Tertiary?)

Map Unit Description

Quartz latite porphyry, diorite, and lamprophyre intruded along faults. Only dikes thicker than 20 ft shown; one crosses Callahan Creek and one is at southeastern edge of map area

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Kg

Unit Name: Felsic plutons (Cretaceous)

Map Unit Description

Biotite or hornblende-biotite granite, quartz monzonite, and granodiorite. Occurs as stocks and also as small unmapped dikes in and near the Cabinet Mountains. The Dry Creek stock in the central Cabinet Mountains has a minimum Rb-Sr age of about 73 Ma (Wells and others, 1981)

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ks

Unit Name: Syenite (Cretaceous)

Map Unit Description

Gray to buff, coarse-grained stocks and dikes. Composed largely of orthoclase, andesine, and small amounts of pyroxene and hornblende (Gibson, 1948). Largest exposures are in pyroxenite-syenite complex at Vermiculite Mountain about 6 mi east from Libby, Mont. Syenite interpreted to be essentially the same age as the pyroxenite (Kpy), which the syenite intrudes (Boettcher, 1967)

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Kpy

Unit Name: Pyroxenite (Cretaceous)

Map Unit Description

Found only in the Rainy Creek-Vermiculite Mountain area. A core of biotitite is surrounded by coarse-grained biotite pyroxenite, which in turn is ringed by magnetite pyroxenite (Boettcher, 1967). Biotitite yielded a Rb-Sr age of 104±3 Ma (C.E. Hedge, U.S. Geological Survey, unpub. data, 1982). Biotite pyroxenite has been altered at places to rocks containing vermiculite; Rainy Creek stock is main source of vermiculite in United States

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Jf

Unit Name: Fernie Formation (Jurassic)

Map Unit Description

An incomplete section of deformed Fernie is exposed on a thrust plate in northeast Whitefish Range adjacent to north boundary of map. Upper part is gray dolomitic sandstone and interbedded dark-gray siltstone and shale. Lower in the section are layers of black fissile shale and gray limestone that contain belemnite fossils. Base not exposed. Minimum thickness about 500 ft

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Mz

Unit Name: Mesozoic sedimentary rocks, undivided

Map Unit Description

Shown only in cross sections. Strata probably include Jurassic and Cretaceous rocks mapped by Mudge and Earhart (1983) beneath the Lewis thrust fault about 40 mi east of Kalispell quadrangle

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: P[Pr

Unit Name: Rocky Mountain Formation (Permian and Pennsylvanian?)

Map Unit Description

Found only on thrust plates in northeast Whitefish Range. Light-gray, well-sorted, laminated and cross-laminated quartzite. Commonly has carbonate cement. Ripple marks present locally. Upper part includes beds of sandy dolomite that contain chert nodules. Contact with underlying Mississippian strata may be disconformable. Minimum thickness about 600 ft

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Mu

Unit Name: Mississippian sedimentary rocks, undivided

Map Unit Description

Includes Etherington, Mount Head, Livingstone, and Banff Formations as identified and described by Barnes (1963), and as published by Johns (1970). These rocks, found only on faulted thrust plates in northeast Whitefish Range, are a series of limestone and dolomite units that include some shale and calcarenite. Some units are bituminous, and several are cherty. Fossils that help distinguish the formations include brachiopods, crinoids, bryozoans, and corals. Estimated minimum thickness about 3,000 ft

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Du

Unit Name: Devonian sedimentary rocks, undivided

Map Unit Description

Found only in fault blocks and thrust plates across north end of Whitefish Range. Primarily dolomite and minor dolomitic sandstone and siltstone (Barnes, 1963). Estimated thickness about 2,000 ft

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Cu

Unit Name: Middle Cambrian sedimentary rocks, undivided

Map Unit Description

In descending order, carbonate-bearing rocks, shale, and sandstone found in a series of fault blocks in northern Whitefish Range, in a southerly trending zone of faults beginning about 14 mi south of Libby, Mont., and in an isolated exposure of carbonate--bearing strata about 6 mi south of Troy, Mont. In more complete exposures along Fishtrap Creek, about 12 mi south of southernmost exposures in Kalispell quadrangle, the carbonate-bearing rocks have been called informally the Fishtrap dolomite (Keim and Rector, 1964; Bush and Fischer, 1981) or the dolomite of Fishtrap Creek (Harrison and Cressman, in press). The carbonate-bearing rocks consist principally of gray crystalline to pelletoidal or oolitic dolomite and interbedded shale, limey mudstone, and minor laminated siltstone. Conformably beneath the carbonate-bearing strata is an olive, fissile shale unit, a few hundred feet thick, that is equivalent to the Wolsey (or Gordon) Shale. Conformably beneath the shale is a buff-colored sandstone unit, a few tens of feet thick, that is equivalent to the Flathead Quartzite. The Flathead rests unconformably on the underlying Libby Formation. Maximum thickness of the Middle Cambrian sequence is about 430 ft in northern Whitefish Range and about 2,400 ft in southern exposures at Fishtrap Creek

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Dcu

Unit Name: Devonian and Middle Cambrian sedimentary rocks, undivided

Map Unit Description

Used locally in northern Whitefish Range where units are too thin to show individually at map scale

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Pz

Unit Name: Paleozoic sedimentary rocks, undivided

Map Unit Description

Shown only in cross sections. Strata probably include Cambrian, Devonian, and Mississippian strata mapped by Mudge and Earhart (1983) beneath the Lewis thrust fault about 40 mi east of Kalispell quadrangle

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: ZYd

Unit Name: Mafic sills (Late and Middle Proterozoic)

Map Unit Description

Dioritic to gabbroic rocks that commonly show alteration of mafic minerals. Sills range in thickness from less than 3 to 500 ft. Thicker sills tend to have contact-metamorphosed zones around them. Sills commonly persist for many miles; some maintain approximately the same stratigraphic position, whereas others cut across the section at a low angle. Intrusion probably occurred three times (at about 1,430, 1,100, and 800 m.y. ago; Harrison, 1972). Unit ZYd used for younger two generations of sills above the Prichard Formation; unit Yd used for oldest generation of sills and confined to Prichard.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ylu

Unit Name: Upper part, Libby Formation

Map Unit Description

Upper half of unit is dark, olive-gray, silty-argillite that is very thinly laminated or apparently structureless; about 415 ft thick near Libby. Lower half of unit is dark greenish-gray, blocky-weathering hummocky cross-laminated, coarse siltite to very fine grained quartzite; siltite or quartzite beds commonly 3-15 ft thick and separated by partings of even-parallel--laminated silty argillite 1-3 in. thick; about 510 ft thick near Libby. Grades by interlayering into the lower part of the Libby. Minimum thickness of upper part is about 925 ft near Libby but increases to at least 3,200 ft in northern Whitefish Range where upper part overlies the McNamara Formation.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yl

Unit Name: Libby Formation, undivided

Map Unit Description

In addition to separately mapped upper part (Ylu), includes Kidder’s lower five informal members, which on Flagstaff Mountain are, in descending order: (1) about 1,850 ft of alternating beds of dark-gray argillite and wavy-laminated green siltite, (2) about 1,380 ft of wavy-laminated green argillite and siltite that contain scattered carbonate concretions, (3) about 950 ft of stromatolitic and oolitic parallel- to wavy-laminated green siltite, (4) about 280 ft of light- and dark-green parallel-laminated siltite containing abundant small-scale sedimentary structures and thin chert laminae and chips, and (5) about 180 ft of dark-gray argillite thinly interlaminated with dark-green siltite. Rests sharply on the Bonner Quartzite or its siltite facies. Lower five members are probably a distal black and green facies of the green and red McNamara Formation into which it grades laterally by interlayering and intertonguing.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ym

Unit Name: McNamara Formation (Middle Proterozoic)

Map Unit Description

Predominantly grayish-green, interbedded and interlaminated argillite and siltite that contain thin chert laminae and chips. Oolites, stromatolites, quartzarenite, and stratabound copper minerals present at places. Three relatively thin red-bed sequences of laminated argillite and siltite occur at top, middle, and bottom of section in Whitefish Range. Strata commonly exhibit ripple marks, shrinkage cracks, scours, and small-scale cross-bedding. Red-bed sequences drop out to west where green strata pass to dark-gray and green strata of lower five members of the Libby Formation. Sharply overlies the Bonner Quartzite. Maximum thickness of about 4,200 ft exposed in northern Whitefish Range.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ybo

Unit Name: Bonner Quartzite (Middle Proterozoic)

Map Unit Description

Red to pink, micaceous, arkosic, cross-bedded, fine- to medium-grained quartzite containing red argillite intraclasts; tabular and trough cross-beds and climbing ripple marks common. Interbeds of red, laminated argillite and pink, planar-laminated siltite increase in abundance to north, and siltite facies (Ybos) mapped where quartzite beds decrease to minor component. Sharply overlies the Mount Shields Formation. Maximum thickness about 1,000 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ybos

Unit Name: Siltite facies, Bonner Quartzite

Map Unit Description

Interbedded fine- to medium-grained feldspathic siltite and red argillite seen as beds and tongues in all exposures of Bonner; siltite facies is a minor component in the southern Libby thrust belt and southernmost Purcell anticlinorium. Cross-bedding and ripple cross-lamination common. Contains a few 10- to 20-ft-thick beds of typical Bonner Quartzite. Also contains some beds of green, parallel-laminated argillite and siltite, particularly near base. Sharply overlies the Mount Shields Formation. Thins from about 900 ft in south to 600 ft in north.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ymsu

Unit Name: Upper part, Mount Shields Formation

Map Unit Description

West of the lead thrust in the Libby thrust belt, the upper two members (shown as members 6 and 5 on fig. 2) are mapped together as the upper part of the Mount Shields where exposure permits. Member 6 (uppermost member) is black and green or white, thinly laminated argillite and siltite commonly displaying small-scale slump folds and shrinkage cracks. Maximum thickness about 300 ft. Member 5 (conformably underlying member 6) is gray, silty, stromatolitic limestone and dolomite that has conspicuous boxwork structure formed by siliceous laminae intersected by thin quartz veinlets along vertical joints. Green, dolomitic, silty argillite beds as thick as 30 ft are interlayered with the boxwork limestone. Maximum thickness about 500 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation, undivided

Map Unit Description

In western part of map area, includes members 6 and 5 (where not mapped as Ymsu) plus members 4 through 1 (from upper to lower, as shown on fig. 2). Member 4 is blocky, green, dolomitic, silty argillite that shows parallel-laminated graded couplets; 1-ft-thick carbonate beds are scattered through member, and stromatolites are common near base; rare salt casts; ranges in thickness from about 350 ft in south-central part of map area to 550 ft in north- and east-central parts. Member 3 is predominantly alternating red and green beds of interlaminated argillite and siltite; mud chips, mud cracks, ripple marks, and fluid-escape structures are common; salt casts are abundant, particularly in red beds; stratabound films of chalcopyrite or chalcocite occur in some green beds; thickness ranges from about 700 ft in south-central part of map area to about 1,200 ft in north-central part. Member 2 is pale-red or green, flat-laminated, coarse-grained siltite to fine-grained quartzite that is blocky, feldspathic, and dolomitic; dolomite in cement, streaks, and pods parallel to bedding; minor layers of red or green argillite; red or buff stromatolite and oolite zone at top; ranges in thickness from about 700 ft in south-central part of map area to a maximum of 1,700 ft in west-central part. Member 1 is red to maroon, feldspathic, medium- to coarse-grained quartzite interbedded with red siltite; red argillite partings common between beds; cross stratification, mud chips, and heavy mineral streaks common; stromatolites at a few places; thickness about 1,000 ft in southern Libby thrust belt but thins in all directions from there (fig. 2). Sharply overlies Shepard Formation.

In eastern part of map area in Whitefish Range, member 1 is missing, member 2 is thin in the south and missing in the north, member 3 is lowest member exposed in the north and is about 1,000 ft thick, and member 4 thickens to about 700 ft and includes at the top about 180 ft of thinly laminated, grayish-green argillite and siltite that contain a few beds of olive, fine-grained arenite (Whipple, 1984). Sharply overlies Shepard Formation.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yla

Unit Name: Basalt

Map Unit Description

Dark-gray, amygdaloidal basalt. Occurs only in lower part of Mount Shields Formation in Glacier National Park. About 30 ft thick.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ysh

Unit Name: Shepard Formation (Middle Proterozoic)

Map Unit Description

Consists of a variety of rock types, most of which are carbonate bearing or carbonate rich. Exposures in northern and northeastern parts of map area are mostly gray, fine-grained quartzite and siltite, some of which is pyritic and calcareous; less abundant interbeds include limestone (some of which is stromatolitic and oolitic), dolomite, and green calcareous argillite. Exposures in western and southwestern parts of map area contain a few quartzite beds but are predominantly (1) green, platy, dolomitic argillite, (2) green, slightly dolomitic, interlaminated argillite and siltite, and (3) silty dolomite that at places is stromatolitic and oolitic and may also display molar-tooth structure or horizontal calcite pods. Pyrite is common in the more carbonate-rich rocks. Zones of red interlaminated argillite and siltite are limited to a few places in the green argillitic rocks of south-central part of map area and locally in Whitefish Range. Black laminated argillite first appears in the green argillitic beds in southwestern part of map area and thickens to the west. The Shepard is commonly sheared or folded into chevrons where found in tight to overturned major folds. Grades by interlayering into the Snowslip Formation or its green facies, but the contact is marked at places by shallow channels of quartzite or, in the northeastern part of map area, by an angular unconformity that separates the Shepard from the Purcell Lava. The Shepard is lithologically similar to and correlates with members 4 and 5 of the Wallace Formation as mapped by Harrison and Jobin (1963) in the Clark Fork 15-minute quadrangle, which is adjacent to southwest corner of map area. Thickness ranges from about 280 ft in northern Whitefish Range (Whipple, 1984) to about 2,800 ft in southwest corner of map area.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypr

Unit Name: Purcell Lava (Middle Proterozoic)

Map Unit Description

Black to blackish-green basalt of continental alkaline basalt affinity (McGimsey, 1985). Multiple flows, commonly 5-10 ft thick, in the upper part of the Snowslip Formation or at the Snowslip-Shepard contact. Generally can be divided into two or three groups of flows in most areas.

In northeastern part of map area, upper, middle, and lower flows are present. Upper flows are fine grained in their lower parts and amygdaloidal and vesicular in their upper parts (Whipple, 1984); ropy flow structures cap many flows. Middle flows have indistinct contacts and fine-grained porphyritic zones. Lower flows are porphyritic and contain long (1-2 in.) tabular plagioclase crystals in a fine-grained and highly altered groundmass. Flows are locally pillowed. Thickness ranges from 0 to about 700 ft.

In western and southwestern parts of map area, only upper and lower flows were observed. Upper flows are similar to those of northeastern part of map area except rope flow tops are absent. Lower porphyritic flows have vague pillow structures and vesicles or amygdaloids at their tops. At a few places, individual flows are separated by a few inches to a few feet of beds similar to those of the Snowslip. Southern end of exposed flows is found at two places in southern Whitefish Range and near the mouth of the Fisher River in western part of map area. Thickness ranges from 0 to about 160 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ysn

Unit Name: Red and green facies of Snowslip Formation

Map Unit Description

Generally contains units from a hundred to several hundred feet thick of thinly laminated red to purple argillite and siltite interbedded with thinly laminated green argillite and siltite that alternate with similarly thick units of couplets of greenish-gray siltite and olive argillite. Some units contain beds of arenite, carbonate, and stromatolites. Whipple and Johnson (1988) recognized six informal members in northeast corner of map area; similar members were separated on the basis of amount of arenite or presence of carbonates and stromatolitic limestone. Mud cracks, ripple marks, and fluid-escape structures are common in argillite beds. Arenite beds display small-scale cross laminae at many places. In west-central part of map area, red beds become fewer and thinner, green laminated argillite and siltite predominates, and a marker bed of thinly laminated black argillite and green siltite is found in green strata about one-third of the distance below the top of this facies. Green beds commonly have chlorite on bedding surfaces and some contain small amounts of stratabound copper minerals. This facies of the Snowslip either grades by interlayering into the upper member of the Wallace Formation or rests sharply on the middle member. Thickens in all directions from about 600 ft in northern Whitefish Range to 3,000 ft or more in northern and central parts of map area (fig. 2).

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ysng

Unit Name: Green facies of Snowslip Formation

Map Unit Description

Predominantly evenly laminated couplets of green argillite and siltite containing sparse or no red beds. Chlorite common on bedding surfaces. Laminated black argillite and green siltite increases in abundance to the west (fig. 2). The black argillite commonly displays small soft sediment folds, shrinkage cracks, small-scale cut-and-fill structures, and fluid-escape structures. Grades laterally by intertonguing into red and green facies of the Snowslip and grades vertically by interlayering into the underlying Wallace Formation. This informal member is lithologically similar to and correlates with member 3 of the Wallace Formation as mapped by Harrison and Jobin (1963) in the Clark Fork 15-minute quadrangle, which is adjacent to southwest corner of map area. Thickness ranges from about 2,000 to 3,000 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ywu

Unit Name: Upper member of Wallace Formation

Map Unit Description

Thinly to very thinly laminated dark-green or black argillite and light-green siltite. Beds locally show small-scale cut-and-fill structures and shrinkage cracks. Dark- to light-green beds are always very thinly laminated and have parallel bedding. Differs from overlying green beds of the Snowslip in displaying thinner laminae, being less silty, and having no chlorite on bedding surfaces. Thickness ranges from 0 to 1,200 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ywm

Unit Name: Middle member, Wallace Formation

Map Unit Description

Black argillite alternating with white slightly dolomitic siltite or very fine grained quartzite layers and lenses that range from 1 to 20 in. in thickness; characteristically uneven and wavy bedded. Thicker siltite layers and lenses commonly display load casts and flame structures. Zones a few hundred feet thick in upper and lower parts are at places carbonate rich and show irregular, vertical calcite ribbons (molar-tooth structure) or small (2 in.), vertical calcite pod structures that transect tens of feet of beds. Also includes some beds of black laminated argillite, green interlaminated argillite and siltite, and dolomitic argillite. Slump folds in zones a few feet thick are present in southern Libby thrust belt (fig. 2). Cycles of quartzite or black silty argillite overlain by dolomitic siltite or dolomite a few feet thick are sparsely present in southwest corner of map area; these cycles are similar to those that characterize the main body of the Helena Formation, Pyrite and chalcopyrite common in any of the carbonate-bearing lithologies. Thickness ranges from about 500 ft in Whitefish Range to about 6,000 ft at west edge of map area.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ywl

Unit Name: Lower member, Wallace Formation

Map Unit Description

Predominantly blocky, green, parallel-laminated and interbedded dolomitic argillite and argillitic siltite, some of which contains molar-tooth structure and pods or irregular blobs of calcite. Includes a few beds a foot or two thick of white to buff, medium-grained quartzite. Resembles the Empire Formation but differs in containing molar-tooth structures and not exhibiting fluid-escape structures that characterize the Empire. Interfingers laterally with the lower member of the Helena in northwestern part of map area where the interfingered zone has been mapped as either lower Wallace or lower Helena depending on the predominant lithology. Where underlain by the St. Regis Formation, the contact is fairly sharp; where underlain by the Empire Formation, the contact grades by interlayering. Thickness ranges from 0 to about 900 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yw

Unit Name: Upper, middle, and lower members, undivided, of Wallace Formation

Map Unit Description

Wallace Formation

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ysw

Unit Name: Shepard, Snowslip, and Wallace Formations, undivided (Middle Proterozoic)

Map Unit Description

Used only in southern part of Cabinet Mountains for unit mapped by Wells and others (1981).

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yh

Unit Name: Main body of the Helena Formation (Middle Proterozoic)

Map Unit Description

Hundreds of distinct lithologic cycles in units a few feet to a few tens of feet thick form the main body of the Helena. Each complete cycle consists of three parts: an upper bed of dense conchoidal-fracturing dolomite that weathers orange brown, a middle bed of gray dolomite that commonly displays horizontal calcite pods or blobs that grade successively upward to vertical pods and blobs and then into molar-tooth structures, and a lower clastic bed rarely more than a foot thick of white quartzite or quartzite and black argillite resting on a cut surface. Complete cycles are seen in many exposures, but most commonly the lower bed is missing and less commonly one of the other beds is missing, Pyrite and some chalcopyrite common. Stromatolite beds present at some places, particularly east of the Rocky Mountain trench. A zone a few tens to a few hundred feet thick at top of map unit is black wavy-bedded argillite and tan-weathering white dolomitic siltite typical of the middle member of the Wallace Formation. At places includes the lower member of the Helena Formation where not mapped separately. Main body of Helena interfingers with middle member of Wallace in northern and central parts of map area (fig. 2). Thickness of main body of Helena ranges from about 9,000 ft in southeastern part of map area to 0 where it fingers out westward into the middle member of the Wallace.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yhl

Unit Name: Lower member, Helena Formation

Map Unit Description

Alternating beds a few feet to a few tens of feet thick of dense, orange-weathering dolomite and thinly laminated, apple-green to tan argillite. Half-inch-thick beds of brown-weathering quartzite scattered through unit. Dolomite commonly pyritic and displays irregular-shaped pods of calcite and molar-tooth structure. Tongues and layers of main body of Helena a few hundred feet thick are common in unit. Contact with main body of Helena placed on top of uppermost green and tan argillite bed. Grades by interlayering into the underlying Empire Formation, and grades by intertonguing laterally into lower member of the Wallace Formation. Maximum thickness about 3,000 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yhw

Unit Name: Main body of the Helena Formation and middle member of the Wallace Formation, undivided (Middle Proterozoic)

Map Unit Description

Mapped in north-central part of map area where beds of the main body of the Helena and middle member of the Wallace are interlayered and intertongued on a scale of a few tens of feet to a few hundreds of feet. Minor interlayering at other places is mapped as either Helena or middle Wallace depending on the predominant lithology. Includes lower member of the Helena where not mapped separately.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ye

Unit Name: Empire Formation (Middle Proterozoic)

Map Unit Description

Thinly laminated, dark-green and light-green dolomitic argillite and silty argillite or siltite. Laminae mostly wavy and discontinuous although some are even parallel. Fluid-escape structures are characteristic, and horizontal pods of white or pink calcite are particularly abundant in upper part. Ripple marks, syneresis cracks, and mud chips common in places. Lower part contains white dolomitic quartzite beds as thick as 2 ft. White, rounded-grain quartzite beds and lenses a few inches thick occur in northeast quarter of map area; cross-bedding and mud chips common in these beds. Pyrite cubes common in more carbonate-rich strata, and a few exposures display stratabound copper minerals. A few purple interlaminated argillite and siltite beds commonly occur near base and at places near middle of unit. Intertongues with underlying St. Regis Formation and probably with overlying lower member of Wallace. Thickness ranges from 0 to about 2,000 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ysr

Unit Name: St. Regis Formation (Middle Proterozoic)

Map Unit Description

Purple interlaminated argillite and siltite beds that alternate with green interlaminated argillite and siltite beds. Upper part has carbonate specks and some carbonate cement; lower part has scattered beds of pink, fine-grained quartzite or siltite. Sedimentary structures include abundant mud cracks, mud chips, ripple marks, and fluid-escape structures. Formation present only in western part of map area. Grades by interlayering over a few tens of feet into underlying Revett Formation. Maximum thickness is about 1,000 ft, but thins to about 600 ft in north and to a few feet in southwest (fig. 2) before thickening again to about 1,100 ft near Clark Fork, Idaho, a few miles west of map area (Harrison and Jobin, 1963).

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yr

Unit Name: Revett Formation (Middle Proterozoic)

Map Unit Description

Characterized by blocky cosets of white, green, or pale-purple- gray, cross-bedded quartzite beds. In most areas, the Revett can be divided into three informal members: upper and lower quartzite-rich members and a middle member that contains significantly more argillite and siltite. Some quartzite is purple striped and commonly shows Liesegang rings of purple hematite coloration both along and across bedding. Many beds display climbing ripple marks, ripple cross laminae, load casts, and 1- to 5-ft-deep channels. Heavy minerals are common on cross laminae. Argillite beds are purple or green, generally display even- to wavy-parallel laminae, and contain mud cracks, mud chips, ripple marks, and fluid-escape structures. Siltite beds are commonly pale purple and parallel laminated; siltite alternates with beds of argillite. In southwestern part of map area, parts of the upper and lower quartzite members are green or white, show conspicuous iron-carbonate cement, and contain major ore deposits of stratabound copper-silver. In northern and western parts of map area, the characteristic quartzite beds are purple gray, thinner and less abundant, and enclosed in argillite and some siltite. In some of the easternmost exposures, the characteristic quartzite beds are only a few tens of feet thick. Small flakes of secondary biotite and tiny euhedral magnetite crystals are displayed in the formation throughout map area. Grades by interlayering into underlying Burke Formation. Thickness ranges from about 2,000 to about 2,800 ft in exposures west of the Rocky Mountain trench; formation is not recognized east of the trench.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ys

Unit Name: Spokane Formation (Middle Proterozoic)

Map Unit Description

Three lithologic members are found in most areas. Upper member has beds a few feet to a few tens of feet thick of green laminated argillite and siltite that alternate with beds of purple laminated argillite and siltite. Dolomitic cement is common as are ripple marks, mud chips, desiccation cracks, fluid-escape structures, ball-and-pillow structures, and flute casts. Beds a few inches to a few feet thick of white, rounded-grain, medium-grained, cross-bedded quartzite that displays mud chips and balls on cross strata are abundant in eastern part of map area but decrease rapidly in both number and thickness west of the Rocky Mountain trench. A section of this member on Blacktail Mountain about 13 mi south of Kalispell was drilled extensively to evaluate stratabound copper mineralization in green beds. Detailed descriptions of the surface geology of that area are given by Harrison and Reynolds (1979) and of selected cores by Reynolds (1979). Middle member is predominantly pink to purple-gray, very fine-grained feldspathic quartzite or coarse siltite that has planar lamination or long tabular cross lamination. Interbeds of purple argillite are common. Lower member is similar to the upper member but has more purple argillitic beds, is more dolomitic, and has scattered iron-carbonate specks and cement.

The Spokane intertongues westward with the St. Regis and Revett Formations, but exact nature of intertonguing is uncertain owing to lack of critical exposures in and near the Rocky Mountain trench. Where the Spokane loses the distinctive white, rounded-grain quartzite beds westward and the underlying Revett loses the definitive cosets of cross-bedded quartzite eastward, the formations are difficult to distinguish, and some identifications of the mapped units were arbitrary. Thickness ranges from about 5,000 ft in eastern part of map area to 0 ft in western part.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ygl

Unit Name: Grinnell Formation (Middle Proterozoic)

Map Unit Description

Formation nomenclature as used by Whipple (in press). Lithologically the same as upper and lower members of the Spokane Formation, but the upper part of the Grinnell contains as much as 20 percent of white, rounded-grain quartzite beds (Whipple and others, 1984). Mapped only in Glacier National Park where it is about 2,600 ft thick.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yb

Unit Name: Burke Formation (Middle Proterozoic)

Map Unit Description

Divisible into three informal members in most areas (fig. 2). Upper member consists predominantly of blocky beds of purple-gray interlaminated argillite and siltite interbedded with greenish-gray interlaminated argillite and siltite. Mud cracks and mud chips common in upper part of member. White to purple-gray parallel-laminated siltite and quartzite beds a few feet thick are interbedded in the upper part of the member and increase in abundance upward. Contact with the overlying Revett is placed where cosets of cross-bedded quartzite first appear.

Middle member is predominantly gray to purple-gray parallel- and thinly-laminated siltite in blocky planar beds that have minor argillite partings or beds. Some siltite has zebra-striped markings of hematite coloration. Outcrops of middle member along northern part of Lake Koocanusa show wavy, wispy, discontinuous laminae.

Lower member is predominantly green parallel-laminated interbedded argillite and siltite that generally are in beds about 2-20 in. thick and weather to give a blocky-flaggy outcrop. Upper part of lower member has some purple-gray interbeds of argillite and siltite.

Siltite and some argillite lithologies in all members are commonly speckled by tiny euhedral magnetite crystals and display small flakes of secondary biotite. Grades by interlayering into the transition member of the underlying Prichard Formation. In the southern Cabinet Mountains, the Burke as mapped by Wells and others (1981) includes the transition member of the underlying Prichard Formation. Thickness ranges from about 2,500 ft to 3,600 ft west of the Rocky Mountain trench.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yu

Unit Name: Unnamed formation (Middle Proterozoic)

Map Unit Description

Predominantly thin to thick beds of olive siltite and very fine grained quartzite speckled by brown spots of limonite after iron carbonate and perhaps magnetite. Lamination faint but generally even parallel; minor cross lamination. Contact placed above highest black argillite bed in underlying transition member of the Prichard. Unit unnamed because authors differ in interpretation of the rocks as a facies of either the Burke or the Appekunny Formation. Mapped only along west side of Whitefish Range and west of Blaine Mountain. Thickness about 600 ft.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yap

Unit Name: Appekunny Formation (Middle Proterozoic)

Map Unit Description

Formation nomenclature as used by Whipple (in press). The Appekunny Formation of Glacier National Park has been divided by Earhart and others (1983) into an upper part and a lower informal "Wolfgun member." Regional mapping of the Kalispell quadrangle and regional synthesis of the Prichard Formation by Cressman (1989) indicates that the Wolfgun is actually a stratigraphic and lithologic equivalent of the transition member of the Prichard Formation, which has been mapped over thousands of square miles to the west and southwest of Glacier National Park. As a consequence, we do not use "Wolfgun member" and assign those beds to the transition member of the Prichard (Ypt). The Appekunny as shown in the park consists mostly of interlaminated green argillite and siltite and some beds an inch or two thick of light-gray quartzite. Thickness is about 140 ft where exposed but thickens eastward.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Yd

Unit Name: Mafic sills (Middle Proterozoic)

Map Unit Description

Identical in composition and habit to unit ZYd but confined to the Prichard Formation and inferred to be the oldest of three generations of similar sills. Maximum thickness of a single sill is about 1,800 ft in the No.1 Gibbs borehole (near Lincoln County-Flathead County line in T. 28 N., R. 26 W.). One sill in lower part of Prichard along the Kootenai river about 22 mi northwest of Troy, Mont., yielded an age of 1,433±30 m.y. for igneous zircon in a granitic differentiate in the sill (Zartman and others, 1982). Sills are prominent seismic reflectors that decrease in abundance eastward from the crest of the Purcell anticlinorium to the Rocky Mountain trench (Harrison and others, 1985).

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypt

Unit Name: Transition member, Prichard Formation

Map Unit Description

Generally consists of three units: (1) an upper unit of interlaminated light- and dark-gray siltite and argillite similar to the middle unit, but containing interbeds of light-olive-gray siltite and quartzite similar to those in the overlying Burke Formation, (2) a middle unit of interlaminated light- and dark-gray siltite and argillite, and (3) a basal unit of medium-gray blocky-weathering siltite and minor quartzite. All three units are present in nearly every outcrop area of member, but their relative proportions vary from place to place. Laminae are wavy to lenticular; scour-and-fill structures, fluid-escape structures, and syneresis cracks common. Iron sulfides weather to give rusty aspect to many outcrops. Randomly oriented biotite porphyroblasts common, particularly near top of upper unit, in all but easternmost exposures. Calcareous siltite and argillite beds make up a small part of the member (some in the middle unit but most in the upper unit) and gradually become more abundant eastward; in Glacier National Park contains some stromatolitic beds. Basal contact is sharp. Member is 2,000-2,500 ft thick throughout much of quadrangle but thins to about 1,050 ft in Whitefish Range and to about 860 ft in Glacier National Park. Some variation in the mapped thickness results from inconsistencies in placement of the gradational upper contact.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypu

Unit Name: Upper member, Prichard Formation

Map Unit Description

Medium-gray argillite that contains planar laminae and thin planar beds of light-gray and dark-gray silty argillite. Alternating light and dark layers, 1-3 mm thick, give lined or banded appearance. Dark-gray silty argillite contains discontinuous laminae of carbonaceous matter and iron sulfide (mostly pyrrhotite, but locally pyrite). Iron sulfide weathers to give rusty appearance to outcrops. Randomly oriented biotite porphyroblasts common except in Glacier National Park. In the park, upper part of member contains thin lenticular beds and pods of calcareous and dolomitic silty argillite. Near Lake Koocanusa, upper part of member contains some thin beds of white quartzite that at places contains metamorphic garnet, hornblende, and calcite; white quartzite beds become less abundant westward and are absent on west limb of Sylvanite anticline. Slump folds locally in lower part of member. Basal contact ranges from sharp to gradational through several hundred feet. Member is 1,600-2,000 ft thick in most of map area west of Rocky Mountain trench, and about 3,500 ft thick in Whitefish Range; about 3,500 ft is exposed east of map area near head of McDonald Lake in Glacier National Park.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypq

Unit Name: Quartzite member, Prichard Formation

Map Unit Description

Interbedded quartzite and argillite that enclose a distinctive tongue of argillite mapped separately as unit Ypa. Mostly (65 percent) medium-dark- to medium-light-gray, fine-grained and very fine grained, slightly feldspathic, argillitic quartzite in even beds 0.7-2 ft thick and in sets mostly 3-5 ft thick. Quartzite beds commonly grade to siltite and argillite in top few inches, and some beds exhibit sole marks. Quartzite sets alternate with argillite sets mostly about 10 ft thick. Argillite is silty, dark gray, and weathers brownish gray. Xenoblastic biotite present throughout member in amounts of as much as 20 percent; xenoblastic chlorite present locally. Member is a minimum of 12,000 ft thick in the Sylvanite anticline and west of the Moyie thrust system. Quartzite member thins and intertongues eastward with argillite in lower part of the Prichard (Ypl); is less than 4,000 ft thick and included in upper part of the lower Prichard (Ypl) immediately west of the Pinkham thrust; and probably pinches out near the Rocky Mountain trench.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypa

Unit Name: Argillite member, Prichard Formation

Map Unit Description

Slabby-weathering, medium-gray, silty argillite in beds 0.5-1.5 ft thick. Parts of member display dark-gray laminae and thin beds of silty argillite that contain abundant pyrrhotite and carbonaceous matter; pyrrhotite weathers to impart rusty color to outcrops. Slump folds common near base. Xenoblastic biotite and chlorite common. Upper and lower contacts with enclosing quartzite member are sharp. About 800 ft thick in the Sylvanite anticline. Argillite member exposed in the Sylvanite anticline and west of the Moyie thrust system is a tongue of the argillite that makes up most of the Prichard Formation (Ypl) in central and eastern parts of quadrangle (see cross section B-B').

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ypl

Unit Name: Lower part, Prichard Formation

Map Unit Description

Where exposed on the Purcell anticlinorium, consists of quartzite interbedded with argillite and is similar in character to the quartzite member. About 1,000 ft exposed. In No. 1 Gibbs borehole, lower part consists of six lithologic units that correlate with the informal members A-G described by Cressman (1985, 1989). These are from top to bottom:

Quartzite interbedded with argillite and similar to quartzite member (member G). Total thickness of unit including core and surface exposures is about 4,000 ft.

Dolomitic siltite, 3,000 ft thick (facies of member F).

Interlaminated siltite and argillite interbedded with well-sorted quartzite, 2,800 ft thick (member E).

Argillite, 500 ft thick (member D).

Argillitic quartzite, 160 ft thick (member C).

Argillite and siltite, 2,500 ft thick (members A and B, undifferentiated).

Lowest beds in borehole are schistose and garnetiferous.

Inferred thickness of entire Prichard Formation as shown in cross sections is about 25,000 ft and is based on thickness at borehole plus interpretation of gravity, magnetotelluric, and seismic data of depth to basement (Harrison and Cressman, in press)

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: Ylb

Unit Name: Lower Belt rocks, undivided (Middle Proterozoic)

Map Unit Description

Shown only in cross sections to indicate inferred rocks of the lower Belt that are not exposed. May include Prichard, Altyn, or Waterton Formations.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Kalispell_rect

Map Title

Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia

Map name: Kalispell 250K

Map Unit Symbol: B

Unit Name: Basement rocks (Early Proterozoic)

Map Unit Description

Shown only in cross sections to indicate inferred crystalline rocks of uncertain character and pre-Belt age.

Map Citation

Harrison, J.E., Cressman, E.R., and Whipple, J.W., 1992, Geologic and structure maps of the Kalispell 1° X 2° quadrangle, Montana, and Alberta and British Columbia: U.S. Geological Survey Miscellaneous Investigations Map 1-2267, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Qs

Unit Name: Surficial deposits, undivided (Quaternary)

Map Unit Description

Bridger Range area: Alluvium, colluvium, talus, landslide deposits, rock glaciers, and glacial and glaciofluvial deposits. Only selected major areas, generally exposed for at least 1 mi in a single direction, are shown.

Crazy Mountains area: Alluvium, talus, rock glaciers, and glacial deposits. Only selected major areas, generally exposed for at least 1 mi in a single direction, are shown.

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Tfl

Unit Name: Fort Logan Formation (lower Miocene)

Map Unit Description

Sandy and conglomeratic tuffaceous siltstone with interbedded volcanic ash, freshwater gastropod limestone, and fossiliferous lenses of conglomerate and gravel. Coarse fractions mostly derived from Proterozoic Belt Supergroup and Paleozoic limestone. Shown only in extreme northeast corner of Bridger Range. Exposures more than 100 ft thick; actual thickness not measured (McGrew, 1977)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ti

Unit Name: Intrusive rocks, undivided (Eocene)

Map Unit Description

Bridger Range area: Dacite, diorite, diabase, and basalt dikes and sills. Diorite dike in northern part of Bridger Range is olive-gray, coarsely crystalline, pyroxene phenocrysts (Skipp and Peterson, 1965); composite dike in southern part of range may be similar in composition (McMannis, 1955). Sills differentiated into upper syenite layer and lower layer of biotite-augite diorite. Thickness 80-200 ft (McMannis, 1955).

Crazy Mountains area: Diorite, diabase, and fine-grained rocks ranging from basalt to rhyolite; includes dikes and sills. Commonly porphyritic; phenocryst composition ranges from 5 to 50 percent. Transitional between alkaline and calc-alkaline compositions. Probably genetically related to quartz monzodiorite phase of Big Timber stock (Tqm) (du Bray and others, 1993). Probably includes alkalic bodies (Ta) on west flank of Crazy Mountains and north of Shields River

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: TKf

Unit Name: Fort Union Formation (Paleocene and Upper Cretaceous)

Map Unit Description

Bridger Range area: Cliff-forming, massive, nonmarine conglomerate, sandstone, and siltstone; conglomerate clasts derived from pre-Cretaceous rocks. Contains fossil spores, plants, wood, freshwater mollusks, and vertebrates. About 6,600 ft thick (Roberts, 1964b, c; 1972).

Crazy Mountains area: Siltstone, mudstone, sandstone, and pebble conglomerate. Unit is mainly hornfels in a several-mile-wide aureole of contact metamorphism adjacent to Big Timber stock (du Bray and others, 1993). Near Livingston, 6,615 ft thick (Roberts, 1972).

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Klv

Unit Name: Livingston Group (Upper Cretaceous)

Map Unit Description

Bridger Range area: In descending order, includes Hoppers, Billman Creek, and Sedan Formations. Sedan Formation correlates with Miner Creek and Cokedale Formations, which are exposed in southernmost part of Bridger Range and in a narrow band extending to the east past Cokeville and Livingston (Skipp and McGrew, 1977). Livingston Group is volcaniclastic conglomerate, sandstone, and mudstone; and volcanic flows, sills, tuff, and breccia (Roberts, 1972). Hoppers Formation is purple-gray to gray-green, epiclastic volcanic sandstone, siltstone, mudstone, and conglomerate; 2,400 ft thick (Skipp, 1977). Billman Creek Formation is grayish-red, grayish-green, and gray volcanic mudstone and siltstone interbedded with minor volcanic sandstone, conglomerate, and vitric tuff. Includes freshwater gastropods and dinosaur bones (Skipp, 1977); 2,500 - 3,000 ft thick (Roberts, 1972; Skipp, 1977). Sedan Formation is primarily greenish-gray, epiclastic volcanic sandstone, mudstone, and conglomerate interbedded with mudflow conglomerate, welded tuff, devitrified silicified vitric tuff, bentonite, and lignitic coal (Skipp and McGrew, 1977). Freshwater mollusks, wood, and dinosaur bones present in upper part of Sedan Formation. Lower part contains ironstone nodules, magnetite-rich beds, volcanic granule-and-pebble conglomerate, and carbonaceous plant material. Lignite coal locally present at base. Sedan Formation about 3,000-4,500 ft (Skipp and McGrew, 1977).

Crazy Mountains area: Volcaniclastic conglomerate, sandstone, and mudstone; tuff and volcanic breccia. Contains flows and sills (Roberts, 1972). Thickness 6,455 ft (Roberts, 1972)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ke

Unit Name: Eagle Sandstone (Upper Cretaceous)

Map Unit Description

Upper part is gray, thin- to thick-bedded, very fine grained to conglomeratic, largely calcareous, cross-bedded sandstone; calcareous concretions and intercalated coal and shale. Lower part is massive, indurated, ledge-forming, cross-bedded sandstone and greenish-gray and grayish-orange volcanic sandstone and conglomerate; intercalated coal, siltstone, and shale. Thickness 150-300 ft (Roberts, 1964a; Skipp, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ku

Unit Name: Upper Cretaceous sedimentary rocks, undivided

Map Unit Description

In descending order, includes Telegraph Creek Formation, Cody Shale, and Frontier Formation. Telegraph Creek Formation is predominantly gray, biotitic, silty shale that contains thin interbeds of fine-grained sandstone, limestone, and altered crystal vitric tuff. Upper part contains large calcareous cannonball concretions; lower part contains pelecypods and ammonites. About 285-400 ft thick (Roberts, 1964a; Skipp, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965). Cody Shale is dark-gray shale and mudstone that contain thin interbeds of gray-green, glauconitic, calcareous to argillaceous, cross-laminated and rippled, fossiliferous (ammonites) sandstone and siltstone; ironstone nodules and cone-in-cone structures occur locally. About 600-1,100 ft thick (McGrew, 1977; Skipp, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965). Frontier Formation is mostly gray, green, or brown, thin- to medium-bedded, fine- to coarse-grained, calcareous to argillaceous, locally cross-laminated, ridge-forming sandstone; light-gray quartz, feldspar, and rock fragments contrast with dark-gray chert grains and give the sandstone a characteristic "salt-and-pepper" appearance. Contains interbeds of mudstone, siltstone, shale, quartzite, chert-pebble conglomerate, siliceous limestone, and fossil oyster banks; mudstone and siltstone intervals form valleys. About 500-700 ft thick (McGrew, 1977; Skipp, 1977; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Kul

Unit Name: Upper and Lower Cretaceous sedimentary rocks, undivided

Map Unit Description

In descending order, includes Mowry Shale (Upper Cretaceous) and Thermopolis Shale and Kootenai Formation (Lower Cretaceous). Mowry and Thermopolis Shales are dark-gray shaly mudstone and porcellanite interbedded with greenish-gray, medium-grained to very coarse grained, feldspathic, calcareous and argillaceous, thin-bedded sandstone; basal grayish-orange, ledge-forming quartzitic sandstone. Shales total about 600 ft thick (McGrew, 1977; Roberts, 1964a; Skipp, 1977; Skipp and Hepp, 1968). Kootenai Formation is red, gray, and purple hematitic mudstone interbedded with yellowish-gray and grayish-purple, quartzose, medium- to coarse-grained sandstone. Gray, nodular, gastropod-bearing, freshwater limestone common in upper part (about 100 ft below top) and just above basal ledge- and talus-forming, salt-and-pepper sandstone. Lenses of granule- to pebble-size chert conglomerate in basal sandstone. About 200-400 ft thick (McGrew, 1977; Skipp, 1977)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ju

Unit Name: Jurassic sedimentary rocks, undivided

Map Unit Description

Includes Morrison Formation (Upper Jurassic) and underlying Ellis Group (Upper and Middle Jurassic). Ellis Group comprises Swift, Rierdon, and Sawtooth Formations; near Livingston the Sawtooth's lithic equivalent is the Piper Formation. Morrison Formation is red, gray, and purple mudstone and hackly shale intercalated with light-gray, yellowish-brown, and yellowish-orange siltstone and sandstone, some conglomeratic; calcareous, quartzose, commonly cross-bedded. Black shale near top; gray freshwater limestone in beds and nodules; thick red mudstone at base. About 200-400 ft thick (McGrew, 1977; Roberts, 1964a; Skipp and Hepp, 1968; Skipp and Peterson, 1965). Ellis Group is light-gray to light-brown, quartzose, calcareous, commonly iron stained sandstone and siltstone, interbedded with gray, fossiliferous, ledge-forming oolitic or sandy limestone and chert-pebble conglomerate. Basal bed grades from chert breccia or chert-pebble conglomerate on the west to thin gray mudstone to fossiliferous limestone on the east. Thickness ranges from 2 to 213 ft (McGrew, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: PMu

Unit Name: Permian, Pennsylvanian, and Mississippian sedimentary rocks, undivided

Map Unit Description

In descending order, includes Phosphoria (Permian), Quadrant (Pennsylvanian), and Amsden (Lower Pennsylvanian and Upper Mississippian) Formations. Phosphoria Formation (McKelvey and others, 1959) (probably better correlated with Shedhorn Sandstone in this area) consists of a thin (no thicknesses given- presumably not more than several feet thick) section of phosphorite, phosphatic mudstone, carbonaceous mudstone, and chert (McKelvey and others, 1959); mapped with Quadrant Formation by Roberts (1964a, 1972). Quadrant Formation is well-sorted calcareous quartzite to quartzose sandstone; light-gray dolomite in lower part; lower part forms ledges. Thickness 0 to 150 ft (McGrew, 1977; Roberts, 1964a; Skipp and Hepp, 1968). Amsden Formation is light-gray, weathering to white, thin- to thick-bedded dolomite. Interbeds of pale-grayish-orange sandstone and siltstone in upper part. Massive red sandstone, gray sandstone, siltstone and mudstone, and red claystone interbedded with gray argillaceous limestone in lower part; dolomite-limestone breccia at base. About 250-600 ft thick (McGrew, 1977; Skipp and Hepp, 1968)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Mm

Unit Name: Madison Group (Mississippian)

Map Unit Description

Includes Mission Canyon Limestone and underlying Lodgepole Limestone. Mission Canyon Limestone is gray, aphanitic to medium-crystalline, cherty, massive, cliff-forming limestone and dolomite. Red-siltstone-filled cavernous zones, limestone breccia beds, and gray dolomite locally in upper part. About 700-1,200 ft thick (McGrew, 1977; Roberts, 1964a; Skipp, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965). Lodgepole Limestone is gray, thin- to medium-bedded, fossiliferous, locally cherty limestone and dolomite; weathers into platy blocks. Red and yellow silty limestone interbeds; thin dark-gray shale at base. Forms step-like ledges. About 500-750 ft thick (McGrew, 1977; Roberts, 1964a; Skipp, 1977; Skipp and Hepp, 1968; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: MDt

Unit Name: Three Forks Formation (Lower Mississippian and Upper Devonian) and Jefferson Formation (Upper Devonian), undivided

Map Unit Description

Three Forks Formation is yellow calcareous siltstone, impure gray fossiliferous limestone, and dark-gray and green mudstone and shale. Thin beds of dolomite in upper part; olive-gray and reddish-brown, calcareous, fossiliferous shale in lower part. Thickness 150-200 ft (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965). Underlying Jefferson Formation is brownish- to olive-gray, thick-bedded to massive, sparsely fossiliferous, fetid dolomite and interbedded gray limestone; local stromatolites. About 400-600 ft thick (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Cu

Unit Name: Cambrian sedimentary rocks, undivided

Map Unit Description

In descending order, includes Snowy Range Formation (and laterally equivalent Red Lion Formation) and Pilgrim Limestone (Upper Cambrian); and Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone (Middle Cambrian). Locally may include Devonian Maywood Formation (McGrew, 1977), a red and yellow calcareous siltstone and gray dolomitic limestone (Skipp and Peterson, 1965). Snowy Range Formation is mainly limestone and shale distinguished by rounded limestone pebbles in the Grove Creek Limestone Member; underlain by thick red, gray, and green shale, gray limestone, and siltstone-pebble conglomerate of undivided lower members; bed of columnar limestone locally in lower part of formation (Roberts, 1964a; Skipp and Peterson, 1965). Combined thickness of Maywood and Snowy Range Formations 100-200 ft (Skipp and Peterson, 1965). Pilgrim Limestone is gray, thin-bedded to massive limestone and dolomite; forms cliffs. Oolites, grayish-orange and yellow mottling, and flat-pebble conglomerates are common. Interbeds of greenish-gray shale in lower part; glauconitic and fossiliferous at base. Thickness 350-500 ft (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965). Park Shale is grayish-green to multicolored clay shale; thin beds of argillaceous limestone, siltstone, and sandstone; sparse fossiliferous limestone and limestone-pebble conglomerate in upper part. Nonresistant; forms valleys. Thickness 100-200 ft (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965). Meagher (pronounced "mar") Limestone is thin- to medium-bedded, mottled grayish-orange and medium-gray, fine-grained limestone and yellowish-gray dolomite; locally oolitic; crumpled bedding. Thickness 300-600 ft (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965). Wolsey Shale is olive- to brownish-gray micaceous clay shale; contains gray impure limestone in upper part and fine-grained, thin-bedded, glauconitic sandstone in lower part. Abundant trace fossils ("worm cast" markings). Forms valleys. Thickness 100-500 ft (Roberts, 1964a; Skipp and Peterson, 1965). Flathead Sandstone is yellowish-gray to reddish-gray, fine- to coarse-grained, thin- to thick-bedded, locally cross-bedded quartzite and quartz sandstone. Locally conglomeratic in lower part. Very resistant; forms ridges. Thickness 0-300 ft (McGrew, 1977; Roberts, 1964a; Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ym

Unit Name: Middle Proterozoic metasedimentary rocks, undifferentiated

Map Unit Description

Includes the Spokane and underlying LaHood (formerly North Boulder Group) Formations of the Belt Supergroup. Spokane Formation is light-grayish-green argillite, gray to yellowish-gray quartzite and sandstone, and minor thin-bedded grayish-red limestone; rippled beds are common. Thickness 2,200-3,200 ft (McGrew, 1977). LaHood Formation is dark-greenish-gray, medium-grained to very coarse grained to conglomeratic, micaceous, feldspathic sandstone that contains interbedded dark-gray limestone and impure aphanitic laminated calcareous argillite; sandstone forms about 30 percent of sequence and is most common in upper part; limestone, with cone-in-cone structures, and argillite dominate lower part. More than 2,500 ft thick (Skipp and Peterson, 1965)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Am

Unit Name: Metamorphic rocks (Archean)

Map Unit Description

Primarily gneiss. Includes schist, granite, quartzite, pegmatite, amphibolite, and mafic intrusive rocks (Roberts, 1964a)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Ta

Unit Name: Alkalic intrusive rocks (Eocene)

Map Unit Description

Mafic alkalic rocks (including malignite, nepheline syenite, analcite syenite, and theralite), trachyte porphyry, and related intrusive rocks. Typically these rocks are sodium rich, silica undersaturated, and strongly alkaline (Harlan, 1986). No plagioclase feldspar and calcic amphibole (Dudas, 1990). Includes dikes, sills, laccoliths, and small stocks

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Tqm

Unit Name: Quartz monzodiorite phase

Map Unit Description

Quartz monzonite to granodiorite. Locally contains inclusions of diorite and gabbro (Tdg) along contact. Forms an irregular-shaped mass at center of Big Timber stock (du Bray and others, 1993). 40Ar/39Ar ages on biotite: 49.23±0.1 and 49.33±0.12 Ma (S.S. Harlan, USGS, unpub. data, 1996)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Tdg

Unit Name: Diorite and gabbro phase

Map Unit Description

Granular diorite and gabbro form main part of Big Timber stock. Locally contains stoped blocks of pyroxene-rich gabbro. Coarser grained and darker in color than quartz monzodiorite phase (Tqm) (du Bray and others, 1993). 40Ar/39Ar ages on biotite: 49.2±0.07 and 49.33±0.11 Ma (S.S. Harlan, USGS, unpub. data, 1996)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: North Part Gallatin National Forest

Map Unit Symbol: Tcl

Unit Name: Porphyry of Campfire Lake (Eocene)

Map Unit Description

Quartz monzodiorite porphyry, compositionally similar to quartz monzodiorite phase of Big Timber stock (Tqm). Separated from main body of Big Timber stock by sedimentary rocks of Fort Union Formation (TKf). At southern end of area of outcrop, unit has a quenched appearance with plagioclase phenocrysts (2- to 5-mm long) in an aphanitic to glassy groundmass (du Bray and others, 1993)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Td

Unit Name: DACITE (MIOCENE?-OLIGOCENE)

Map Unit Description

Medium- to light-gray, aphanitic dacite in volcanic neck or plug and sills, groundmass of greenish-gray feldspar with phenocrysts of light-gray feldspar, hornblende, and biotite. Present only at and near Haystack Butte in southeast part of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Tm

Unit Name: HORNBLENDE MONZONITE (EOCENE?)

Map Unit Description

Light-gray, fine-grained, and equigranular monzonite dikes and sills composed of andesine, sanidine, hornblende, augite, biotite, magnetite, and apatite. Rock characterized by small hornblende needles (Schmidt, 1972a, b; Schmidt and Strong, 1972). Dated at 46.3 m.y. by K-Ar method (R. G. Schmidt, oral commun. 1975). Widespread in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ta

Unit Name: BIOTITE TRACHYANDESITE AND ANDESITE (EOCENE? OR PALEOCENE?)

Map Unit Description

Biotite trachyandesite and andesite in dikes, sills, and irregular-shaped bodies. Includes trachybasalt and biotite trachybasalt of Schmidt (1972a, b). Dark-gray, aphanitic groundmass with hornblende and some biotite phenocrysts, weathers brown. Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Tva

Unit Name: ADEL MOUNTAIN VOLCANICS OF LYONS (1944) (PALEOCENE?)

Map Unit Description

Volcanic and volcanic-sedimentary rocks. Trachyandesite and trachybasalt flows (Schmidt, 1972c), volcanic conglomerate, breccia, and lacustrine deposits of volcanic sandstone, siltstone, and mudstone (Schmidt, 1972c). Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Tmp

Unit Name: MONZONITE PORPHYRY (PALEOCENE?)

Map Unit Description

Light-gray, coarsely porphyritic monzonite in stocks, dikes, and sills. Includes abundant, large phenocrysts of orthoclase that weather out as euhedral crystals. Dated at 58.3 m.y. by K-Ar method (Schmidt, 1978, p. 62). Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: TKi

Unit Name: TRACHYANDESITE (PALEOCENE OR UPPER CRETACEOUS)

Map Unit Description

Dark-grayish-brown, aphanitic, trachyandesite sills. Groundmass of feldspar with some phenocrysts of plagioclase, potassium feldspar, pyroxene, and quartz (Mudge, 1972). Widespread near the North Fork Sun River in eastern part of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: TKr

Unit Name: RHYOLITE (PALEOCENE OR UPPER CRETACEOUS)

Map Unit Description

Light-gray to white rhyolite dikes and sills. Finely porphyritic with abundant, small phenocrysts of quartz and oligoclase (Schmidt, 1972a). Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: TKw

Unit Name: WILLOW CREEK FORMATION (PALEOCENE AND UPPER CRETACEOUS)

Map Unit Description

Variegated mudstone with some thin beds of sandstone. Mapped with St. Mary River Formation in southeastern part of mapped area. Upper part of the Willow Creek is bright-reddish-brown mudstone in beds as much as 1 m thick, interbedded with gray, gray-green, and tan-gray mudstone. Lower part of Willow Creek is variegated mudstone, dominantly grayish green, gray, and locally tan, pinkish gray, purple, and red brown. Some thin interbeds have irregular-shaped, tufa-like nodules that probably contain barite. Thin, gray, poorly sorted, fine- to medium-grained sandstone beds locally. Weathers to badland topography. At least 235 m thick in north part of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kp

Unit Name: QUARTZ MONZONITE PORPHYRY (CRETACEOUS?)

Map Unit Description

Light-grayish-orange, quartz monzonite porphyry sills. Coarsely porphyritic with abundant large phenocrysts of potassium feldspar and oligoclase andesine in fine-grained groundmass (Schmidt, 1978)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kdr

Unit Name: DIORITE AND RHYODACITE PORPHYRY SILLS (CRETACEOUS?)

Map Unit Description

As mapped by Schmidt and Strong (1972). Greenish-gray rhyodacite with phenocrysts of oligoclase and hornblende, mainly in groundmass of quartz and feldspar. Greenish-gray, fine-grained, and equigranular diorite (Schmidt and Strong, 1972). Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kl

Unit Name: LATITE (UPPER CRETACEOUS)

Map Unit Description

Gray, grayish-purple sill. Massive and porphyritic with abundant phenocrysts of labradorite in an aphanitic groundmass (Schmidt, 1972a). Present only in southeast corner of mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ksm

Unit Name: ST. MARY RIVER FORMATION (UPPER CRETACEOUS)

Map Unit Description

Mostly grayish-green mudstone with interbedded sandstone and some tuff and volcanic sandstone. Willow Creek Formation in the southeast included in map unit. Consists mostly of poorly indurated, grayish-green mudstone with light-red and purple interbeds in upper part. The middle part has thin bed of white, ash-fall tuff in the southern part. In that area, the upper part contains some volcanic sandstone and conglomerate, the lower part consists of grayish-green, olive-drab mudstone with sandy mudstone and many interbedded sandstone units. In northern outcrops, some poorly indurated, gray-brown to tan-gray, cross-bedded sandstones fill small channels. Locally abundant gray-brown, argillaceous limestone nodules. Thin (1.0 m) bed of carbonaceous shale, near base of the St. Mary River, commonly overlain by thin (1.0 m) oyster bed. In southern outcrops, lower part of the St. Mary River contains some coarse- to very coarse grained beds of volcanic sandstone (Schmidt, 1972c). Some reptile bones and pelecypods in sandstone beds in lower part of formation. The St. Mary River weathers to badland topography. This formation about 518 m thick in southeastern part of mapped area and about 366 m thick near the Augusta syncline in southern part. Stebinger (1916) reported thickness of about 300 m in the northern part of the Blackfeet Indian Reservation. The St. Mary River is similar in lithology to Two Medicine Formation; both contain nonmarine sedimentary rocks

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kh

Unit Name: HORSETHIEF SANDSTONE, HORSETHIEF-BEARPAW TRANSITION UNIT, AND THE BEARPAW SHALE (UPPER CRETACEOUS)

Map Unit Description

The Horsethief Sandstone is gray to gray-brown, fine- to medium-grained marine sandstone, commonly cross-bedded. Titaniferous magnetite sandstone locally present in upper 6-12 m of the formation. Large calcareous concretions locally present in the middle part in northern outcrops. The top of the Horsethief contains volcanic-rich sandstone and conglomerate in southern outcrops (Viele and Harris, 1965). Formation as much as 50 m thick. Position marked by an Ostrea glabra bed in southeast part of mapped area (Viele, 1960).

The Horsethief-Bearpaw transition unit (Cobban, 1955) is dark-gray, marine mudstone, interbedded with thin, fine- to medium-grained sandstone. The sandstone becomes thicker bedded and more abundant in the upper part. Some beds cross-bedded and contain ripple marks (Cobban, 1955). A coal bed (0.3 m thick) occurs about 6 m below top of unit at the Sun River. Locally an Ostrea bed is present in upper part of unit in northern outcrops. Unit as much as 122 m thick to the north (Cobban, 1955), thins southward to about 60 m near the Sun River, and absent in southeastern part of map area.

The Bearpaw Shale is only present north of Dupuyer Creek, mostly a dark-gray marine shale with ferruginous concretions, bentonite, and thin layers of sandstone (Cobban, 1955). Selenite crystals common on many weathered surfaces. The Bearpaw contains ammonites and some pelecypods. About 122 m thick in northeast part of map area (Cobban, 1955), thins to a few meters westward

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ktm

Unit Name: Sedimentary facies

Map Unit Description

Nonmarine mudstones with some sandstone, north of Augusta. Upper and middle parts consist mostly of gray-green to gray mudstone with reddish-gray. red-brown, and purple interbeds. Interbeds of fine- to medium-grained sandstone in upper part of sandstone beds. Locally contain abundant vertebrate bones and pelecypods in upper 150 m. Thin conglomerate about 245 m below the top occurs north of Birch Creek (Cobban, 1955). Contains many thick beds of gray- to greenish-gray sandstone, interbedded with gray-green, olive-drab, and gray mudstone in lower part of formation (about 170 m). Locally as much as 50 m thick, poorly indurated, fine-to medium-grained, massive- to thin-bedded, and in part cross-bedded sandstone beds, a conglomerate is included in the sandstone (Mudge, 1972). Carbonaceous shale, as much as 1.5 m thick, widespread near base of formation. Locally abundant petrified wood in a sandstone unit above the carbonaceous shale, erodes into badland topography similar to the St. Mary River Formation. The Two Medicine is about 670 m thick. Widespread in eastern part of mapped area and present in the North Fork Sun River area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ktv

Unit Name: Volcanic and sedimentary facies

Map Unit Description

Mudstone and some sandstone and conglomerate, south of Augusta, contains volcanic rocks as described by Viele (1960), Viele and Harris (1965), Schmidt (1972a,b,c), and Schmidt and Strong (1972). Volcanic rocks include brown, pink, and white ash-fall and ash-flow tuffs, and interbedded trachyte and latite flows. Sandstones in middle and upper parts of formation derived from volcanic materials, some are conglomeratic. Facies ranges from 640 m to possibly as much as 1,500 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kvt

Unit Name: VIRGELLE SANDSTONE AND TELEGRAPH CREEK FORMATION (UPPER CRETACEOUS)

Map Unit Description

The Virgelle Sandstone is light-gray, moderately thick bedded, fine-grained marine sandstone. Locally contains cross-bedded, iron-impregnated beds that weather into large concretions. Contains dark-brownish-gray, resistant titaniferous magnetite sandstone as much as 6 m thick at many places in the top of formation. Contains sparse pelecypods and wood fragments. Ranges from 50 to 60 m thick.

The Telegraph Creek Formation is a transitional unit between the underlying Marias River Shale and overlying Virgelle Sandstone; similar to the transitional unit between the Bearpaw Shale and Horsethief Sandstone. Mainly beds of gray mudstone interbedded with fine-grained sandstone. Sandstone beds become thicker toward top of the unit and locally cross-bedded, ripple marked, and contain wood fragments, sparse pelecypods, and ammonites. Formation ranges from about 90 to 165 m thick, thinning to the east and northeast

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Km

Unit Name: MARIAS RIVER SHALE (UPPER CRETACEOUS)

Map Unit Description

Mainly dark-gray, marine mudstone, ranges from 365 to 395 m thick. Divided into four members by Cobban, Erdmann, Lemke, and Maughan (1959b, 1976), in descending order: Kevin, Ferdig, Cone, and Floweree.

The Kevin is dark-gray, calcareous mudstone with some thin, very fine grained sandstone in upper part. Characteristically contains many thin, micaceous bentonite beds and zones of calcareous and ferruginous limestone concretions. Bentonite beds thicker and far more numerous in southern outcrops. Pelecypods and ammonites common. The Kevin Member ranges from about 226 m thick in the east to as much as 326 m in the west (Mudge, 1972).

The eastern facies of the Ferdig Member contains gray, noncalcareous mudstone with many very thin, iron-stained sandstone beds, concretions of yellow-weathering limestone and red-weathering ferruginous dolostone, and some very thin bentonite beds, about 50 m thick. The western facies of the Ferdig, exposed in the North and South Forks of the Sun River, is about 150 m thick, and resembles the Cardium Formation of southern Alberta, Canada (Mudge, 1972). Contains nodular sandstone, sandy shale, and even-bedded sandstone in the middle and upper parts of the western facies; thick-bedded, light-gray sandstone in upper part. Organic burrows and trails common. The lower part is like that exposed in the eastern facies.

The Cone Member contains abundant, very thin, medium-gray, calcareous siltstone and crystalline limestone beds in the upper part and dark-gray noncalcareous fissile shale with some limestone concretions in the lower part (Cobban, Erdmann, Lemke, and Maughan, 1976); contains several bentonite beds throughout. The upper beds commonly have petroliferous odor on a freshly broken surface. Contains a characteristic fauna which includes Mytiloides labiatus (Cobban, Erdmann, Lemke, and Maughan, 1976). Ranges from 15 to 30 m thick.

The Floweree Member is noncalcareous, dark-gray, nonfossiliferous shale (Cobban, Erdmann, Lemke, Maughan, 1976; Mudge, 1972). Locally contains basal siltstone with chert-pebble conglomerate. The shale has metallic luster and yellowish-brown stains on bedding and fracture planes (Mudge, 1972). Ranges from 9 to 12 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kbk

Unit Name: BLACKLEAF AND KOOTENAI FORMATIONS, UNDIVIDED (LOWER CRETACEOUS)

Map Unit Description

Unit shown where parts of both formations present but too thin to map separately

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kb

Unit Name: BLACKLEAF FORMATION (LOWER CRETACEOUS)

Map Unit Description

Gray, marine mudstone and interbedded sandstone. Divided into three members by Cobban, Erdmann, Lemke, and Maughan (1959b, 1976), in descending order: Vaughan, Taft Hill, and Flood. The formation ranges from about 200 m thick in southern outcrop to about 490 m in the west and about 260 m in the north.

The nonmarine Vaughan Member consists of alternating gray to olive-drab mudstones and bentonitic mudstone with many thin interbeds of light-gray, locally cross-bedded sandstone. Contains less sandstone to the north and lower beds are laterally equivalent to upper part of the marine Taft Hill strata to the south. Locally, beds of conglomerate fill small channels at base of some sandstone units (Mudge, 1972). In the Sun River area, the upper part of member contains tuffaceous debris, one bed contains accretionary lapilli (Mudge, 1972). Member locally contains wood and leaf fragments and, in the vicinity of Teton Pass, contains beds of coal and carbonaceous shale. Ranges from 90 m thick in the eastern outcrops to possibly 213 m in the north.

In the south, the marine Taft Hill Member consists of thinly bedded, gray, fossiliferous sandstone, locally cross-bedded and ripple marked (Mudge, 1972), interbedded with dark-gray mudstone containing some very thin bentonite beds. These units grade northward into nonmarine lithologies of the Vaughan. The Taft Hill is as much as 183 m thick in west-central part of the area, thins to 0 m to the north and 58 m in the southeast outcrop.

The marine Flood Member in the south consists of two sandstone units with a distinctive intervening shale unit. Lower sandstone absent to the north where upper sandstone unit is thicker and shale unit thinner, as compared to southern exposures. Gray, thinly cross-bedded, very fine grained, finely micaceous and moderately well sorted sandstones (Mudge, 1972); commonly weather grayish brown. Locally large sandstone nodules in lower part. The shale unit, transitional with upper sandstone unit, is distinct, very dark gray fissile shale with a metallic luster on bedding surfaces. Thin sandstone lentils and nodules of limestone and claystone common, locally phosphatic nodules present. Organic trails and burrows abundant in transition zone. The Flood ranges from 45 m thick in eastern outcrops to 165 m in western. About 40 m thick in the north part of mapped area (Rice and Cobban, 1977)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kk

Unit Name: KOOTENAI FORMATION (LOWER CRETACEOUS)

Map Unit Description

Nonmarine, gray-green and maroon mudstone with numerous lenticular, poorly sorted, greenish-gray sandstone beds, locally cross-bedded and contain lenticular basal conglomerates (Mudge and Sheppard, 1968; Mudge, 1972). Brown to brownish-gray limestone with thin to thick lenses of coquina with pelecypods and gastropods is near top of formation. Brown, iron-stained limestone nodules common in mudstone beds. The Sunburst Sandstone Member of Rice and Cobban (1977) is at base of formation in the southern outcrops and absent to the north. The Sunburst consists of many thin beds of hard, noncalcareous, poorly sorted quartz sandstone with few scattered grains of chert and feldspar. The Kootenai ranges from 198 to more than 305 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Kmp

Unit Name: MOUNT PABLO FORMATION (LOWER CRETACEOUS)

Map Unit Description

Nonmarine, formerly referred to as the western facies of the Morrison Formation in the Sun River Canyon area (Mudge, 1972). Consists of limestone, mudstone, and sandstone in upper part, variegated mudstone interbedded with sandstone in middle part, and sandstone and conglomerate in lower part (Mudge and Rice, 1980). Everywhere overlain unconformably by the Kootenai Formation (Kk). The lower sandstone and conglomeratic sandstone is the Cut Bank Sandstone Member, an important hydrocarbon reservoir rock near Cut Bank, Mont. The upper and middle parts of the formation are mostly gray to gray-green mudstone with some maroon and orange-red mudstone and thin beds of fine-grained sandstone. Mostly reddish-brown mudstone with some sandstone in southwestern area (Mudge, 1972). Widespread, light-gray, lacustrine limestone, as much as 10 m thick, near top of the formation. The Cut Bank Sandstone Member in places contains coarse-grained, cross-bedded sandstone in the upper part, composed of nearly equal amounts of quartz and black chert. Grades upward into very fine grained sandstone as much as 10 m thick in the north. The lower conglomeratic sandstone unit is prominent, cross-bedded, poorly sorted, very coarse grained sandstone that grades upward into very fine sandstone. In many places has dominantly chert-pebble conglomerate at its base, to the south conglomeratic lenses common at various horizons. Commonly about 8 m thick, the lower sandstone unit is as much as 30 m thick. The Mount Pablo Formation (KJm) ranges from 0 to about 90 m thick, unconformably overlies the Morrison Formation except in northeastern outcrops where overlies the Swift Formation

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: KJm

Unit Name: LOWER CRETACEOUS MOUNT PABLO FORMATION AND JURASSIC MORRISON FORMATION AND ELLIS GROUP, UNDIVIDED

Map Unit Description

The Morrison Formation is not mapped separately and therefore is described below.

The most complete sections of the Morrison are in east-central and southern outcrop areas. Mainly grayish-green, tuffaceous siltstone with interbedded sandstone, limestone, and some cherty siderite in the eastern part of the Sun River Canyon area (Mudge, 1972). Maroon and tints of pinkish-gray beds common in the upper part. Cherty siderite occurs as lenses in the middle part, limestone occurs as beds or nodules in the lower part. The Morrison is about 61 m thick in the Sun River area (Mudge, 1972), about 82 m thick in the Wolf Creek area (Schmidt, 1972a). Mostly eroded prior to deposition of the Mount Pablo Formation north of the Sun River area. In most places, the Morrison is less than 30 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Je

Unit Name: ELLIS GROUP (UPPER AND MIDDLE JURASSIC)

Map Unit Description

Divided into three formations by Cobban (1945), in descending order: Swift, Rierdon, and Sawtooth. In the Wolf Creek area the Rierdon Formation is absent, the combined thickness of the Swift and Sawtooth Formations is about 65 m. The three formations have an aggregate thickness of about 87 m in the Sun River area, about 205 m thick west of that area, and more than 188 m in the northern part of mapped area (Mudge and Earhart, 1978)

The Upper and Middle Jurassic Swift Formation was divided into upper and lower unnamed members by Cobban (1945). Ranges from 30 to 36 m thick in the southeast to more than 60 m in the northwest. In the northeast, part of the upper member was eroded prior to sedimentation of the Cretaceous Mount Pablo Formation. The upper member is thin-bedded, gray to gray-brown, very fine to fine-grained sandstone. As much as 30 m thick in the Sun River area (Mudge, 1972), less than 3 m thick in the northeast outcrop. The lower member is dark-gray shale with some interbeds of sandstone. A thin bed of poorly indurated glauconitic sandstone with water-worn belemnites and locally chert pebbles, at base of the member except in the northern outcrops. The lower member averages about 15 m thick in the south and about 21 m thick in the north. The Swift unconformably overlies the Rierdon Formation.

The Middle Jurassic Rierdon Formation contains calcareous gray-brown siltstone and claystone in the upper part and calcareous, dark-gray, laminated shale and claystone in the lower part. Many thin beds of argillaceous limestone scattered throughout formation. Barite nodules, numerous pelecypods and some ammonites common. Phosphatic nodules common in the lower part of northern exposures. About 44 m thick in the Sun River area, as much as 56 m thick to the north.

The Middle Jurassic Sawtooth Formation is divided into three unnamed members by Cobban (1945), the lower member is absent in the northern outcrop area. Ranges in thickness from 15 to 69 m, thickening to the north. The upper siltstone member is a prominent unit, many thin beds of grayish-brown to yellowish-gray siltstone with a few thin beds of shale, increasingly sandy northward. Lenses of phosphatic pellets common in the western and northern outcrops. Pelecypods common and ammonites rare. Member 6-13 m thick in the south (Mudge, 1972), thickens northward to about 18 m (Imlay, 1962). The shale member is dark-gray shale with some siltstone, sandstone, and a few beds of limestone. Thickens northward from 5 m in the Sun River area to about 77 m near Mount Patrick Pass. Some beds locally pyritic. North of the Teton River contains black, phosphatic pellets and lies unconformably on Mississippian carbonate rocks. The lower sandstone member in the southern part of the area rests unconformably on Mississippian rocks. In most places, hard, fine-grained, and light-gray sandstone beds, conglomeratic in the basal part. Locally consists of two beds of sandstone separated by dark-gray shale. The conglomerate consists of pebbles and cobbles and locally boulders of Mississippian carbonate and chert (Mudge, 1972). The sandstone member ranges from 0-6 m thick, in most places 0.6-2 m thick (Mudge, 1972).

Map Citation

Geologic map unit descriptions

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Mm

Unit Name: MADISON GROUP (UPPER AND LOWER MISSISSIPPIAN)

Map Unit Description

Divided into the Castle Reef Dolomite and the underlying Allan Mountain Limestone (Mudge, Sando, and Dutro (1962) equivalent in age to the Mission Canyon and Lodgepole Limestones in Central Montana. The Madison ranges from about 275 m to 550 m thick, much of the variation in thickness is a result of pre-Jurassic erosion (Mudge, 1972).

The Upper and Lower Mississippian Castle Reef Dolomite, ranges from about 230 m thick in the eastern outcrops to about 305 m in the west, is divided into an upper member, the Sun River Member, and a lower unnamed member (Mudge, Sando, and Dutro, 1962). The Sun River Member, 76-137 m thick, consists mostly of thick beds of fine- to medium-crystalline dolomite (Mudge, 1972), and is main hydrocarbon reservoir rock on the Sweetgrass Arch (Chamberlain, 1955). In many places oil residues common in cavities, pores, fractures, and on bedding planes in the upper part of the member. The lower member of the Castle Reef consists of thin to thick beds of fine to coarsely crystalline, light-gray dolomite, calcitic dolomite, and dolomitic limestone, dolomite content increases westward. Beds of coarsely crystalline encrinites at various horizons in the Castle Reef, increasingly abundant to the north and west. Lenses and nodules of dark-gray chert common in lower and middle parts, light-gray chert nodules common in upper part. In places, sand-filled joints and bedding planes in upper part (Mudge, 1972). Corals and brachiopods common in the formation.

The Lower Mississippian Allan Mountain Limestone, ranges from about 165 to 200 m thick, contains three widespread unnamed members. The upper member is mainly gray, medium- to thick-bedded, fossiliferous limestone with some beds of dolomitic and magnesium limestone (Mudge, Sando, and Dutro, 1962). In places encrinite beds occur in middle and upper parts of member. Member ranges from 42 to 106 m thick. The middle member contains abundant, irregular-shaped lenses and nodules of very dark chert in sparsely fossiliferous, medium-bedded, dark-gray limestone and dolomitic limestone, ranges from 45 to 58 m thick. Chert is dispersed throughout member at 15-25 cm intervals. The lower member consists of very thinly bedded, dark-gray, argillaceous limestone and dolomitic limestone with dark-gray shale partings (Mudge, Sando, and Dutro, 1962). The lower part of lower member contains alternating beds of dark-gray to gray-brown limestone and very calcareous shale, locally potential hydrocarbon source rocks (Mudge, Rice, Earhart, and Claypool, 1978); ranges from 50 m to 67 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Du

Unit Name: THREE FORKS, JEFFERSON, AND MAYWOOD FORMATIONS, UNDIVIDED (UPPER AND MIDDLE DEVON-IAN)

Map Unit Description

Widespread in the Lewis, Hoadley, and Eldorado thrust plates in western part of mapped area and in numerous thrust plates in the Sawtooth Range. Range from 290 m thick in the southeast exposures to 457 m northwestward at Slategoat Mountain (Mudge, 1972) and northward to about 519 m southwest of Swift Reservoir. Natural gas produced from Birdbear Member of the Jefferson on the Sweetgrass Arch, and from equivalent rocks and the Three Forks Formation in southern foothills of Alberta.

In most places the Upper Devonian Three Forks almost entirely an evaporite-solution breccia, consists of angular fragments (mostly less than 1 m across) of pale-yellowish-brown dolomite and dolomitic limestone (Mudge, 1972). Grayish-green mudstone and massive gray limestone bed, as much as 30 m thick, overlie breccia in the southern outcrop (Mudge, 1972). Elsewhere beds above the breccia are thinly bedded, yellowish-gray, silty limestone and siltstone and black shale. Black shale mostly about 30 cm thick, locally as much as 1 m thick, observed at north end of Sawtooth Ridge, in Deep Creek (Mudge, 1972), on north side of Crown Mountain, in tributary of the Dearborn River, south of Steamboat Mountain, on South Fork Teton River across from Rierdon Gulch, on a mountain on south side of the upper reaches of that fork, on northeast side of Family Peak, on southeast side of Mount Drewyer, and at head of the north fork of Whitetail Creek. The presence of black shale at these widely scattered localities indicates that it is widespread, but in places is absent as a result of tectonic deformation and in places is covered by thick talus deposits. Fossils recorded in black shale by Gutschick, Suttner, and Switek (1962) and Sandberg (1965). The Three Forks Formation as much as 60 m thick, locally about 15 m thick in eastern outcrops (Mudge, 1972). Thickens westward to 180 m at Slategoat Mountain.

The Upper Devonian Jefferson Formation contains the Birdbear Member at the top (Sandberg,1965) and a lower unnamed member. Ranges from 225 to 245 m thick in the eastern outcrop, thins westward to about 190 m at Slategoat Mountain. The Birdbear Member consists mostly of pale-yellowish-brown, very fine to finely crystalline, thin dolomite beds, characteristically pinches and swells, weathers light yellowish gray. Brachiopods most common fossil (Mudge, 1972). The Birdbear ranges from about 16 m thick in the north to 45 m in the southeast, about 72 m in the southwest. The lower member is mostly limestone in northern and southwestern exposures, mostly dolomite in southeastern exposures. Commonly gray-brown and locally light-gray fetid beds, about 30 cm thick. One or more thin, evaporite-solution breccias in lower part in southern outcrops; thicker and more numerous throughout member in northern outcrops. Biostromes of Amphipora widespread in upper part and locally in lower part, corals and brachiopods occur at several horizons. The lower member ranges from 200 to 210 m thick in the central part of the Sawtooth Range, thinning to about 120 m to the west at Slategoat Mountain and to 130 m to the southeast near Gibson Dam (Mudge, 1972).

The Upper and Middle Devonian Maywood Formation is divisible into two unnamed members (Mudge, 1972). Ranges from 16 to 85 m thick. The upper member is mostly thinly bedded, finely crystalline,

Geologic map unit descriptions

somewhat fossiliferous limestone and dolomitic limestone, forms resistant ledges. Mostly grayish-brown, mottled to pale yellowish orange to yellowish gray on the weathered beds (Mudge, 1972). Locally thin, evaporite-solution breccia in lower part. The upper member thickens westward from about 8 m in the southeastern outcrops, 16 m in the northeastern, to about 50 m in the western outcrops. The lower member is mostly greenish-gray mudstone with thin beds of dolomite, dolomitic limestone, and breccia in the lower part. Maroon mudstone common in the upper part of member in the western outcrops. In places, coarse-grained sandstone at base. North of the Sun River, the lower part of member contains channel fills as much as 6 m deep; the Cambrian- Devonian unconformity is at the base of channel fill deposits, The lower member thickens westward from about 8 m in the Sun River area (Mudge, 1972), about 4 m west of Swift Reservoir, to about 63 m at Slategoat Mountain.

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Cu

Unit Name: CAMBRIAN ROCKS

Map Unit Description

Includes, in descending order: Devils Glen Dolomite, Switchback Shale, Steamboat Limestone, Pentagon Shale, Pagoda Limestone, Dearborn Limestone, Damnation Limestone, Gordon Shale, and Flathead Sandstone. Limestone formations contain considerable mudstone in the east, mostly limestone in the west. All formations well exposed in the western part of mapped area. Only upper three formations exposed in some thrust blocks in the Sawtooth Range. In the western part of the mapped area, Cambrian rocks thin northward from about 535 m in the southwest to about 440 m at Pagoda Mountain, and to 495 m at Pentagon Mountain (Deiss, 1939). In the southern part of the mapped area, the Dearborn River area, they are 680 m thick.

The Upper Cambrian Devils Glen Dolomite is thick-bedded, light-gray dolomite, in most places forms prominent, light-gray cliff. Trilobites recorded in the upper part in the Sun River Canyon area (Mudge, 1972). Ranges from about 32 m thick at Pagoda Mountain (Deiss, 1939) in the west to as much as 167 m at Nineteen Mountain (Mudge, 1972) in the southeast, and about 60 m thick to the north; variation in thickness very likely a result of pre-Devonian erosion.

The Upper and Middle Cambrian Switchback Shale is mostly noncalcareous, greenish-gray, thinly laminated, clayey shale with thin local interbeds of dolomite, limestone, sandstone, and conglomerate. Conglomerates locally contain brachiopods (Mudge, 1972). The Switchback varies considerably in thickness from about 35 m at Pentagon Mountain to 23 m at Pagoda Mountain (Deiss, 1939) to 77 m at Nineteen Mountain, and to 82 m at Arsenic Mountain (Mudge, 1972).

The Middle Cambrian Steamboat Limestone consists of two parts in the western outcrop, a lower shaly interval and a much thicker upper limestone and dolomite interval (Deiss, 1939; Mudge, 1972), whereas in the eastern outcrop, in the Sawtooth Range, is about equal parts of alternating sequences of limestone and dolomite, and calcareous shales. Carbonates in both areas consist of hard, nodular, dark-gray to yellowish-brown, thinly bedded, finely crystalline beds of limestone and dolomite with nodules and lentils of dark-yellowish-orange, limey siltstone. Thin beds of intraformational conglomerate present locally. Mudstone units mainly grayish-green, noncalcareous, clayey shale with interbedded calcareous siltstone and claystone. Trilobites and some brachiopods locally in both limestone and shale beds. The Steamboat Limestone is about 92 m thick at its type locality in Dearborn Canyon, 66 m at Pentagon Mountain, 81 m at Pagoda Mountain (Deiss, 1939), and 67 m at Nineteen Mountain (Mudge, 1972).

The Middle Cambrian Pentagon Shale is present only in the northern part of mapped area, occurs as clastic wedge that extends south from Pentagon Mountain about 22 km (Deiss, 1939), and north about 7 km. The Pentagon consists of calcareous, gray to tan-gray, thick-bedded, platy, fossiliferous shale, contains some platy, blue-gray, argillaceous limestone in upper part (Deiss, 1939). Ranges from 0 to 88 m thick.

Geologic map unit descriptions

The Middle Cambrian Pagoda Limestone consists of an upper limestone member and a lower shale member. Upper member is finely crystalline, pale-yellowish-brown, very thin bedded limestone and thin- to thick-bedded dolomitic limestone and dolomite, the most prominent cliff-forming unit in the Cambrian sequence. Intraformational conglomerate locally in the middle part of the Pagoda. The lower member consists of beds of grayish-green, thinly laminated to nodular, clay shale with some gray-brown limestone and minor sandstone. Fossils locally present in limestone beds. The Pagoda, in general, thickens to the south and west; varies from about 53 m thick along the Continental Divide in the central part of mapped area to about 107 m at Pagoda Mountain, and 111 m near Prairie Reef Lookout Station (Deiss, 1939).

The Middle Cambrian Dearborn Limestone consists of an upper, finely crystalline, pale-yellowish-brown to gray, very thinly and irregularly bedded limestone unit and a lower mudstone unit of gray to gray-green, clayey shale with some sandy shale that contains trilobites. Ranges from about 67 to 106 m thick, averages about 90 m (Deiss, 1939).

The Middle Cambrian Damnation Limestone consists of thinly bedded, finely crystalline, medium- to dark-gray dolomitic limestone and limestone with laminae of grayish-orange to yellowish-gray siltstone. Mottled, grayish-orange limestone beds. Trilobites present in lower part of formation (Deiss, 1939). The Damnation is 31 m thick on the Continental Divide near Cliff Mountain, thickens northward to 58 m at Pentagon Mountain, southward to 45 m at Prairie Reef (Deiss, 1939), and about 51 m thick in the Dearborn Canyon area (Deiss, 1939).

The Middle Cambrian Gordon Shale is mainly a dark-gray to gray-brown, very thinly laminated shale with greenish tint. Contains many thin beds of sandstone and some beds of limestone. In places, limestone contains glauconite, algal structures, fossil fragments, limestone chips, and quartz grains (Mudge, 1972). Organic burrows and trails common in lower sandstone beds. Trilobites numerous in upper part (Deiss, 1939). Thickens southward from about 43 m at Pentagon Mountain to about 90 m along the Continental Divide near Cliff Mountain (Deiss, 1939), from that area it thins southward to 60 m at Prairie Reef (Deiss, 1939).

The Middle Cambrian Flathead Sandstone consists of thin- to thick-bedded, noncalcareous, yellowish-gray, poorly sorted, poorly indurated, fine- to coarse-grained, cross-bedded quartzose sandstone with scattered quartz pebbles. Commonly contains organic trails and burrows, speckled with brown hematite. Ranges from about 13 to 35 m thick, rests unconformably on rocks of the Belt Supergroup.

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Zd

Unit Name: DIORITE (PROTEROZOIC Z)

Map Unit Description

Mostly diorite and quartz diorite with minor diorite-gabbro and monzonite as sills and locally dikes. Dark gray, weathers grayish brown. Dated at 750±25 m.y. by K-Ar method (J. D. Obradovich, oral commun., 1966). Widespread throughout mapped area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ygr

Unit Name: GARNET RANGE FORMATION (PROTEROZOIC Y)

Map Unit Description

Pale-olive to medium-gray, thin and even beds of fine-grained, micaceous quartzite and interbedded, olive-gray, thin- to thick-bedded, micaceous siltite. Present only locally beneath Cambrian rocks on east flank and south end of the Continental Divide syncline. Everywhere present on west flank of syncline to north of Twin Peaks. Quartzite most abundant near Scapegoat Mountain. Groove and flute casts, cross-bedding, and channel fill structures common (Sommers, 1966). Locally, the formation partly or completely eroded prior to Middle Cambrian sedimentation. Near Camp Creek is 250-300 m thick (Sommers, 1966)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ym

Unit Name: MCNAMARA FORMATION (PROTEROZOIC Y)

Map Unit Description

In the southern part of mapped area, the upper part mostly thin beds of reddish-brown quartzite and minor amounts of interbedded greenish-gray siltite. Fine-grained micaceous quartzites contain cross-beds and ripple marks. The lower part of formation in the southern area mostly grayish-green siltite with some thin beds of argillite and quartzite and locally some reddish-gray siltite. Ripple marks, minute cross-bedding, load casts, thin beds of glauconitic quartzite, and lenses of vuggy, reddish chalcedony common. Some vugs filled with barite. Locally thin beds of greenish-gray stromatolitic limestone and edgewise conglomerate. In northern outcrops, the McNamara is thin-bedded, grayish-green siltite with some thin beds of greenish-gray and reddish-brown quartzite. The formation thickens uniformly northward from 640 m in the southwest to 1,650 m in the northwest. Complete sections of the McNamara in the Lewis thrust plate along both limbs of the Continental Divide syncline and along west edge of map

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ybo

Unit Name: BONNER QUARTZITE (PROTEROZOIC Y)

Map Unit Description

Mostly pink, pale-red, and pinkish-gray, poorly sorted quartzite. Consists of fine- to medium-grained quartz with minor amounts of feldspar, and some fragments of red argillite. Many beds cross-laminated, contain ripple marks, and form resistant hillside ledges and smooth rounded knobs (Mudge and Earhart, 1978). From 235 to 245 m thick in eastern and northern outcrops, about 385 m thick in Camp Creek area (Sommers, 1966); as much as 450 m thick in northern part of the Scapegoat Wilderness (Mudge and others, 1974)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yb

Unit Name: MOUNT SHIELDS, SHEPARD, SNOWSLIP, AND HELENA FORMATIONS, UNDIVIDED (PROTEROZOIC Y)

Map Unit Description

Mapped only in upper reaches of Ford and Smith Creeks

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yms

Unit Name: MOUNT SHIELDS FORMATION (PROTEROZOIC Y)

Map Unit Description

Mostly bright-reddish-brown, thinly laminated, micaceous siltite, argillite, and thin- to thick-bedded quartzite. Grayish-green siltite unit with local, interbedded, dark-gray fissile argillite widespread in upper part of formation. Fine- to medium-grained quartzite beds more common in the lower and middle parts of formation. Cross-laminations, ripple marks, mud-crack fillings, and mud chips common. Salt-crystal casts occur consistently in upper part of formation, beneath greenish-gray siltite, and locally common in other parts of formation. Glauconite common in lower part of formation in eastern outcrops. Lower part also contains light-gray beds of stromatolitic and oolitic limestone in eastern outcrops north of Glenn Creek. The formation is about 520 m thick in the Eldorado thrust plate in eastern outcrops, thickens northward to 775 m at the type section in southwestern Glacier National Park (Childers, 1963) and southwest to about 910 m (Mudge and others, 1974)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ysh

Unit Name: SHEPARD FORMATION (PROTEROZOIC Y)

Map Unit Description

Mostly greenish-gray, locally maroon in lower part, very thinly bedded, micaceous, dolomitic siltite with some silty limestone and argillite (Mudge and Earhart, 1978; Mudge, 1972), weathers grayish yellow. Thin, glauconitic quartzite lentils widespread in upper part of the formation in eastern outcrops, also ripple marks, minute cross-lamination, load casts, and mud cracks. Beds of edgewise, micrite-pebble conglomerate and calcareous siltite breccia in upper part of formation in northern outcrops (Childers, 1963). In eastern outcrops, an edgewise conglomerate is near the base of formation; elsewhere stromatolitic limestone occurs near base. The Shepard thickens westward and northward, 69-245 m thick in eastern outcrop (McGill and Sommers, 1967; Mudge, 1972), thickens northward to 475 m in Glacier National Park (Childers, 1963) and westward to 605 m (Sommers, 1966). In the southwest ranges from about 260 to about 455 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ysn

Unit Name: SNOWSLIP FORMATION (PROTEROZOIC Y)

Map Unit Description

Pale-red to reddish-brown and greenish-gray beds of argillite, siltite, and some thin beds of very fine to fine-grained quartzite. Thin beds of poorly sorted, fine- to coarse-grained quartzite and gritstone common in the lower part. At the type section in southwestern Glacier National Park, the basal unit is thinly bedded, sandy, argillite breccia consisting of red and gray flat argillite fragments in matrix of calcite and coarse quartz grains (Childers, 1963). In this area, the lower part also contains a stromatolite zone called the Collenia undosa Zone 2 by Rezak (1957) and Childers (1963). Thin beds of stromatolitic and oolitic limestone, and locally flat pebble conglomerate occur at various horizons elsewhere. Cross-bedding, minute laminae, ripple marks, and mudcracks common. The formation thickens north, west, and south from eastern outcrops. In the east, ranges from 90-213 m. thick (Mudge, 1972), about 680 m thick in the west-central part of area (Sommers, 1966), 975 m thick in the northwestern part (Mudge and Earhart, 1978), about 490 m thick at the type section in southwest Glacier National Park (Childers, 1963), and about 550 m thick in the southern part (Mudge and others, 1974)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yba

Unit Name: HELENA, EMPIRE, AND SPOKANE FORMATIONS, UNDIVIDED (PROTEROZOIC Y)

Map Unit Description

Mapped only in West Fork Sun River where parts of each formation in closely spaced, thrust fault plates

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yh

Unit Name: HELENA FORMATION (PROTEROZOIC Y)

Map Unit Description

Mainly thin- to thick-bedded limestone, dolomite, and calcitic dolomite with some interbeds of dolomitic siltite and argillite. Gray to dark-gray siltites mostly in upper and lower parts. Thin, light-gray, poorly sorted, calcite-cemented quartzite beds at the base in southern outcrops. Light- to medium-gray carbonate beds, weather yellowish gray to grayish orange. Beds as much as 1.8 m thick in upper part of the Helena, contain stromatolites, oolites, or edgewise conglomerates. Molar tooth structures common (O'Connor, 1967), consist of vertical ribbons, blobs, horizontal mats, lenses, and pods that differentially weather to form crenulating patterns. The Helena is 174 m thick in the Eldorado thrust plate in Dearborn Canyon, thickens to 488 m in same plate near U.S. Highway 200, thickens southwest to 1,090 m in the Hoadley thrust plate and northwest to 1,983 m in the Flathead Range

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yes

Unit Name: EMPIRE AND SPOKANE FORMATIONS (PROTEROZOIC Y)

Map Unit Description

Undivided only in eastern and southeastern outcrops where the Empire is locally absent or too thin to map as separate unit

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ye

Unit Name: EMPIRE FORMATION (PROTEROZOIC Y)

Map Unit Description

Transitional unit between the Helena and Spokane Formations. Distinctive, greenish-gray, calcareous to dolomitic argillite and siltite with interbeds of dolomite, quartzite, and locally stromatolitic and oolitic carbonate rock. Red-brown strata in lower part and locally in middle part, interstitial carbonate increases upward. Poorly sorted, very fine to medium grained, locally carbonate cemented quartzite beds, thick bedded, light gray, and partly recrystallized in the northwest. Minute cross-bedding, ripple marks, and mud cracks present. The formation is about 180 m thick in northwestern outcrops (Mudge and Earhart, 1978), from 60 to 300 m in the southeast (J. W. Whipple, oral commun., 1979)

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ys

Unit Name: SPOKANE FORMATION (PROTEROZOIC Y)

Map Unit Description

Pale-purplish-red, grayish-red, and greenish-gray siltite, argillite, and some quartzite, particularly in upper part. Greenish-gray units more widespread in the Hoadley thrust plate than the Eldorado thrust plate (J. W. Whipple, oral commun., 1979). Thin beds of gray and grayish-red, fine- to medium-grained quartzite are interbedded, thicker bedded, and coarser grained in the Hoadley and Lewis thrust plates. In the northwest, they occupy several zones as much as 30 m thick, (Childers, 1963). The southeastern exposures contain limestone that weathers gray brown (Schmidt and Strong, 1972). Minute cross-bedding, ripple marks, desiccation cracks, mud-chips, and compaction features locally present. The Spokane is 915 m thick in the southeast, 1,280 in the southwest, 730 m in the northeast, and 1,340 m in the northwest

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Yg

Unit Name: GREYSON FORMATION (PROTEROZOIC Y)

Map Unit Description

Only the upper part in map area; lower part omitted by thrust faulting. Mainly very thinly bedded, gray, olive-gray, and light-greenish-gray argillite and siltite. In the southeastern part of area, contains some light-gray, thinly bedded, fine-grained quartzites, most thicken westward, and occasional thin beds of light- to medium-gray algal limestone, weathers to green, tan, and brown (Schmidt and Strong, 1972). They (1972) also noted some bedding surfaces with ripple marks, mud-crack casts, and salt-crystal casts. Only the uppermost part of the Greyson is in the northern part of mapped area; consists of about 300 m of medium-green to greenish-gray, finely laminated argillite, interbedded with light-gray, poorly sorted quartzite and sandstone and some sedimentary breccia (Childers, 1963). He noted the commonly massive, coarse grained, conglomeratic quartzites and sandstones with quartz pebbles as much as 5 mm across. Greyson as much as 985 in thick in southeastern part of area

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Ya

Unit Name: ALTYN FORMATION (PROTEROZOIC Y)

Map Unit Description

Present in four mountains on west side of Blackfeet Indian Reservation. Thick-bedded, dark-gray magnesium limestone and dolomite, weathers to distinctive, grayish orange to light gray, as much as 610 m thick

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): Dist_belt_N_rect, Dist_belt_S_rect

Map Title

Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana

Map name: Northern disturbed belt

Map Unit Symbol: Xc

Unit Name: CRYSTALLINE BASEMENT ROCKS OF EARLY PROTEROZOIC AND POSSIBLY ARCHEAN AGES

Map Unit Description

Present in subsurface and shown on cross sections only

Map Citation

Mudge, M.R., and Earhart, R.L., 1983, Bedrock geologic map of part of the northern disturbed belt, Lewis and Clark, Teton, Pondera, Glacier, Flathead, Cascade, and Powell Counties, Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1375, 2 sheets, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Qs

Unit Name: Surficial deposits, undivided (Quaternary)

Map Unit Description

Alluvium, colluvium, talus, landslide deposits, rock glaciers, glacial and glaciofluvial deposits, and boulder fields. Only selected major areas, generally exposed for at least 1 mi in a single direction, are shown

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Qr

Unit Name: Rhyolite (Pleistocene)

Map Unit Description

Rhyolite flows of Madison Plateau, in extreme southern part of map area. Upper part (about 100 ft) is agglomerate consisting of blocks of black obsidian (ranging from granules to large blocks) in a matrix of unconsolidated glass shards. Much of the obsidian is crumbly and spherulitic (1-3 cm in diameter and varicolored). Middle part (several hundred feet) is flow-banded rhyolite. Lower part (30 ft) is perlitic and spherulitic obsidian agglomerate (Hamilton, 1964)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: QTf

Unit Name: Felsic volcanic rocks (Pleistocene and Pliocene)

Map Unit Description

Includes Plateau Rhyolite [Central Plateau Member (Pleistocene: Christiansen and Blank, 1972)] and Yellowstone Group [including Lava Creek Tuff (Pleistocene: Christiansen and Blank, 1972) and Huckleberry Ridge Tuff (Pliocene: Love, 1989)]. Plateau Rhyolite is light-gray, dense, lithoidal, fine-grained to aphanitic ash-flow tuff. Phenocrysts (1.5 mm in diameter) of quartz, sanidine, pyroxene, fayalite, and sphene form 25 percent of rock (Witkind, 1972). Yellowstone Group is light-brown to gray, thick-bedded, mostly rhyolitic, porphyritic welded tuff and minor flows. Matrix is chiefly devitrified glass shards; phenocrysts of sanidine, quartz, and sparse plagioclase (Tysdal and Simons, 1985; Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Tt

Unit Name: Trachyte, trachybasalt, and basalt (Eocene)

Map Unit Description

Basalt porphyry, trachybasalt porphyry, and trachyte porphyry in volcanic flows and breccias; probably correlates with Absaroka Volcanic Supergroup. Mapped south of Hebgen Lake (Christiansen and Blank, 1975)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Tv

Unit Name: Volcanic rocks of the Absaroka Volcanic Supergroup, undivided (Eocene)

Map Unit Description

Includes Hyalite Peak and Golmeyer Creek Volcanics (Chadwick, 1982). Volcanic flows and breccia, andesite and basalt flows, pyroxene trachyte porphyry, breccia, tuff, conglomerate, sandstone, channel-fill deposits, and minor carbonaceous siltstone. Lava flows mostly gray, fine-grained to sparsely porphyritic andesite and basalt; plagioclase and pyroxene phenocrysts; aphanitic groundmass; some lava more (Simons and others, 1985; Tysdal and Simons, 1985) or less (McMannis and Chadwick, 1964) silicic. Volcanic breccia interlayered with the flows. Some volcanic units contain abundant fossil wood

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Ti

Unit Name: Intrusive rocks, undivided (Eocene)

Map Unit Description

Dacitic, andesitic, and basaltic dikes, sills, and small stocks. Dacitic rocks show distinct flow structures and are conspicuously porphyritic; contain phenocrysts of plagioclase, hornblende, and biotite; matrix of feldspar microlites and devitrified glass. Andesitic and basaltic rocks contain a few small phenocrysts of plagioclase in pilotaxitic groundmass of andesine(?) microlites and interstitial pyroxene and opaque minerals (Simons and others, 1985)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Tc

Unit Name: Conglomerate (Eocene)

Map Unit Description

Poorly indurated conglomerate of cobbles and boulders of Precambrian gneiss, amphibolite, vein quartz, Paleozoic carbonate strata, and volcanic rocks. Contacts not exposed; presumed to be basal unit of Tertiary sequence. Mapped only near Garnet Mountain in northern part of Gallatin Range (McMannis and Chadwick, 1964)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Kda

Unit Name: Dacitic and andesitic intrusive rocks (Upper Cretaceous)

Map Unit Description

Gray porphyritic dacite and, locally, andesite sills and dikes; hornblende and plagioclase phenocrysts; fine-grained to aphanitic plagioclase, potassium feldspar, and quartz matrix. Includes dacite porphyry laccolith, more than 1,500 ft thick, along the Gallatin River (Witkind, 1969); sills as much as 400 ft thick and dikes 3-50 ft thick (Tysdal and Simons, 1985; Tysdal, 1990). K-Ar and 40Ar/39Ar dates on hornblende 68-69 Ma (Tysdal and others, 1986; Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Klv

Unit Name: Livingston Formation (Upper Cretaceous)

Map Unit Description

Upper member is volcaniclastic sandstone, mudflow breccia, volcanic conglomerate, and mudstone; middle member is dacite to basalt, autoclastic breccia, tuff breccia, welded tuff, dacite flows, and volcaniclastic sandstone; lower member is intertonguing volcaniclastic sandstone, olivine basalt, mudflow breccia, volcanic conglomerate, and mudstone. Well exposed. Total thickness 1,500-2,500 ft (Roberts, 1972; Tysdal and Simons, 1985; Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Ke

Unit Name: Eagle Sandstone, Virgelle Sandstone, and Everts Formation, undivided (Upper Cretaceous)

Map Unit Description

In extreme northeastern part of map area, near Cokedale, Eagle Sandstone is divided into an unnamed upper member and a lower member, the Virgelle Sandstone. Upper part of upper member includes an upper zone of coal beds, carbonaceous siltstone, and sandstone that is underlain by well-bedded to massive, medium- to well-sorted, light-olive-gray quartzose sandstone and siltstone; lower part of upper member contains two units of coal, carbonaceous siltstone, and fine-grained sandstone. Coal zones contain commercial-grade, high-volatile bituminous coal beds, some of coking quality (Roberts, 1972); some beds were extensively mined until the early 1900's. Underlying Virgelle Sandstone is very light gray, well-cemented, massive to cross-bedded, fine-grained arkosic sandstone (Roberts, 1972). Total thickness of Eagle Sandstone is 645 ft, including the 110-ft-thick Virgelle Sandstone (Roberts, 1966).

In Madison Range only the Virgelle Sandstone is mapped and overlying strata are assigned to the Everts Formation rather than the Eagle Sandstone (Tysdal and Simons, 1985; Tysdal, 1990). Upper 1,000-1,200 ft of Everts Formation is gray, fine- to medium-grained quartz-rich sandstone and interbedded siltstone; contains mudstone, porcellanite, and finely crystalline limestone beds; lower 200-300 ft is thin interbeds of mudstone, siltstone, shale, coal and minor sandstone, and a few beds of several-feet-thick light-gray, fine- to medium-grained, cross-bedded sandstone. Virgelle Sandstone, is thin- to thick-bedded, medium- to coarse-grained, cross-bedded quartz sandstone that forms prominent white-weathering ledges; thickness 75-165 ft (Tysdal, 1990).

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Ku

Unit Name: Upper Cretaceous sedimentary rocks, undivided

Map Unit Description

In descending order, includes Eagle Sandstone, Telegraph Creek Formation, Cody Shale, Frontier Formation, and Mowry Shale. Includes Eagle Sandstone (Ke) along northwest corner of Yellowstone National Park; see description of unit Ke. Telegraph Creek Formation is predominantly siltstone and thin-bedded, moderately well sorted sandstone cemented with calcite and containing calcareous concretions; weathers distinctive yellowish-gray (Roberts, 1972). In Madison Range, upper part of Telegraph Creek Formation is light-brown-weathering mudstone and siltstone, with minor sandstone and glauconite in some beds; middle part has white-weathering tuffaceous siltstone marker; lower part is siltstone and mudstone overlying ledge-forming, gray, "salt-and-pepper" sandstone (Tysdal and Simons, 1985). About 675 ft thick in Madison Range (Tysdal and Simons, 1985). Cody Shale is mudstone and thin interbeds of gray-green siltstone and minor fine-grained sandstone; about 1,000 ft thick (Tysdal and Simons, 1985). Frontier Formation is gray sandstone interlayered with darker gray siltstone and mudstone in northern part of map area; gray-green glauconitic sandstone, siltstone, and mudstone with zones of coaly shale, pale-green tuff and porcellanite in southern part; total thickness about 400 ft thick (Tysdal and Simons, 1985). Mowry Shale is included only along Gallatin River in central part of map area; elsewhere, Mowry Shale is included with undivided Upper and Lower Cretaceous sedimentary rocks (Kul). Upper part of Mowry Shale is slope-forming, gray mudstone; lower part is pastel-colored mudstone, porcellanite, welded tuff, siltstone, and sandstone; total thickness about 700-900 ft (Tysdal and Simons, 1985).

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Kul

Unit Name: Upper and Lower Cretaceous sedimentary rocks, undivided

Map Unit Description

In descending order, includes Mowry Shale (Upper Cretaceous) and Muddy Sandstone, Thermopolis Shale, and Kootenai Formation (Lower Cretaceous). Includes Mowry Shale except along Gallatin River in central part of map area where Mowry is included with undivided Upper Cretaceous sedimentary rocks unit (Ku); see unit Ku for description of Mowry Shale. Upper part of Muddy Sandstone is gray to tan sandstone and arkosic sandstone; middle part is dark-gray siltstone, fine-grained sandstone, and shale; lower part is poorly sorted, ledge-forming, cross-bedded sandstone; total thickness about 125-350 ft (Tysdal and Simons, 1985). Upper part of Thermopolis Shale is dark-gray, locally carbonaceous, fissile shale; lower part is brown, rusty-weathering sandstone with cross-beds and ripple marks; total thickness 200-250 ft (Tysdal and Simons, 1985). Upper part of Kootenai Formation is nonmarine gastropod limestone; middle part is variegated red-yellow-gray mudstone, siltstone, and minor sandstone and limestone; lower part is ledge-forming, cherty, quartzose sandstone and conglomeratic sandstone; total thickness about 350-500 ft (Tysdal and Simons, 1985)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: JT_ru

Unit Name: Jurassic and Triassic sedimentary rocks, undivided

Map Unit Description

In descending order, includes Morrison Formation (Upper Jurassic), Ellis Group (Upper and Middle Jurassic); Chugwater Formation (Triassic); and Thaynes(?) Formation, Woodside Siltstone, and Dinwoody Formation (Lower Triassic). Morrison Formation is varicolored nonmarine claystone and mudstone; about 225-400 ft thick (Simons and others, 1985; Tysdal and Simons, 1985). Ellis Group comprises Swift, Rierdon, and Sawtooth Formations. Swift Formation is cream-colored to brown to gray, oolitic, shelly, cherty, calcareous and glauconitic sandstone, sandy limestone, and chert-pebble conglomerate; Rierdon Formation is gray-brown oolitic limestone, fossiliferous gray shale, and argillaceous limestone; Sawtooth Formation (lithic equivalent to Piper Formation of central Montana) is gray, fine-grained, fossiliferous limestone, argillaceous limestone, shale, and varicolored siltstone. Ellis Group is about 80-300 ft thick (Simons and others, 1985; Tysdal, 1985). Chugwater Formation is poorly exposed red siltstone, shale, and fine-grained sandstone; few thin gypsum beds; about 500 ft thick (Simons and others, 1985). Thaynes(?) Formation is gray-orange, thin-bedded, calcareous siltstone and gray-green clay shale; local ledge former; only 0-10 ft thick (Tysdal and Simons, 1985). Woodside Siltstone is red, thin-bedded siltstone and mudstone interbedded with gypsum and thin gray limestone beds; thickness varies from 0 to 725 ft (Tysdal and Simons, 1985). Dinwoody Formation is brown to yellow-gray, chocolate-brown-weathering, thin-bedded limestone, silty limestone, and calcareous siltstone; about 70-265 ft thick (Simons and others, 1985; Tysdal and Simons, 1985)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: PMu

Unit Name: Permian, Pennsylvanian, and Mississippian sedimentary rocks, undivided

Map Unit Description

In descending order, includes Shedhorn Sandstone (Permian), Quadrant Sandstone (Pennsylvanian), and Amsden Formation (Lower Pennsylvanian and Upper Mississippian). Sandstone, siltstone, mudstone, shale, chert, limestone, and dolomite. Refer to units Ps and [PMu for descriptions of formations

Shedhorn Sandstone: Lateral equivalent to the Phosphoria Formation to the west and south (McKelvey and others, 1959). Mostly brown to gray, locally conglomeratic sandstone containing abundant grains, nodules, and layers of chert and pellets of phosphorite (Simons and others, 1985). From top to bottom: interlayered chert beds and common vertical cylindrical burrows; dark-colored, gray to brown, thin-bedded chert with siltstone partings over phosphatic mudstone and limestone; brown to dark-gray, well-cemented sandstone with interbeds of chert and limestone; and yellow-gray dolomite with abundant chert fragments and a few interbeds of dark-brown sandstone. Thickness 115-225 ft (Tysdal and Simons, 1985; Tysdal, 1990)

Quadrant Sandstone is white to tan, bedded, clean, well-sorted quartz sandstone with silica or calcite cement. Interbeds of yellow-brown dolomite and gray limestone in lower part. Thickness about 200-315 ft (Tysdal, 1990).

Amsden Formation is red to pink, calcareous siltstone to shale. Upper part of formation contains calcareous sandstone cemented with iron oxides; middle and lower parts contain limestone, limestone-pebble conglomerate, and dolomite. Thickness 40-160 ft (Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Ps

Unit Name: Shedhorn Sandstone (Permian)

Map Unit Description

Lateral equivalent to the Phosphoria Formation to the west and south (McKelvey and others, 1959). Mostly brown to gray, locally conglomeratic sandstone containing abundant grains, nodules, and layers of chert and pellets of phosphorite (Simons and others, 1985). From top to bottom: interlayered chert beds and common vertical cylindrical burrows; dark-colored, gray to brown, thin-bedded chert with siltstone partings over phosphatic mudstone and limestone; brown to dark-gray, well-cemented sandstone with interbeds of chert and limestone; and yellow-gray dolomite with abundant chert fragments and a few interbeds of dark-brown sandstone. Thickness 115-225 ft (Tysdal and Simons, 1985; Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: [PMu

Unit Name: Quadrant Sandstone (Pennsylvanian) and Amsden Formation (Lower Pennsylvanian and Upper Mississippian), undivided

Map Unit Description

Quadrant Sandstone is white to tan, bedded, clean, well-sorted quartz sandstone with silica or calcite cement. Interbeds of yellow-brown dolomite and gray limestone in lower part. Thickness about 200-315 ft (Tysdal, 1990). Underlying Amsden Formation is red to pink, calcareous siltstone to shale. Upper part of formation contains calcareous sandstone cemented with iron oxides; middle and lower parts contain limestone, limestone-pebble conglomerate, and dolomite. Thickness 40-160 ft (Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Mm

Unit Name: Madison Group (Mississippian)

Map Unit Description

Includes Mission Canyon Limestone and underlying Lodgepole Limestone. Mission Canyon Limestone is buff to brown, gray-weathering, bedded, finely crystalline limestone and minor dolomite with some oolitic, bioclastic, and cross-bedded layers. Orange solution breccia in upper part. Persistent cliff former. Lodgepole Limestone is more fossiliferous and contains partings of calcareous silty limestone; chert nodules and stringers in lower beds. Total thickness about 1,300-1,450 ft (Tysdal, 1990; Tysdal and Simons, 1985; Simons and others, 1985)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: MDt

Unit Name: Three Forks Formation (Lower Mississippian and Upper Devonian) and Jefferson and Maywood Formations (Upper Devonian), undivided

Map Unit Description

At top of unit, Three Forks Formation includes, in descending order, Sappington, Trident, and Logan Gulch Members. Sappington Member is gray to yellow, calcareous siltstone, siltstone, and sandstone; only uppermost part is Lower Mississippian in age. Trident Member is gray to yellow dolomite, dolomitic shale, and some limestone. Logan Gulch Member is red, orange, or yellow carbonate-shale breccia. Total thickness 100-250 ft (Simons and others, 1985; Tysdal, 1990; Tysdal and Simons, 1985). Jefferson Formation includes Birdbear Member and underlying Lower Member. Birdbear Member is brown, coarse-grained, ledge-forming dolomite. Lower Member is brown-gray, fine-grained (sucrosic) dolomitic limestone and limestone; dolomite is fetid and has petroliferous odor. Total thickness about 300-450 ft (Simons and others, 1985; Tysdal, 1990; Tysdal and Simons, 1985). Locally in northern part of map area, Maywood Formation is at base of unit; pale-brown-gray, silty, sandy, and pebbly dolomite overlying yellow, dolomitic, sandy, and conglomeratic siltstone on a regolith (or breccia) base; about 34 ft thick (McMannis and Chadwick, 1964; Roberts, 1964f)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: OCu

Unit Name: Ordovician and Cambrian sedimentary rocks, undivided

Map Unit Description

In descending order, includes Bighorn(?) Dolomite (Ordovician); Snowy Range Formation (and laterally equivalent Red Lion Formation) and Pilgrim Limestone (Upper Cambrian); and Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone (Middle Cambrian). Bighorn(?) Dolomite is light-gray, dense cryptocrystalline dolomite; about 35 ft thick (Tysdal, 1990). Snowy Range Formation, which includes Grove Creek Limestone, Sage Limestone, and Dry Creek Shale Members, is tan, thin-bedded limestone with irregular-shaped red mottles and interbedded red silty mudstone underlain by green, thin-bedded dolomite and dolomitic mudstone with green clay-shale partings in the upper part and red calcareous siltstone and green sandy clay shale in the lower part; thickness about 300 ft (Tysdal, 1990). Pilgrim Limestone is brown, nodular limestone and dolomitic limestone with partings of dolomitic siltstone and silty dolomite. Limestone is glauconitic and mottled. Mud-pebble conglomerate and oolite beds are common. About 200 ft thick (Tysdal, 1990). Park Shale is gray-green, chippy shale and a few interbeds of limestone, limestone pebble conglomerate, and oolitic limestone. Fossil fragments, burrows, and trace fossils ("worm trails") are common. Thickness about 100 ft (Tysdal, 1990). Meagher Limestone (pronounced "Mar") is finely crystalline limestone with irregular-shaped, yellow-orange siltstone mottles. Upper part contains thin partings of calcareous siltstone or green clay shale; lower part contains mottled gray oolitic limestone and gray, finely crystalline limestone. About 500 ft thick (Tysdal, 1990). Wolsey Shale is gray-green, fissile, micaceous clay shale; 65-200 ft thick (Tysdal, 1990). Flathead Sandstone is white, tan, and red-brown, hematitic quartz sandstone; locally glauconitic. Cross-beds, ripple marks, and worm trails are common. Thickness 10-100 ft (Tysdal, 1990)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: MzPzu

Unit Name: Mesozoic and Paleozoic sedimentary rocks, undivided

Map Unit Description

Limestone, dolomite, chert, shale, siltstone, and sandstone. Mapped only at east edge of northern part of map area (Chadwick, 1982)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: mi

Unit Name: Mafic intrusive rocks, undivided (Proterozoic and Archean?)

Map Unit Description

Diabase and amphibolite dikes and sills. Diabase sills form cliffs. Northwest-trending diabase dikes in Spanish Peaks area are Proterozoic (K.S. Kellogg, USGS, written commun., June 21, 1996). Plagioclase phenocrysts in a matrix of augite, smaller plagioclase laths, and magnetite. Secondary alteration around associated calcite-quartz veins that commonly contain malachite (Becraft and others, 1966; Erslev, 1981, 1983)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Au

Unit Name: Ultramafic rocks (Archean)

Map Unit Description

Serpentinized ultramafic rocks exposed as pods and lenses; generally surrounded by reaction zones (Erslev, 1983)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Am

Unit Name: Metamorphic rocks (Archean)

Map Unit Description

Gneiss, schist (biotite, chlorite-hornblende), quartzite, pegmatite, amphibolite, mafic intrusive (diabase and gabbro) rocks, and minor ultramafic rocks. Includes granitic rocks in Mulherin (also known as Mol Heron) Creek area, east-central part of map area

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: Ad

Unit Name: Dolomitic marble (Archean)

Map Unit Description

Coarsely crystalline dolomite with crenulated quartz veins. Locally contains tremolite (Witkind, 1969, 1972)

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): GallatinNF_N_rect, GallatinNF_W_rect

Map Title

Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana

Map name: Parts Gallatin National Forest

Map Unit Symbol: At

Unit Name: Tremolite marble (Archean)

Map Unit Description

Marble composed almost entirely of bladed tremolite crystals. Light gray to gray; extremely resistant; forms topographic ridges. Technically a calc-silicate; tremolite marble terminology from Witkind (1969). Mapped only in southeastern part of map area

Map Citation

Wilson, A.B. and Elliott, J.E., 1997, Geologic maps of western and northern parts of Gallatin National Forest, south-central Montana: U.S. Geological Survey Geologic Investigation Series I-2584, scale 1:126720.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Q

Unit Name: Unconsolidated sedimentary deposits (Quaternary units)

Map Unit Description

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Tmv

Unit Name: Volcanic rocks (Miocene)

Map Unit Description

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Tc

Unit Name: Challis Volcanic Group (Eocene)

Map Unit Description

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Ti

Unit Name: Intrusive rocks (Eocene)

Map Unit Description

Including granite, rhyolite porphyry, dacite porphyry, and granodiorite

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Kgd

Unit Name: Biotite granodiorite

Map Unit Description

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Kgdk

Unit Name: Hornblende-biotite Granodiorite

Map Unit Description

Includes leucocratic granite border phase.

See Kiilsgaard and others (2001) for additional information.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pg4

Unit Name: Grand Prize Formation, member 4 (Lower Permian)

Map Unit Description

Member 4 (Wolfcampian to Leonardian) of the Grand Prize Formation consists of more than 450 m of thin- to medium-bedded carbonaceous siltstone, sandy to silty micrite, and minor micritic sandstone (fig. 6). Carbonaceous siltstone of member 4 gradationally overlies banded sandstone and siltstone of member 3. Member 4 weathers to a dark-gray regolith and forms slopes in the southern part of the White Cloud Peaks area.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pg3

Unit Name: Grand Prize Formation, member 3 (Lower Permian)

Map Unit Description

Member 3 (Wolfcampian to Leonardian) of the Grand Prize Formation consists of 650-1,700 m of fine-grained sandstone and siltstone arranged in rhythmically interbedded couplets 30 cm-3 m thick. The distinctive banded appearance of the member is produced by these couplets of light-gray fine-grained micritic sandstone gradationally overlain by dark-gray carbonaceous siltstone. Interbedded with the couplets is thick-bedded light-brown micritic sandstone and light-gray sandy micritic limestone (fig. 6). Member 3 gradationally overlies member 2. Member 3 has an irregular weathering pattern; the sandier intervals are exposed in bold relief against the more easily weathered finer grained intervals. The member forms distinctly banded light-gray cliffs throughout the White Cloud Peaks area.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: P[Pg2

Unit Name: Grand Prize Formation, member 2 (Lower Permian to Middle Pennsylvanian)

Map Unit Description

Member 2 (Desmoinesian to Wolfcampian) of the Grand Prize Formation consists of 500-1,100 m of thick-bedded to massive light-brown micritic sandstone and subordinate light-gray sandy micritic limestone and gray carbonaceous siltstone. Member 2 gradationally overlies member I; the contact is placed above the bioclastic limestone of member I. Member 2 forms discontinuous cliffs and ledges in the northern Smoky Mountains and in the White Cloud Peaks.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: [Pgl

Unit Name: Grand Prize Formation, member 1 (Middle Pennsylvanian)

Map Unit Description

Member 1 (Desmoinesian) of the Grand Prize Formation is 0-400 m thick and consists of 0-350 m of light-brown to light-gray polymict conglomerate and sandstone overlain by 30-50 m of medium-gray bioclastic limestone (fig. 6). Member 1 is resistant and forms conspicuous cliffs and ledges. The lower contact of member 1 is an erosional unconformity with the underlying Paleozoic Salmon River assemblage. This contact was strongly sheared during Mesozoic compression, and the original stratigraphic thickness of the basal conglomerate is generally not preserved.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pdu

Unit Name: Dollarhide Formation, upper member (Lower Permian)

Map Unit Description

The upper member of the Dollarhide Formation (Wolfcampian and Leonardian) is approximately 900 m thick and is composed of thin-bedded to laminated dark-gray carbonaceous siltstone and light-gray silty micritic limestone and minor light-brown micritic sandstone and conglomerate (fig. 6). The upper member gradationally overlies the middle member, and the upper boundary is not recognized due to erosion. The upper member weathers to a dark-gray regolith, is poorly exposed, and forms slopes throughout the Smoky Mountains, which, as a result, contain large areas of sparsely vegetated "black-shale" regolith (Wavra and Hall, 1989) (fig. 1, plate 1).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pdm

Unit Name: Dollarhide Formation, middle member (Lower Permian)

Map Unit Description

The middle member of the Dollarhide Formation (lower Wolfcampian) consists of about 300 m of fine-grained light-brown micritic sandstone and light-gray sandy micritic limestone and subordinate dark-gray to black carbonaceous siltstone and lenticular conglomerate (fig. 6). The middle member forms prominent light-colored cliffs throughout the central and southern Smoky Mountains. North of Deer Creek (plate 1) it is interpreted to grade into thick sandstone beds of the Eagle Creek Member of the Wood River Formation.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: P[Pdl

Unit Name: Dollarhide Formation, lower member (Lower Permian to Middle Pennsylvanian)

Map Unit Description

The lower member of the Dollarhide Formation (Desmoinesian to lower Wolfcampian) is at least 800 m thick and consists of rhythmically interbedded dark-gray carbonaceous silty micritic limestone and very fine grained light-gray to light-brown micritic sandstone and subordinate medium- to thick-bedded light-brown micritic sandstone and light- to dark-gray lenticular conglomerate containing mainly intrabasinal clasts of siltstone and bioclastic limestone. Extrabasinal clasts (vitreous quartzite and fine-grained sandstone) are rare. The lower member of the Dollarhide Formation includes at the base a minimum of 175 m of quartzite, phyllite, and calc-silicate hornfels formerly assigned to the "Carrietown sequence." The lower member is exposed in the southern Smoky Mountains, where it forms dark-colored slopes punctuated by thin ridges of resistant micritic sandstone. The base of the lower member either is a fault or is masked by the Idaho batholith, and the upper contact is placed above a mappable dark-gray carbonaceous limestone and below thick light-brown micritic sandstone of the middle member (O'Brien, 1991) (fig. 6).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pww

Unit Name: Wood River Formation, Wilson Creek Member (Lower Permian)

Map Unit Description

The Wilson Creek Member (Wolfcampian to Leonardian) consists of more than 800 m of dark-gray carbonaceous siltstone and sandstone, thin-bedded light-brown graded silty micritic limestone, light-brown silty micritic limestone, light- to dark-gray sandy micritic limestone, and subordinate light-brown medium-bedded micritic sandstone (fig. 6). The member forms slopes and is sparsely exposed east of Bellevue and Hailey, although it is well exposed in alpine ridges of the Boulder Mountains northeast of Ketchum (figs. 1, 9, plate 1). The fine-grained, thin-bedded silty micritic limestone of the Wilson Creek Member weathers to a characteristic reddish-brown regolith. The upper part of the member is dolomitic in part and contains diagenetic chert. The Wilson Creek Member contains a diverse assemblage of bathyal trace fossils that has been interpreted to reflect oxygenation levels controlled by turbidite depositional facies (Burton and Link, 1991). The upper contact of the Wilson Creek Member is eroded below an unconformity with the Eocene Challis Volcanic Group or the present-day topographic surface (fig. 8).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: P[Pwe

Unit Name: Wood River Formation, Eagle Creek Member (Lower Permian to Middle Pennsylvanian)

Map Unit Description

The Eagle Creek Member of the Wood River Formation (upper Desmoinesian to Wolfcampian) is 880-1,300 m thick and consists of 260 m of light-purple silty micritic limestone overlain by 620-1,140 m of light-brown micritic sandstone, light-gray sandy micritic limestone, and subordinate quartzarenite (fig. 6). The Eagle Creek Member forms the bulk of the outcrop area of the Wood River Formation both east and west of the Wood River. It is best exposed on the high ridges of the Boulder Mountains (fig. 9).

About 250 m of anomalous carbonate-rich facies assigned to the Eagle Creek Member by Batatian (1991) crops out just east of the summit of Kent Peak. The rock is coarse-grained carbonaceous bioclastic limestone and resembles bioclastic beds in the Wilson Creek Member (David Seeland, U.S. Geological Survey, written commun., 1992). The unit yielded conodonts (collection 12, fig. 7) that indicate a Late Pennsylvanian to Early Permian age and macrofossils, including Chaetetes sp., that indicate a (Middle Pennsylvanian) Desmoinesian age (D.E. Fortsch, Idaho State University, oral commun., 1991). If the Desmoinesian age is correct, the beds may be the carbonaceous equivalent of limestone in the upper part of the Hailey Member. The facies resembles bioclastic parts of the Bloom Member of the Snaky Canyon Formation (Chesterian to Missourian) exposed 55 km to the east across several thrust faults in the Lost River Range (Skipp, Kuntz, and Morgan, 1979) (fig. 7).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: [Pwh

Unit Name: Wood River Formation, Hailey Member (Middle Pennsylvanian)

Map Unit Description

The basal Hailey Member of the Wood River Formation, as defined by Mahoney and others (1991), consists of the Hailey Conglomerate Member and the bioclastic limestone of unit 2 of the Wood River Formation, as described by Hall and others (1974). Unit 2 is vertically and laterally gradational with the conglomerate (Burton, 1988; Mahoney and others, 1991). The Eagle Creek Member consists of units 3 through 6 of Hall and others (1974), and the Wilson Creek Member consists of units 7 and 8 of Hall and others (1974,1978).

The Hailey Member is 0-200 m thick and consists of 0-180 m of light-brown to light-gray conglomerate gradationally overlain by 15-30 m of bluish-gray bioclastic limestone (fig. 6). The member is primarily exposed east of the Wood River in the Pioneer and Boulder Mountains, although it is exposed in a few areas west of the Wood River near Hailey (plate I). To the east, near Fish Creek Reservoir in the Idaho Falls lox2° quadrangle, the Hailey Member contains 180 m of calcareous sandstone and dispersed chert-pebble conglomerate and bioclastic beds (Link and others, 1988). The Hailey Member may have been deposited on an irregular topographic surface and is locally depositionally absent (Winsor, 1981).

The basal contact of the Hailey Member is a locally sheared unconformity with the underlying Devonian Milligen Formation (Burton, 1988; Burton and others, 1989; Ratchford, 1989. in press; Mahoney and others, 1991; Burton and Link. this volume). In many areas interstratal slip along the unconformity has produced a shear zone in which the Hailey Member is present as kilometer-scale boudins, or is attenuated. particularly in fold limbs, or is thickened in fold hinges. Silver-lead-zinc vein deposits are present locally along this sheared unconformity (Burton and Link, this volume). The upper contact of the Hailey Member is placed at the first appearance of the distinctive light-purple silty micrite of the Eagle Creek Member (table 2, fig. 6). The age of the Hailey Member is Desmoinesian, based on the biostratigraphy of coral. fusulinid, and phylloid green algae occurrences (Bostwick. 1955; Hall and others, 1974) (fig. 9).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Mcb

Unit Name: Copper Basin Formation, undifferentiated (Lower Mississippian)

Map Unit Description

Includes rocks west of the Pioneer thrust fault.

The Copper Basin Formation contains graded beds of cobble and pebble conglomerate, as well as sand- and silt-size siliciclastic turbidite and argillite. Clasts in conglomerate include dark-colored chert and argillite similar to rocks of the Devonian Milligen Formation, as well as a large proportion of light-colored quartzite clasts of uncertain provenance.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Mcu

Unit Name: Copper Basin Formation, upper part (Lower Mississippian)

Map Unit Description

Includes the Scorpion Mountain Formation of Paull and others (1972) and rocks equivalent to the Green Lake Limestone Member.

An upper unit (unit Mcu) of pebble and cobble conglomerate, sandstone, and argillite (more than 1,150 m thick) is mapped on plate I. This upper unit includes the Scorpion Mountain Formation of Paull and Gruber (1977), the lower part of the Muldoon Canyon Formation of Paull and Gruber (1977), and the beds mapped as Green Lake Limestone Member of Copper Basin Formation north of Dry Canyon along the East Fork of the Big Lost River by Dover (1981).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Mcl

Unit Name: Copper Basin Formation, lower part (Lower Mississippian)

Map Unit Description

Includes the Little Copper Member and Drummond Mine Limestone Member of Paull and others (1972) and Dover (1981).

The lower part of the Copper Basin Formation is of Early Mississippian age (Kinderhookian and Osagean) and is at least 3,000 m thick....the formation consists of a lower interval (unit Me!) that contains a basal of dark-gray argillite, siltite, and granule conglomerate turbidite (the Little Copper Member, from 0 to more than 660 m thick) overlain by a discontinuous, but generally eastward thickening wedge of fine-grained mixed carbonate-siliciclastic turbidite (Drummond Mine Limestone Member, 0-910 m thick).

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Dm

Unit Name: Milligen Formation (Upper and Lower Devonian)

Map Unit Description

The Lower to Upper Devonian Milligen Formation is the host for rich silver-lead-zinc ores in the historically productive Minnie Moore and Triumph mineralized areas near Hailey and Bellevue (fig. I). The Milligen Formation was named by Umpleby and others (1930) for carbonaceous and argillaceous rocks originally included in the lower part of the Wood River Formation by Lindgren (1900). As described by Sandberg and others (1975), Dover (1981), and Turner and Otto (1988, this volume), the Devonian Milligen Formation contains more than 1,200 m of unfossiliferous, fine-grained, locally carbonaceous strata that are poorly exposed on sagebrush- and grass-covered slopes in the Boulder and Pioneer Mountains east of the Wood River. The base of the Milligen Formation has not been observed in detailed mapping of the Triumph mine area or on the western side of the Boulder Mountains (Dover, 1983; Turner and Otto, this volume). The upper contact varies along strike and is locally an unconformity below the Middle Pennsylvanian Hailey Member of the Wood River Formation, a possibly conformable contact with strata mapped as Mississippian Copper Basin Formation, or a fault against Pennsylvanian and Permian strata of the Sun Valley Group.

A stratigraphic division of the Milligen Formation in the area near the Triumph mine (Turner and Otto, 1988, this volume) (fig. 3) includes, as informal members, (1) a lower argillite member (130+ m thick), which locally contains diamictite or is chert- or sandstone-rich, (2) the limestone member of Lucky Coin (50-250 m thick), which contains limestone turbidite, black argillite, and diamictite, (3) the quartzite member of Cait (lenses of variable thickness, usually less than 10m), which contains carbonaceous coarse grained sandstone, diamictite, and black argillite, (4) the argillite member of Triumph (0-150 m thick), which contains black argillite, locally cherty, and interbedded sandstone, and (5) the sandstone member of Independence (150+ m thick), which contains interbedded sandstone and limestone turbidite. Diamictite in the lower argillite member, coarse-grained sandstone in the quartzite of Cait, and calciclastic turbidite of the limestone of Lucky Coin represent distinctive markers that allow correlation of the Milligen Formation across structurally complex areas.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: DSO

Unit Name: Devonian, Silurian and Ordovician argillaceous rocks, undifferentiated

Map Unit Description

Includes the Trail Creek and Phi Kappa Formations and unnamed rocks

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: DOC

Unit Name: Devonian, Ordovician, and Cambrian calcareous rocks and quartzite

Map Unit Description

Carey Dolomite, Jefferson Formation, Picabo Formation in the Dry Canyon inlier; Hanson Creek Formation, unnamed Middle Silurian limestone unit, Roberts Mountain Formation, and unnamed carbonate, conglomerate, and breccia units of Devonian age in the Wildhorse Canyon inlier.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pzsr

Unit Name: Salmon River assemblage (Devonian and Cambrian?)

Map Unit Description

The Paleozoic Salmon River assemblage (Hobbs, 1985) is exposed in the southern part of the Challis lox2° quadrangle directly to the north of the Hailey 1°x2° quadrangle. The Salmon River assemblage contains isoclinally folded slices of dark-colored argillite, lighter colored siltstone, limestone, and quartzite. The assemblage may be about 2,000 m thick, but isoclinal folds and faults make this estimate tenuous (Hall and Hobbs, 1987). Samples collected in situ from the Salmon River assemblage contain Late Cambrian and Late Devonian conodonts; however, the Late Cambrian fauna were derived from carbonaceous limestone within what is interpreted to be a tectonic slice at the base of the assemblage (Hall, 1985). Fossils in two blocks of limestone float found north of the Salmon River contain Late Mississippian fossils (Nilsen, 1977; Hobbs, 1985). The Salmon River assemblage is described as Late Mississippian by Nilsen (1977) and Tschanz and others (1986) and as simply Paleozoic by Fisher and others (1983). The Mississippian age assignment for the assemblage is doubtful because bioclastic limestone beds similar to those that yielded the Late Mississippian fossils are unrecognized within Salmon River assemblage stratigraphy. It is our opinion that the majority of the Salmon River assemblage is Devonian in age.

The Salmon River assemblage occupies a structural position similar to the entire Ordovician through Devonian section in the Boulder Mountains west of the Pioneer thrust fault. On the west side of the White Cloud Peaks it underlies the Pennsylvanian and Permian Grand Prize Formation along a sheared unconformity that had formerly been interpreted as a regional thrust fault similar to the "Wood River thrust" (Sengebush, 1984; Hall, 1985; Hall and Hobbs, 1987; Mahoney and Sengebush, 1988; Mahoney and others, 1991; Mahoney, this volume). On the east side of the outcrop belt the Salmon River assemblage is thrust over Ordovician carbonate and quartzite strata including the Clayton Mine Quartzite, Ella Marble, Kinnikinic Quartzite, and Saturday Mountain Formation (Hobbs, 1985; Hall and Hobbs, 1987) (fig. 1, plate 1).

In the Washington Basin mineralized area (Mahoney, this volume) (fig. 1) of the White Cloud Peaks, the Salmon River assemblage underlies sheared conglomerate boudins of the basal Grand Prize Formation. These boudins are similar to those of the Hailey Member of the Wood River Formation along the sheared contact between the Wood River and Milligen Formations. The map of Tschanz and others (1986) shows this unconformable relationship, though it includes rocks now recognized as Grand Prize Formation within the Wood River Formation and assigns a Mississippian age to the Salmon River assemblage.

The bulk of the Salmon River assemblage south of the Salmon River in the White Cloud Peaks (fig. 1, plate 1) contains dark-colored argillite, siltite, and sandstone that yield Late Devonian fossils. The Paleozoic Salmon River assemblage and the Devonian Milligen Formation are similar lithologically and stratigraphically in that both contain thick sections of homogeneous black argillite, abundant thin-bedded fine-grained turbidite sequences, and intercalated blue gray, locally tremolitic, limestone. The Salmon River assemblage and the Milligen Formation both host inferred syngenetic sulfide deposits

Geologic map unit descriptions

that have identical lead-isotope signatures (Sanford and Wooden, this volume). We suggest that the Salmon River assemblage in the White Cloud Peaks area mostly correlates with the Milligen Formation. Hall (1985, p. 121) noted that the Salmon River assemblage contains a fracture cleavage almost parallel with bedding and differs from that of the Milligen, "which has a penetrative shear cleavage that is at a large angle to bedding, has a much higher metamorphic grade, and has a phyllitic sheen." Our mapping has not revealed a systematic difference in degree of deformation between the two units.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: OC

Unit Name: Ordovician and Cambrian rocks, undifferentiated

Map Unit Description

Exposed only below the Pioneer thrust fault and Wildhorse detachment fault in the core of the Pioneer Mountains

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Yu

Unit Name: Quartzite, calc-silicate rocks, and schist (Middle Proterozoic)

Map Unit Description

Calc-silicate, gneissose quartzite, pelitic schist, and marble

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Xw

Unit Name: Gneiss complex of Wildhorse Creek (Early Proterozoic)

Map Unit Description

Layered quartzofeldspathic, quartzitic, and mafic gneiss, as well as calc-silicate marble

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Hail_Chal_rect

Map Title

Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho

Map name: Parts Hailey & Challis 250K

Map Unit Symbol: Pg3?

Unit Name: Grand Prize Formation, member 3 (Lower Permian)

Map Unit Description

Member 3 (Wolfcampian to Leonardian) of the Grand Prize Formation consists of 650-1,700 m of fine-grained sandstone and siltstone arranged in rhythmically interbedded couplets 30 cm-3 m thick. The distinctive banded appearance of the member is produced by these couplets of light-gray fine-grained micritic sandstone gradationally overlain by dark-gray carbonaceous siltstone. Interbedded with the couplets is thick-bedded light-brown micritic sandstone and light-gray sandy micritic limestone (fig. 6). Member 3 gradationally overlies member 2. Member 3 has an irregular weathering pattern; the sandier intervals are exposed in bold relief against the more easily weathered finer grained intervals. The member forms distinctly banded light-gray cliffs throughout the White Cloud Peaks area.

Map Citation

Link, P.K., Mahoney, J.B., Bruner, D.J., Batatian, L.D., Wilson, Eric, and Williams, F.J.C., 1995, Geologic map of outcrop areas of sedimentary units in the eastern part of the Hailey 1º x 2º quadrangle and part of the southern part of the Challis 1º x 2º quadrangle, south-central Idaho: U.S. Geological Survey Bulletin 2064-C, 33 p., Plate 1, scale 1:100000.

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Qa

Unit Name: Alluvium

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ql

Unit Name: Loess

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name RosaliaOF98_357

Map Unit Symbol Qfg

Unit Name Outburst flood gravels

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Qglf

Unit Name: Glaciolacustrine and outburst flood deposits, undivided

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Mvssl

Unit Name: Saddle Mountains Basalt, Weissenfels Ridge Member, basalt of Sprague Lake

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Mvwp

Unit Name: Wanapum Basalt, Priest Rapids Member

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Mvwr

Unit Name: Wanapum Basalt, Roza Member

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: MvgN2

Unit Name: Grande Ronde Basalt, magnetostratigraphic unit N2

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name RosaliaOF98_357

Map Unit Symbol TKiqm

Unit Name Granitic rocks

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ymssp

Unit Name: Missoula Group, Striped Peak Formation

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ymswu

Unit Name: Wallace Formation, upper unit

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ymswl

Unit Name: Wallace Formation, lower unit

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ymssr

Unit Name: Ravalli Group, St. Regis Formation

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: Ymsrb

Unit Name: Ravalli Group, Revett and Burke Formations, undivided

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name RosaliaOF98_357

Map Unit Symbol pCsc

Unit Name Schist

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): Rosalia_rect

Map Title

Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map

Map name: RosaliaOF98_357

Map Unit Symbol: pCbgm

Unit Name: Gneiss of Mica Peak

Map Unit Description

Map Citation

Derkey, P.D., Johnson, B.R., Lackaff, B.B., and Derkey, R.E., 1998, Digital geologic map of the Rosalia 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 S.Z. Waggoner map: U.S. Geological Survey Open-File Report 98-357, 29 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-357/

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Qu

Unit Name: Alluvial, colluvial, landslide, and glacial deposits, undivided (Quaternary)

Map Unit Description

Composite unit of unconsolidated gravel, sand, silt, and clay deposits of present streams, rivers, and washes; hillside colluvium; landslide material; and glacial moraines and outwash

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: QT

Unit Name: Gravel, limestone, sandstone, and volcaniclastic sediments (Holocene to Oligocene(?))

Map Unit Description

Composite unit of volcaniclastic sedimentary rocks, limestone, conglomerate, sandstone, shale, and mudstone, deposited as the present basin-range topography formed during extensional faulting. Unconsolidated and slightly consolidated boulder to pebble conglomerate is interbedded with sandstone and mudstone near top of unit where it accumulated as colluvium, landslide debris, and some glacial outwash. Limestones are laminated and platy, and formed in fresh-water lakes and hot springs. Tuffaceous sedimentary rocks and volcanic-derived conglomerates are dominant in lower part of unit. Well-exposed outcrops indicate that angular unconformities are common within unit (Lucchitta, 1966)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ttu

Unit Name: Tuff and tuffaceous conglomerate (Pliocene to Miocene)

Map Unit Description

Mainly very light gray, friable, vitric, well-sorted tuff in beds as much as 1 m thick, interbedded with very light grayish brown, medium-grained tuff and tuffaceous conglomerate, and very light gray, very finely crystalline to aphanitic limestone in beds 0.3-1 m thick. Unit is commonly veneered with angular chips of vitreous quartzite lag gravel derived from tuffaceous conglomerate and from sparse quartzite fragments scattered throughout tuff. Fossil vertebrate fauna, gastropods, and diatoms indicate an age span from Miocene to Pliocene (Ruppel and Lopez, 1988)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ts

Unit Name: Sedimentary rocks - basin fill (Miocene(?) to Eocene)

Map Unit Description

Tuffaceous, basin-fill strata, tentatively divided into two sequences (Ruppel and Lopez, 1988). Upper sequence consists of light-olive-gray and yellowish-gray to yellowish-brown or yellowish-orange, tuffaceous mudstone and shale; fine- to medium-grained, tuffaceous sandstone; and lenticular beds of conglomerate with a sandy, tuffaceous matrix. Shale and mudstone dominate the base of the upper sequence but decrease up section where they are locally absent altogether. Upper sequence is at least 600-700 m thick. Lower sequence overlies the Challis Volcanic Group with angular unconformity and is predominantly olive-gray and yellowish-gray to grayish-orange, tuffaceous, bentonitic mudstone and shale with 2 to 15-cm-thick beds of lignite, lignitic mudstone, and beds with abundant woody fragments. This lower sequence also contains some interbeds of fine-grained to very fine grained, crossbedded sandstone as thick as 1 m and lenticular interbeds of conglomerate 1-8 m thick. The thickest unfaulted section of lower sequence is about 250 m but total thickness is unknown. Harrison (1985) interpreted the unit to represent eight depositional facies based on a transition from proximal alluvial fans to shallow lacustrine basins

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Toc

Unit Name: Older colluvium of Panther Creek (Eocene)

Map Unit Description

Poorly consolidated sandstone, mudstone, boulder conglomerate, and tephra that are locally carbonaceous; includes large landslide masses of variegated volcanic rocks. Unit was deposited in the rapidly subsiding Panther Creek graben during regional rifting concurrent with Challis volcanism. Strata are easily eroded and subject to a considerable degree of landsliding

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tc

Unit Name: Challis Volcanic Group, undivided

Map Unit Description

Composite unit used in areas where the volcanic rocks have not been subdivided or where units have been combined in order to show at map scale. Most of the group was erupted from 45 to 51 Ma, although minor activity persisted to about 39 Ma (Fisher and Johnson, 1995)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcs

Unit Name: Sunnyside tuff

Map Unit Description

Rhyolitic tuff with multiple cooling units. Upper part of unit is a multiple-flow compound cooling unit of red-weathering, densely welded, devitrified rhyolite tuff; it contains lithic fragments and flattened pumice lapilli and has a black vitrophyre at its base. Below this, megabreccia contains fragments of lower tuffs and probably formed from collapse of the Thunder Mountain caldera wall during eruption. Below the megabreccia the unit consists of (from top to bottom): (1) a single cooling unit of reddish-gray, densely welded rhyolite tuff; (2) at least two cooling units of red, flow-layered lava or ash-flow tuff with black vitrophyre and intercalated black vesicular latite flows; and (3) three or more cooling units of white to pink, only slightly welded, pumice-bearing, slightly porphyritic bases and gray, vertically jointed, densely welded, phenocryst-rich (as much as 50 percent) quartz latite tops. Leonard and Marvin (1982) reported K-Ar ages on biotite of 47.7±1.6 Ma, and on sanidine of 46.3±1.1 and 46.3±1.0 Ma. Total thickness is as much as 1,000 m. Unit constitutes most of the Thunder Mountain cauldron complex as subdivided by Fisher and others (1992); the name was originally an informal designation used locally by Shannon and Reynolds (1975) in the Thunder Mountain mining district

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcp

Unit Name: Perlitic rhyolite

Map Unit Description

Three rhyolite cooling units separated by green epiclastic sediments. Upper unit is an ash-flow tuff having a nonwelded top. All three units display devitrified, lavender to salmon, flow-layered lava or high-temperature, densely welded tuff at the top that grades downward into black vitrophyre at the base. Phenocryst content varies and assemblage includes alkali feldspar, plagioclase, hornblende, and trace clinopyroxene. Total thickness 0-300 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tct

Unit Name: Lapilli tuff

Map Unit Description

Complex sequence of ash-flow tuff, commonly separated by beds of tuffaceous sandstone and siltstone, and locally by thin black latite lava. Greenish-gray or buff lapilli tuff is densely welded and contains conspicuous dark-green or brownish-green, 1 to 2.5-cm-long collapsed pumice lapillae. Phenocrysts (9-16 percent) in tuffs include as much as 5 percent quartz, 2-8 percent alkali feldspar, 70-83 percent plagioclase, as much as 2 percent biotite, as much as 4 percent hornblende, and as much as 16 percent (mostly altered) pyroxene. Tuffs have been pervasively propylitized, resulting in mafic minerals being altered to chlorite, calcite, and iron oxide. Eruption of unit associated with initial collapse of the Thunder Mountain cauldron complex. Total thickness 0-500 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcll

Unit Name: Lower latite lava

Map Unit Description

Dark-gray to dark-purplish-gray lavas consisting of interlayered crystal-poor latite and crystal-rich latite, dacite, and rhyodacite. Porphyritic flows contain 30-40 percent phenocrysts of biotite, hornblende, and pyroxene. Unit is found on the margins of the Thunder Mountain caldera and is more abundant to the west in the Payette National Forest (Lund and others, 1998). Leonard and Marvin (1982) reported a sanidine K-Ar age of 50.8±1.7 Ma. Total thickness 0-500 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcc

Unit Name: Tuffs of Castle Rock

Map Unit Description

Five cooling units of reddish ash-flow tuff and thin interbeds of ash-fall tuff within the cauldron. Upper cooling unit is a cliff-forming, densely welded tuff about 228 m thick; beneath it are two thin, partly welded, lithic-rich cooling units each about 30 m thick; these are underlain by a cliff-forming, moderately welded cooling unit about 150 m thick; a lowermost slope-forming, partly welded cooling unit is rich in lithic fragments and about 190 m thick. Phenocrysts assemblages are similar throughout but vary considerably in relative proportions; minerals include quartz, alkali feldspar, plagioclase, biotite, hornblende, and pyroxene. Quartz is slightly smoky in all cooling units and chatoyant alkali feldspar is common. Total thickness about 620 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcb

Unit Name: Tuffs of Camas Creek-Black Mountain

Map Unit Description

Cauldron-filling sequence of mostly very densely welded quartz latite to rhyodacite ash-flow tuff consisting of 10 or more separate cooling units that are characterized by small (about 2 mm) phenocrysts. Phenocryst content (11-40 percent) in upper part of unit consists of trace quartz and alkali feldspar, 65-75 percent plagioclase, as much as 10 percent biotite, trace altered hornblende, and 10-20 percent altered pyroxene. Phenocryst content (5-25 percent) in middle part of unit consists of trace quartz, as much as 20 percent alkali feldspar, 65-77 percent plagioclase, as much as 9 percent altered biotite, as much as 3 percent altered hornblende, and 3-10 percent altered pyroxene. Phenocryst assemblage (3-15 percent) in lower part of unit consists of 2-12 percent quartz, 2-8 percent alkali feldspar, 60-75 percent plagioclase, 2-10 percent altered biotite, as much as 3 percent altered hornblende, and up to 10 percent altered pyroxene. Thickness from 0 to 3,000 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcl

Unit Name: Intermediate and mafic lavas

Map Unit Description

Andesitic to basaltic lava flows that are predominantly aphyric reddish brown weathering, gray and greenish gray, brittle, columnar jointed, and blocky to platy; locally interbedded with oxidized flow breccias. Pyroxene phenocrysts are visible in some specimens; microphenocrysts include olivine, clino- and orthopyroxene, and common xenocrystic quartz. Groundmass is rich in trachytic and pilotaxitic plagioclase and may contain reddish-brown, strongly pleochroic mica and considerable apatite. Thickness from 0 to 700 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tcem

Unit Name: Tuff of Eightmile Creek

Map Unit Description

Light-gray and greenish-gray, massive-weathering, partly welded and densely welded quartz latite to rhyodacite. Unit is megascopically similar to unit Tce but is distinguished by presence of alkali feldspar, more quartz, and less biotite and hornblende. Phenocryst assemblage (25-35 percent of rock) consists of 13-17 percent quartz, 12-16 percent alkali feldspar, 45-55 percent plagioclase, 9-12 percent biotite, as much as 2 percent hornblende, and trace clinopyroxene. K-Ar biotite analysis yields age of 48.4±1.7 Ma (Fisher and others, 1992). Thickness from 0 to 300(?) m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tce

Unit Name: Tuff of Ellis Creek

Map Unit Description

Light-greenish-gray, massive-weathering, densely welded, crystal-rich rhyodacite ash-flow tuff. Unit represents outflow from major collapse of the Van Horn Peak cauldron complex. Phenocrysts (36-50 percent) consist of 4-15 percent quartz (as long as 4 mm and "worm-eaten"), 60-75 percent plagioclase (as long as 6 mm), 12-20 percent biotite, 8-16 percent hornblende, and trace clinopyroxene. Unit contains abundant pumice lapilli. K-Ar biotite analysis yields age of 48.4±1.6 Ma (Fisher and others, 1992). Thickness from 0 to 300 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ti

Unit Name: Mafic to felsic intrusions, undivided (Eocene)

Map Unit Description

Small, poorly exposed basaltic, andesitic, and granitic plutons scattered throughout the eastern part of the Salmon National Forest. Most abundant in the Lemhi Range and along the Salmon River north of Salmon

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tgp

Unit Name: Gray porphyry (Eocene)

Map Unit Description

Mixed sequence of gray and greenish-gray extrusive and intrusive rocks of intermediate composition exposed in the Camas Creek drainage at the southwestern margin of the Salmon National Forest. Some exposures display flow layering indicating that they are lavas; most are massive with crystalline groundmasses. Phenocrysts constitute 30-45 percent of the rock and have the following proportions: quartz, as much as 5 percent; plagioclase, 60-75 percent; biotite, 1-12 percent; hornblende, as much as 25 percent; pyroxene, as much as 20 percent (Ekren, 1988). Intrusive contacts of the massive rock with lavas of the Challis Volcanic Group suggest an age for the unit of 48-51 Ma or less

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tg

Unit Name: Granite (Eocene)

Map Unit Description

Medium- to coarse-grained, phaneritic to porphyritic hornblende-biotite syenogranite and gray monzogranite that occur predominantly as large plutons in western part of the Salmon National Forest. Pink to tan syenogranite is composed of 45-55 percent alkali feldspar, 15-20 percent plagioclase, 15-20 percent quartz, 5-8 percent biotite, 3-5 percent hornblende, and accessory magnetite (Schmidt and others, 1994). Gray monzogranite is composed of 35-40 percent alkali feldspar, 25-30 percent plagioclase, 25-30 percent quartz, 5-8 percent biotite, and minor hornblende. Weathering produces exfoliated outcrops and coarse grus. This unit includes parts of the Painted Rocks pluton (Lund, Rehn, and Holloway, 1983), the Casto pluton (Cater and others, 1973), and the Chamberlain Basin pluton (Lund and others, 1998) with its easternmost extension known as the Bighorn Crags pluton (Cater and others, 1973; Lund and others, 1998). K-Ar biotite ages range from 44 to 49 Ma (recalculated from Armstrong, 1974)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tgd

Unit Name: Granite, granodiorite, and quartz monzodiorite (Eocene)

Map Unit Description

Discrete plutons in the Lemhi Range west and southwest of Leadore ranging in composition from monzogranite to granodiorite and quartz monzodiorite (Ruppel and Lopez, 1988). Granite is medium-light-gray to medium-dark-gray, porphyritic biotite monzogranite with subhedral phenocrysts (4-6 mm long) of plagioclase, alkali feldspar, quartz, biotite, and hornblende set in a fine-grained groundmass. The granite in the core of the Big Eightmile stock, southeast of Big Eightmile Creek has been intensely hydrothermally altered. Granodiorite is commonly medium dark gray and porphyritic with phenocrysts (2-3 mm long) of plagioclase, hornblende, and biotite set in a fine-grained groundmass. Quartz monzodiorite is medium dark gray to medium gray and porphyritic with phenocrysts (1-3 mm long; rarely 8 mm) of plagioclase, hornblende, biotite, and pyroxene set in a very fine grained to fine-grained groundmass. K-Ar biotite data suggest an age of about 50 Ma (Ruppel and Lopez, 1988)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Tir

Unit Name: Intrusive rhyolite (Eocene)

Map Unit Description

Dikes and plugs of light-gray, dense, phenocryst-poor rhyolite. Locally, unit has conspicuous phenocrysts of sanidine as long as 8 mm and sparse phenocrysts of quartz. Unit crops out in the southwestern part of the Salmon National Forest

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: TKi

Unit Name: Intrusions, mostly intermediate and felsic (Tertiary to Cretaceous)

Map Unit Description

Mostly composite plutons of the Carmen stock in the headwaters of Carmen Creek in the northern Beaverhead Mountains, and the Chief Joseph plutonic complex near Lost Trail Pass, Idaho-Montana. The Carmen stock is mostly granite, granodiorite, and quartz monzodiorite; Ar ages about 48-55 Ma; eastern part of stock is more mafic and yields ages of about 80-83 Ma (Kilroy, 1981). The Chief Joseph plutonic complex is located mostly outside the Salmon National Forest in Montana, and includes granite, hornblende-biotite granodiorite, biotite granodiorite, and tonalite. K-Ar, U-Pb zircon, and fission track ages indicate an age range of about 43-78 Ma (Desmarais, 1983)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Kt

Unit Name: Hornblende-biotite tonalite (Cretaceous)

Map Unit Description

Dark-gray, slightly foliated, medium-grained, phaneritic hornblende-biotite tonalite with local mafic enclaves; poorly exposed in the northwestern part of the Salmon National Forest. Pluton is 40-50 percent feldspar (<5 percent alkali feldspar), 15-20 percent quartz, 5-10 percent hornblende, 15-20 percent biotite, and less than 5 percent brown pyroxene(?) (Schmidt and others, 1994). Unit Kt is intruded by unit Tg and intrudes Kpg and Ybgn, suggesting a Cretaceous age similar to that of tonalitic rocks in the Payette National Forest to the west (Lund and others, 1998)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Kg

Unit Name: Biotite-muscovite granite (Cretaceous)

Map Unit Description

Light-gray, nonfoliated, medium-grained, phaneritic two-mica granite in upper Owl Creek, west of Shoup and north of the Salmon River. Rock consists of 20-30 percent alkali feldspar, 30-40 percent plagioclase, 25-30 percent quartz, 5-10 percent muscovite (euhedral books), and less than 5 percent biotite (Schmidt and others, 1994). Outcrops tend to exfoliate and weather to a coarse, light-gray grus. Pluton intrudes units Ybgn, Ymg, and Kgd with sharp contacts. Unit Kg commonly crops out to the west in the Payette and Nez Perce National Forests, Idaho, where it has been dated by 40Ar/39Ar methods at about 74 Ma (Lund and others, 1986)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Kpg

Unit Name: Porphyritic granite and granodiorite (Cretaceous)

Map Unit Description

Light-gray, nonfoliated to weakly foliated, medium-grained, porphyritic granite and granodiorite exposed within the Salmon River canyon at the northwest margin of the Salmon National Forest and along Camas Creek in the southwestern part of the forest. Similar in composition to unit Kgd but contains pink alkali feldspar phenocrysts generally 5-7 cm in length. Weathering characteristics are similar to those of unit Kgd

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Kgd

Unit Name: Biotite granodiorite (Cretaceous)

Map Unit Description

Light-gray, nonfoliated to weakly foliated, medium-grained, phaneritic biotite granodiorite in the western part of the Salmon National Forest; forms plutons, dikes, and sills within Mesoproterozoic units. Made up of 20-25 percent alkali feldspar, 45-55 percent plagioclase, 15-25 percent quartz, and 3-10 percent biotite, with accessory sphene and magnetite (Schmidt and others, 1994). Locally, near contacts with Proterozoic rocks, unit Kgd can contain as much as 10 percent muscovite. Outcrops weather to a light-gray, coarse grus. Unit Kgd is a major component of the Idaho batholith to the west in the Payette National Forest (Lund and others, 1998)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Kgdf

Unit Name: Foliated biotite granodiorite (Cretaceous)

Map Unit Description

Light-gray, medium-grained, foliated biotite granodiorite in the southwestern part of the Salmon National Forest along and near the Middle Fork Salmon River. Ekren (1988), based on one thin section, described a composition of about 11 percent alkali feldspar, 51 percent plagioclase, 28 percent quartz, and 10 percent biotite. Although exposures underlie only a small part of the Salmon National Forest, unit Kgdf is widespread west of the Thunder Mountain caldera in the Payette National Forest (Lund and others, 1998)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: TRd

Unit Name: Dinwoody Formation (Lower Triassic)

Map Unit Description

Yellow-brown-weathering, dark-gray, fissile shale and calcareous shale, with interbeds of medium-gray and brownish-gray limestone and calcareous sandstone; present in the Beaverhead Mountains southeast of Leadore. Coarse-grained recrystallized limestone contains distinct, abundant fossil debris. Spaced cleavage is prevalent and locally obscures bedding. The upper contact is disconformable and the lower contact with the Phosphoria Formation (Pp) is abrupt. Unit poorly exposed. Although structurally deformed, the formation is probably about 300 m thick (Lucchitta, 1966)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Pp

Unit Name: Phosphoria Formation (Lower Permian)

Map Unit Description

Crops out in the Beaverhead Mountains; definition follows usage of Lucchitta (1966). Upper part is bedded black chert with thin beds of dolomite and limestone. Bluish-white phosphatic spots are found in the chert beds. Chert is about 50 m thick and is equivalent to the Tosi Chert Member (McKelvey and others, 1959). Lower part is dark-gray dolomite and minor limestone with dark-gray to black, ropy chert nodules, (mapped as Phosphoria and Park City Formations, undivided, by Lucchitta, 1966). Lower part may belong to the upper Juniper Gulch Member of the Snaky Canyon Formation, but structural complexity and lack of definitive age information make it difficult to assign these beds. Lowest part exposed is a bluish siltstone less than 30 m thick. The upper contact, with the Dinwoody Formation (TRd), is abrupt; the lower contact with the undivided Snaky Canyon and Bluebird Mountain Formations (PMs), where preserved, is gradational. Thickness difficult to measure but probably about 260 m (Lucchitta, 1966)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: PMs

Unit Name: Snaky Canyon (Lower Permian to Upper Mississippian) and Bluebird Mountain (Upper Mississippian) Formations, undivided

Map Unit Description

Combined unit present in the Beaverhead Mountains in the southeastern part of the Salmon National Forest. The upper member of the Snaky Canyon (Juniper Gulch Member) is medium-bluish-gray, sandy dolomite with interbedded quartz sandstone layers. The amount of interbedded sandstone decreases upward so that light- to medium-gray cherty dolomite predominates. The underlying Gallagher Peak Sandstone Member of the Snaky Canyon Formation is similar to the Bluebird Mountain strata but has more calcareous cement. The lower member of the Snaky Canyon Formation (Bloom Member) is medium- to dark-gray, cherty limestone with common chert nodules and interbedded thin quartz sandstone similar to Bluebird Mountain sandstone. Sandstone of the Bluebird Mountain Formation is light-brown-weathering, fine-grained, light-gray quartzitic sandstone and minor quartzite. Unit PMs totals about 560 m thick (Lucchitta, 1966). The type section for these units is south of the Salmon National Forest in the extreme southern Beaverhead Mountains, where the total thickness is 1,350 m (Skipp, Hoggan, and others, 1979). The upper contact is gradational and some cherty dolomite beds included in the Phosphoria Formation (Pp) on this map may belong to the upper part of the Snaky Canyon Formation. The lower contact is abrupt. Intense structural disruption is common in this unit

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Mu

Unit Name: Surrett Canyon(?), South Creek(?), and Scott Peak Formations (Upper Mississippian) and Middle Canyon (Upper and Lower Mississippian) Formation, undivided

Map Unit Description

Combined unit of limestones in the Beaverhead Mountains that are either so brecciated or sheared that original bedding characteristics are obscured and the strata cannot be assigned to particular formations. This unit may include strata correlative with the South Creek and Surrett Canyon Formations, although these two units have not been recognized in this part of the Beaverhead Mountains

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Mss

Unit Name: Surrett Canyon, South Creek, and Scott Peak Formations (Upper Mississippian) and Middle Canyon (Upper and Lower Mississippian) Formation, undivided

Map Unit Description

Combined unit of limestone and silty limestone that crop out low on the eastern side of the southern Lemhi Range. Shaly beds at top of unit may be equivalent to the Railroad Canyon Formation. Underlying minor thin-bedded silty limestone, preserved locally above massive limestone, is probably equivalent to parts of the South Creek and Surrett Canyon Formations. Thickest part of unit is massive cherty bioclastic limestone that is equivalent to the Scott Peak Formation. Lower part of unit is thin-bedded, cherty, yellow- to red-weathering silty bioclastic limestone that is highly cleaved and deformed. Although not mapped separately, these lower rocks are equivalent to the Middle Canyon Formation. Originally mapped as the White Knob Limestone (Hait, 1965), the rocks were subsequently subdivided and renamed (Huh, 1967; Skipp, Sando, and Hall, 1979). Total thickness about 700 m (Hait, 1965)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Mr

Unit Name: Railroad Canyon Formation (Upper Mississippian)

Map Unit Description

Dark-gray, pink-, and yellow- to orange-weathering shale, mudstone, silty limestone, and calcareous siltstone present in the Beaverhead Mountains north and east of Leadore. Strata are mostly thin bedded and flaggy, though some dark shale is fissile and flaggy. Dark shale and siltstone have a musty odor. Unit is poorly exposed and underlies swales and valleys, where springs and slumps are preferentially located in it. Shaly strata commonly acts as locus for faults that in many places excise all or part of the formation. Slivers of unit Mr are preferentially silicified along fault zones; narrow zones of silicified siltstone are common indicators of low-angle faults. Formation was mapped previously as Big Snowy Group (Lucchitta, 1966) and Big Snowy Formation (Skipp and others, 1984). Unit Mr is 205 m thick at the type section on the west side of upper Railroad Canyon northeast of Leadore and is considered equivalent to the Surrett Canyon and Arco Hills Formations of the foredeep carbonate bank sequence of Idaho (Wardlaw and Pecora, 1985; Skipp, Sando, and Hall, 1979). Upper and lower contacts are conformable

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ms

Unit Name: Scott Peak Formation (Upper Mississippian)

Map Unit Description

Medium-dark-gray, medium- to thick-bedded, mostly pure limestone with bedded chert horizons in the Beaverhead Mountains in the vicinity of Leadore and in the Lemhi Range near Gilmore. Much of the unit contains orange-weathering, wispy and bedded, dark-gray chert. Beds are fossiliferous with corals and brachiopods dominant; encrinite layers are common but not diagnostic. Unit typically forms cliffs. Thin-bedded strata, recognized in the upper part by Lucchitta (1966) but not mapped separately, may be correlative with the South Creek and Surrett Canyon Formations. Near low-angle normal faults, the unit is brecciated and recemented with calcite. Throughout the study area the Scott Peak is strongly cleaved as a result of deformation associated with thrust faulting. Although commonly thinned by low-angle normal faults, the unit may be as much as 700 m thick (Skipp and others, 1984)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Mm

Unit Name: Middle Canyon Formation (Upper and Lower Mississippian)

Map Unit Description

Medium- to dark-gray, thin-bedded cherty limestone and silty limestone crop in the southeastern part of the Salmon National Forest. Bedding is commonly 0.5-5 cm thick. Silty interbeds weather tannish-orange and give the unit a tannish-gray appearance. Unit forms smooth slopes and generally only crops out on canyon walls. Exposures in the range front north of Leadore indicate that the strata are strongly ductilely deformed, having undergone multiple deformations. In the Lemhi Range west of the hamlet of Lemhi, near junction of Hayden and Basin Creeks, unit Mm forms prominent outcrops in the footwall of the Poison Creek thrust fault. Some of these strata are silicified adjacent to rocks of the Eocene Challis Volcanic Group and locally were misinterpreted as Beaverhead Conglomerate (now Beaverhead Group) (Cretaceous and Paleocene) by Anderson (1961). Total thickness about 160 m (Lucchitta, 1966)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Mg

Unit Name: McGowan Creek Formation (Lower Mississippian)

Map Unit Description

Gray to pink calcareous siltite, argillite, and shale poorly exposed in the Lemhi Range in the southeastern part of the Salmon National Forest. Thickness about 200 m in southern part of the Lemhi Range (Hait, 1965)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Du

Unit Name: Three Forks and Jefferson Formations, undivided (Upper Devonian)

Map Unit Description

Widespread in the Lemhi Range and Beaverhead Mountains in the southeastern part of the Salmon National Forest. Uppermost part of unit locally includes limey siltstone beds that were not mapped separately, but which may correlate with the McGowan Creek Formation. The Three Forks Formation consists of dark-gray siliceous mudstone, tan to gray to pink siltstone, and platy fine-grained dark-gray limestone. The underlying Jefferson Formation is primarily dark-gray dolomite with lesser amounts of limestone, limestone evaporite-solution breccia, and sandy dolomite. Strong tectonic brecciation of unit in most locations makes identification of bedding difficult. Beneath (east of) the Hawley Creek thrust (east-southeast of Leadore) in the Beaverhead Mountains, base of unit is an angular unconformity with underlying Ordovician and Mesoproterozoic strata. Above (west of) the Hawley Creek thrust in the Lemhi Range and north of Leadore in the Beaverhead Mountains, the unconformity is less profound and Silurian and Upper Ordovician rocks are present. Ruppel and Lopez (1988) reported a maximum thickness in the Lemhi Range, near Gilmore, of about 825 m of Jefferson and 90 m of Three Forks strata, but both units (especially the Jefferson) thin rapidly to the south and east

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: SOu

Unit Name: Laketown Dolomite (Silurian) and Saturday Mountain Formation (Lower Silurian to Middle Ordovician), undivided

Map Unit Description

Where present in the Lemhi Range south of Poison Creek, the Laketown Dolomite is too thin to show separately and has been combined with the underlying Saturday Mountain Formation (see description of unit SOs). The Laketown Dolomite is a light-olive-gray to medium-light-gray and light-gray, fine- to medium-crystalline dolomite in beds 0.6-3 m thick. Fresh surfaces of the Laketown are characterized by a sparkling appearance, in contrast to the Saturday Mountain Formation. Vugs (1-2 mm in diameter) are moderately abundant but fossils are rare. Thickness of the Laketown Dolomite in the central Lemhi Range is about 60 m; total thickness of unit SOs as much as 430 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: SOs

Unit Name: Saturday Mountain Formation (Lower Silurian to Middle Ordovician)

Map Unit Description

Medium-light- to medium-dark-gray, very fine grained dolomite located in the Poison and Warm Spring Creeks area of the Lemhi Range and in the Beaverhead Mountains near Leadore. South of Poison Creek in the Lemhi Range the unit has been combined with the overlying Laketown Dolomite into unit SOu. Unit SOs consists of four members (Ruppel and Lopez, 1988). The uppermost member consists of medium-gray to medium-light-gray, finely crystalline, thick- to massive-bedded dolomite that weathers to a mottled appearance. Black chert nodules are present but notably less abundant than in lower members; however the member is quite fossiliferous. Underlying this is medium-dark-gray to medium-gray, finely crystalline dolomite that weathers to distinctly mottled lighter gray colors; black chert nodules are also common as well as numerous beds with abundant fossils and fossil fragments. This grades downward into yellowish-gray to medium-gray, finely crystalline dolomite characterized by a network of irregular, interlaced, hair-like wisps and veinlets of white dolomite and locally by abundant black chert nodules. The basal Lost River Member consists of interbedded clastic deposits of generally dark-colored sandstone, quartzite, shale, and mudstone. Ruppel and Lopez (1988) reported fossil data that indicate an age in the central Lemhi Range of mostly Ordovician with the top part being Lower Silurian; in the southern Lemhi Range, however, the unit is wholly Ordovician. It is overlain along a deeply weathered, erosional unconformity by the Silurian Laketown Dolomite. Maximum thickness of unit SOs in the central Lemhi Range is about 370 m, but it thins to the south and east

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ok

Unit Name: Kinnikinic Quartzite (Middle Ordovician)

Map Unit Description

White to light-gray, fine- to medium-grained, vitreous quartzite present in the Beaverhead Mountains and Lemhi Range. Unit is compositionally supermature and well sorted with tightly cemented subrounded grains; as a result, bedding is usually difficult to identify. The lower contact is conformable with the underlying Summerhouse Formation (Os), although locally the Kinnikinic rests unconformably on Mesoproterozoic strata (Ruppel, 1980). Thickness about 300 m in the Lemhi Range (Ruppel, 1980)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Os

Unit Name: Summerhouse Formation (Lower Ordovician)

Map Unit Description

White and light-gray to pale-yellowish-orange, fine- to coarse-grained (locally bimodal) quartzite and dolomitic quartzite; locally includes an uppermost unit of massive dolomite. Unit exposed in the Rattlesnake Creek area of the Salmon River Mountains. Bedding is commonly 50-100 cm thick. Beds virtually identical to those of the Kinnikinic Quartzite (Ok) are intercalated with medium- to coarse-grained, locally bimodal quartzite with dolomitic cement, consistent with relationships in the type section of unit Os in the central Lemhi Range (Ruppel and others, 1975; McCandless, 1982). Quartzites grade upward through an approximately 10-m-thick transition zone of dolomitic quartzite into about 30 m of medium-gray, fine-grained, locally massive dolomite (which in this study has been included in map unit Os). Conodonts and brachiopods from the dolomite suggest an age of Middle or Late Ordovician, possibly equivalent in part to the Middle Ordovician Ella Dolomite of the Challis area (Ekren, 1988). This is in accord with the interpretation that the quartzites are pre-Kinnikinic and best correlated with the Summerhouse Formation. Because the dolomite is too thin to show at the scale of the map and because regional relationships of the Ella Dolomite and the Summerhouse Formation are undefined (McCandless, 1982; Hobbs and Hays, 1990), the dolomite is tentatively mapped as part of the Summerhouse Formation. In the Rattlesnake Creek area, the dolomite is truncated upward by the Poison Creek thrust but the base of the quartzites is thrust onto the Gunsight Formation (Yg) along one of several imbricate faults below the Poison Creek thrust. Total thickness about 230 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Oks

Unit Name: Kinnikinic Quartzite (Middle Ordovician) and Summerhouse Formation (Lower Ordovician), undivided

Map Unit Description

Map unit used only in the northern Lemhi Range where poor exposure and the map scale used for compilation prevented the two units from being shown separately. In the Goldbug Ridge area north of the Poison Creek thrust fault, the dolomite is overlain (conformably?) by the Kinnikinic Quartzite but unfoliated quartzite of the basal Summerhouse rests unconformably on locally strongly cleaved Swauger Formation. Further south near Poison Peak and the thrust fault, coplanar cleavage presumably produced by thrusting occurs in both quartzites and post-unit Ok carbonates. Total thickness about 530 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: CZw

Unit Name: Wilbert Formation (Lower Cambrian to Neoproterozoic?)

Map Unit Description

Predominantly quartzite pebble to cobble conglomerate and quartzite with minor carbonate-cemented sandstone and sandy dolostone. Unit crops out in small area in the Beaverhead Mountains north of Leadore. Most recognized exposures are quartzite with interbedded conglomerate, but where conglomerate is lacking parts of this unit may include some underlying Gunsight Formation (Yg). Quartzite shows bimodal grain size distribution, and is cemented by silica in lower part of unit. Conglomerate layers are as thick as 2 m; cobbles derived primarily from quartzite of the Mesoproterozoic Swauger (Ys) and Gunsight Formations; minor clasts of vein quartz and rare chips of light-colored siltite. Amount of carbonate cement increases upward where the carbonate-cemented sandstone is interbedded with sandy dolomite. Unit is probably correlative with the Wilbert Formation as defined in the Lemhi Range (Ruppel and others, 1975; McCandless, 1982). Total thickness of unit CZw is unknown because it only crops out in fault slivers; maximum thickness observed is about 10 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: PzZv

Unit Name: Metavolcanic and metasedimentary strata (lower Paleozoic to Neoproterozoic)

Map Unit Description

Greenschist facies mafic and felsic metavolcanic rocks with minor volcaniclastic conglomerate, graywacke, and quartzite. Occurs as roof pendant in batholithic rocks along and near the Middle Fork Salmon River in southwest corner of map area. Mafic volcanic rocks are amphibolites with relict plagioclase and pyroxene phenocrysts; felsic volcanic rocks contain relict potassium feldspar, plagioclase, and quartz phenocrysts. Minor associated sedimentary strata include amphibolite conglomerate with heterogeneous lithic clasts, biotitic-feldspathic metasandstone, and quartzite. Rocks in the roof pendant along the Middle Fork Salmon River are probably equivalent to lithologically similar pendants better exposed along strike to the west in the Payette National Forest, where the mafic volcanic unit is about 500 m thick (Leonard, 1962; Lund and others, 1997, 1998; Lund, 1998). Felsic Metavolcanic strata from a pendant near Big Creek, Idaho (Payette National Forest) has been dated using SHRIMP U-Pb methods on zircon to be 686±10 Ma (date slightly revised from Evans and others, 1997)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: OZi

Unit Name: Mafic to predominantly felsic alkalic intrusions (Ordovician to Neoproterozoic)

Map Unit Description

Medium-grained, phaneritic to porphyritic, alkali-feldspar syenite, alkali-feldspar quartz syenite, and alkali-feldspar granite with generally lesser amounts of gabbro and mafic-rich quartz syenite. Crops out in the Beaverhead Mountains (Beaverhead pluton of Scholten and Ramspott, 1968; Skipp, 1984), west of Salmon (Deep Creek and Arnett Creek plutons, Evans and Zartman, 1988), and near Yellowjacket and Middle Fork Peak (Ekren, 1988). U-Pb zircon dates indicate an age of about 490 Ma, in contrast to compositionally similar alkalic plutons to the west in the Payette National Forest (Lund and others, 1998), where preliminary data indicate an age of about 650 Ma (Evans and Zartman, 1988; J.N. Aleinikoff and K.V. Evans, unpub. data, 2002)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: PzZgm

Unit Name: Gray marble (lower Paleozoic to Neoproterozoic)

Map Unit Description

Greenschist facies marble and calc-silicate marble locally preserved as isolated blocks in intrusive rocks along the Middle Fork Salmon River in southwest corner of map area. Silicate minerals present in the calc-silicate rocks include tremolite, actinolite, and chlorite. Unit probably correlates with similar strata preserved as roof pendants to the west in the Payette and Nez Perce National Forests (Lund, 1998)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ylc

Unit Name: Lawson Creek Formation (Mesoproterozoic)

Map Unit Description

Intercalated siltite and metasandstone to orthoquartzite. Strata are gray to grayish green and blueish green, and range from near equal parts quartz and feldspar in a fine-grained chloritized matrix to orthoquartzite. Beds are 1 cm to 1.5 m thick and planar to cross-laminated, and locally contain "floating" rip-up clasts of argillite. A few beds are light gray, fine-grained metasandstone with fine laminations and dark-gray, heavy-mineral laminae 1-2 grains thick. Other metasandstones are poorly sorted with well-rounded, medium- to coarse-grained quartz, minor plagioclase, and medium- to coarse-grained silt. Siltite is medium to dark gray and forms sequences as thick as 10 m in which siltite and metasandstone are interlayered in beds 0.5-5 cm thick. These strata are planar to ripple cross-laminated and show abundant flaser and lenticular bedding, as well as cut and fill structures. Hobbs (1980) named the unit for strata in the Lost River Range and Tysdal (1996a) and Tysdal and Moye (1996) extended the term to rocks in fault slivers south of the Lem Peak fault in the Lemhi Range. The description is from Tysdal (1996a). Tysdal (2000a) interpreted the unit to have formed in an intertidal environment. Total thickness in the type section is about 1,200 m, but only about 300 m is preserved in the Salmon National Forest due to thinning by faults

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ys

Unit Name: Swauger Formation (Mesoproterozoic)

Map Unit Description

Light-gray, pale-green, and pale-red-purple, medium- to coarse-grained quartzite. Unit is widespread in the Lemhi Range and present in the Beaverhead Mountains near Leadore and in the Salmon River Mountains west of Salmon. Quartz content typically ranges from 90 to 95 percent; well-rounded, well-sorted, tightly cemented, and glassy grains. Feldspar content seldom exceeds 5-10 percent. A speckled appearance is quite common and results from 0.5 to 3-mm-diameter (usually reddish) spots of hematite, local limonite, and rare chlorite commonly concentrated along cross-laminae. Beds are 0.5-2 m thick and commonly show trough cross-laminations and lesser herringbone cross-laminae. Two-dimensional ripples and dunes are quite well developed in places; dunes have wavelengths of 4-8 m and heights of 0.7-1 m and ripples have wavelengths of 2-15 cm and heights of 0.3-3 cm. Tysdal (2000a) interpreted the bulk of the Swauger to have been deposited in a tidal environment, based on the compositional maturity of the quartzites, presence of herringbone cross-beds, subordinate current cap deposits (de Mowbray and Visser, 1984) on some dunes, rare antidunes, and local flaser and lenticular bedding. The Swauger grades upward into the Lawson Creek Formation. Total thickness about 3,100 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yg

Unit Name: Gunsight Formation (Mesoproterozoic)

Map Unit Description

The Gunsight Formation was defined by Ruppel (1975) for rocks at Gunsight Peak in the Lemhi Range west-southwest of Leadore, Idaho. McBean (1983) further studied the type section and much of the following description for the Gunsight south of the Lem Peak fault is taken from his work. North of the Lem Peak fault and in the Beaverhead, Salmon River, and Clearwater Mountains, strata previously mapped as the upper unit of the Yellowjacket Formation (unit Yyu of Evans, 1998) are now correlated with the Gunsight (Tysdal, 2000b). Accordingly, the Gunsight is separately described as follows: south of Lem Peak fault (that is, type section), north of Lem Peak fault (that is, mostly former unit Yyu), and in the Beaverhead and Clearwater Mountains.

South of Lem Peak fault-Pale-brown to gray, very fine grained to medium-grained metasandstone typifies most of the type section. Quartz and feldspar are the dominant components, with feldspar content ranging from 25 to 50 percent; matrix content is 0-8 percent. Sedimentary structures include trough and planar cross-beds; parallel ripple and climbing ripple cross-laminations; ripple and climbing ripple laminations; straight-crested, asymmetrical and oscillation ripples; and dewatering structures. In the uppermost 100+ m, where the unit is transitional into the compositionally mature Swauger Formation (Ys), quartz content increases to 80-90 percent. Lower 450 m of unit consist of interbedded siltite, argillite, and very fine grained metasandstone transitional into the underlying siltite of the Apple Creek Formation. Matrix content in this lower part can reach 40 percent. Total thickness is 1,700+ m. McBean (1983) interpreted the formation to have been deposited in a shallow marine setting, but Tysdal (2000a) considered most of the unit to be fluvial. Trough crossbedded metasandstone (as thick as 1-2 m) that fines upward into siltite is indicative of channel and overbank deposits and strongly supports Tysdal's reevaluation. Upper part of formation may be shoreface deposits transitional into marine deposits of the Swauger (Tysdal, 2000a). Lower part of formation, with its intercalated siltite and argillite, probably formed in an intertidal to subtidal environment transitional into the turbidites of the Apple Creek Formation.

North of Lem Peak fault-Light- to dark-gray, very fine grained to medium-grained, feldspathic metasandstone (arkose) typifies this unit in the northern Lemhi Range and Salmon River Mountains. Bed thickness ranges from 10 to 100 cm. Decimeter-thick trough and planar cross-beds are typical; hummocky cross-stratification is present locally in the Salmon River Mountains. Conglomeratic beds exist locally, containing clasts that are angular and rounded. Deposition was probably in fluvial to shallow marine environments, with features such as the local conglomerates probably representing slumping of partially lithified channel margins into tidal(?) channels. Total thickness probably exceeds 4,000 m. In the Salmon River Mountains the unit is transitional downward into the banded siltite unit of the Apple Creek Formation (Yab), and upward into the Swauger Formation (Ys).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ya

Unit Name: Apple Creek Formation, undivided (Mesoproterozoic)

Map Unit Description

The Apple Creek Phyllite was defined by Anderson (1961) for foliated rocks near Hayden Creek in the central Lemhi Range. Ruppel (1975) redefined the unit as the Apple Creek Formation and Tietbohl (1981, 1986) studied a diamictite unit within the formation. Tysdal (1996a, b, c, 2000a, b; Tysdal and Moye, 1996) slightly redefined and subdivided the formation into mappable informal subunits, described below. On our geologic map, Tysdal's subunits are used where recent mapping is available; where it is not available or distinctions could not be made in the field, the undivided designation (Ya) is used.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yab

Unit Name: Banded siltite unit

Map Unit Description

Centimeter-scale layers of light-gray siltite to very fine grained metasandstone alternating with black siltite or argillite characterize the easily identified banded member. The thickness of layers and the percentage of metasandstone versus siltite/argillite vary considerably. Layers range from 0.5 to 10 cm thick and percentages of metasandstone to siltite/argillite range from equal to 95 percent dominance by either component. These couples and couplets of the unit are interpreted to be turbidites (Sobel, 1982; Tysdal, in press). In addition to the visually striking light and dark layering, argillite beds in virtually any outcrop exhibit predominantly (but not exclusively) downward-penetrating dikelets of coarser sediment from the overlying layer. Commonly the dikelets are 'ptygmatically' folded due to compaction of the originally very water laden argillaceous layers. Unit is widespread in the Salmon River Mountains northeast of the Iron Lake fault, and reaches a thickness of at least 2,000 m. Unit apparently thins to the southeast due to erosion so that only a thin sliver is preserved in the footwall of the Poison Creek thrust in the Lemhi Range. Unit is the primary host for the stratabound Blackbird Co-Cu-Au deposit. Base of unit is gradational downward into the coarse siltite unit (Yac), and top grades upward through a relatively abrupt transition into the overlying Gunsight Formation (Yg). As previously noted, in the Lemhi Range unit Yab thins below the Gunsight due to erosion.

Unit was called the "middle subunit of the Yellowjacket Formation" by Connor and Evans (1986), but because the unit lies conformably above the coarse siltite unit of the Apple Creek Formation, Tysdal (in press) assigned it to the Apple Creek Formation. The "banded siltite" name resurrects an informal name that was used originally by Connor and Evans (1986)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yac

Unit Name: Coarse siltite unit

Map Unit Description

Grayish-green, medium- to coarse-grained siltite and fine-grained quartzite (metasandstone) best preserved between Bear Valley Lakes and Basin Lake in the Lemhi Range. In the Salmon River Mountains southwest of the town of Salmon, strata previously mapped as the lower unit of the Yellowjacket Formation (unit Yyl of Evans and Connor, 1993) are now identified as the coarse siltite member of the Apple Creek Formation (Tysdal, 2000a, b; Tysdal and others, 2000). Unit is named for distinctive light-gray, quartz-rich graded beds of coarse-grained siltite to fine-grained quartzite that are most abundant in the lower part of this member. Light-gray beds have erosional bases, show Bouma sequences (Tb-c, Tb-c-d, locally also Ta), and grade upward into gray-green medium siltite. Graded beds commonly are 10-30 cm thick but are as thick as 1 m. Upper part of unit is dominated by graded beds of grayish-green siltite and minor beds of argillite and fine-grained quartzite. Bedding ranges from 1 to 100 cm; most about 10-25 cm thick. Magnetite bands are present both in the Lemhi Range where this unit was defined by Tysdal (1996a, b, c, 2000a) and in the redefined strata (formerly lower Yellowjacket Formation) in the Salmon River Mountains (Nash, 1989). Soft-sediment deformation structures are common in this unit, including convolute lamination, dish, pillar, and flame structures, syneresis cracks, and ball-and-pillow structures. Unit Yac is interpreted to be primarily a turbidite deposit with minor debris flows indicated by rare pebbly beds. Total thickness about 2,000-2,500 m. Unit grades upward through a transition into the Gunsight Formation (Tysdal, 2000a)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yad

Unit Name: Diamictite unit

Map Unit Description

Grayish-green argillite, argillaceous siltite, and fine- to medium-grained siltite forms the matrix and interbeds to matrix-supported, poorly sorted conglomerate, first characterized as diamictite by Tietbohl (1981). Unit is generally intensely cleaved, obscuring sedimentary features; however graded beds are commonly recognized in those siltite beds that are less pervasively deformed. Conglomeratic beds are tabular in shape with thicknesses of as much as several meters and lateral extent of several tens of meters. Clasts in conglomeratic beds are subangular to well rounded and commonly 1-5 cm in long dimension; locally, some clasts are 20-25 cm long and one observed clast was 50 cm. Matrix material is composed of sericite, muscovite, chlorite, and silt of quartz and plagioclase. Tietbohl (1986) indicated that about 90 percent of clasts are detrital rock fragments ranging from argillite to fine-grained metasandstone. Tysdal (2000a) described sparse laminae and beds (=1 cm) of magnetite locally present in the Lemhi Range. He interpreted graded bedding in the siltite beds to indicate an origin by turbidity currents, and attributed conglomeratic beds that lack grading to subaqueous debris flows. Thickness estimates are complicated by deformation but the unit is about 600 m thick on the west side of the Lemhi Range and 1,000-1,500 m on the east side. Unit grades upward into the conformably overlying coarse siltite member (Yac) (Tysdal, 2000a)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yaf

Unit Name: Fine siltite unit

Map Unit Description

Greenish-gray to olive-gray, planar-laminated and ripple-cross-laminated, fine-grained siltite and argillaceous siltite well exposed in upper reaches of Bear Valley Creek drainage in the Lemhi Range. Some beds contain planar laminations that grade upward to small-scale (1-3 cm) sets of ripple-cross-laminated siltite. Planar-laminated strata locally developed water-escape structures. Beds commonly beds graded from 1 to 2-cm-thick, light-gray, medium- to fine-grained siltite upward into dark-gray, fine-grained siltite. Upper part of fine siltite member contains sparse, local, matrix-supported, gravel-size argillite clasts in horizons 1-2 clast diameters thick. Fine silt and clay content also is more abundant in upper part of unit. Graded beds with Bouma sequences and sedimentary structures indicate most of unit consists of turbidites, with lesser debris flows and some reworking by bottom currents (Tysdal, 2000a). Base of unit is unconformable on the Big Creek Formation (Yb) and top is conformably overlain by the abrupt appearance of the diamictite member (Yad). Total thickness about 1,000 m (Tysdal, 2000a)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yb

Unit Name: Big Creek Formation (Mesoproterozoic)

Map Unit Description

The Big Creek strata are primarily exposed in the Lemhi Range and Beaverhead Mountains. In the Lemhi Range, the Lem Peak (normal) fault separates somewhat different sequences of unit Yb; the following descriptions from Tysdal (2000a) focus on these two areas (Tysdal, 1996a, b, c; Tysdal and Moye, 1996).

North of Lem Peak fault-Light-gray, coarse-grained siltite to medium-grained quartzite (metasandstone); prominent silty laminae of rusty-brown-weathering carbonate and dark-gray, heavy-mineral laminae. Quartzite is composed of 50-60 percent quartz, 10-20 percent feldspar, 5-15 percent matrix, and as much as 5 percent heavy-mineral laminae, including such minerals as tourmaline, zircon, and ilmenite. Beds commonly are composed of two-dimensional dunes (megaripples) with planar cross-lamination in sets 0.5-1 m high; dune wavelengths as much as 3 m, and dune heights 0.3-0.5 m. Other beds show three-dimensional dunes with trough cross-laminae; dune wavelengths 3-5 m, and dune heights of 0.3-0.5 m. In upper part of formation, dark-gray argillaceous siltite in sequences less than 5 m thick is intercalated with light-gray, coarse-grained siltite and fine-grained quartzite. Locally, double clay drapes and reactivation surfaces are developed, indicating deposition by tidal current processes. Other sedimentary features indicating or consistent with bipolar tidal currents include herringbone cross-lamination, flaser and lenticular bedding, interbedded dunes and mudstone lenses, and tidal channel deposits. Locally, an amygdaloidal andesite flow is 2-4 m thick in upper Big Creek strata. Thickness about 2,700 m. Bottom of the Big Creek is not exposed in the Salmon National Forest and top is unconformably overlain by the Apple Creek Formation (Tysdal, 2000a).

South of Lem Peak fault-Light-gray, coarse-grained siltite to medium-grained quartzite is also the dominant lithology south of the Lem Peak fault, including the area designated the type section by Ruppel (1975). Upper part of the Big Creek in the type area consists of stacked two-dimensional dunes with heights of 0.5-1.5 m and wavelengths of 2-3 m. Reactivation surfaces and double clay drapes indicate deposition in a tidal environment with bipolar currents trending northeast-southwest (present coordinates). Lower part of formation is typified by heavy-mineral laminae commonly as thick as 3 cm and extending laterally in gently inclined cross-beds for as much as 100 m. These strata have been interpreted as beach deposits (Tysdal, 2000a). Total thickness about 3,100 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yu

Unit Name: Lawson Creek Formation, Swauger Formation, and (or) Lemhi Group, undivided (Mesoproterozoic)

Map Unit Description

Composite unit generally used for areas where Mesoproterozoic strata were mapped prior to the definition of current stratigraphic nomenclature, and have not been re-examined during this mapping and compilation effort

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yaq

Unit Name: Argillaceous quartzite, unnamed (Mesoproterozoic)

Map Unit Description

Predominantly dark gray (but ranging from light to dark gray), thin- and thick-bedded, fine-grained and very fine grained, feldspathic and micaceous quartzite interlayered with lesser amounts of medium-gray argillaceous siltite (Ekren, 1988; Tysdal, 2000b); crops out in and near upper Shovel Creek in southwestern part of map area. Sedimentary structures include abundant cross-beds, ripple cross-laminations, and local rip-up clasts. Unit grades downward through a conformable transition zone into the Hoodoo Quartzite (Yh), as noted by Ross (1934), Ekren (1988), Evans and Connor (1993), and Tysdal and others (2000). An intertidal depositional environment is suggested by sedimentary structures and alternating lithologies, which reflect contrasting energy conditions. Top of unit not exposed; minimum thickness 500 m.

Unit Yaq was recognized by Ross (1934) as a separate unit from the Yellowjacket Formation (Yy), which occurs below the Hoodoo, but he did not assign a stratigraphic name. Ekren (1988) also did not assign a formal name to the unit, preferring instead to use the informal "argillaceous quartzite." Evans and Connor (1993), following the lead of Evans and Ekren (1985), included both Ross' Yellowjacket below the Hoodoo Quartzite and the argillaceous quartzite above the Hoodoo in their "lower Yellowjacket." This tentative correlation implied that the Hoodoo could be a tongue of clean white quartzite interfingering with the "expanded" Yellowjacket. To further complicate the issue, Evans and Connor (1993), as well as other workers, also extended use of their "lower Yellowjacket" to include rocks to the east now interpreted to be Lemhi Group (see Yellowjacket Formation description). Subsequent work indicates that the sequence Yellowjacket Formation (as defined by Ross)-Hoodoo Quartzite-argillaceous quartzite reflects a genetically related package of shallow-water strata that occur in a thrust plate which has later been cut by high-angle faults. This package is fault-bounded and, as shown on the geologic map, is structurally isolated from Lemhi Group strata to which it has been correlated previously. Tysdal (2000b) provided a detailed account of the geology and history of correlations relevant to this stratigraphic package

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yh

Unit Name: Hoodoo Quartzite (Mesoproterozoic)

Map Unit Description

White to light-gray (locally brownish gray), medium-grained, thin- to thick-bedded quartzite composed of about 80-90 percent well-rounded quartz, 5-10 percent feldspar (orthoclase, microcline, and albite), and 5-10 percent biotite, chlorite, sericite, and iron oxide (Ekren, 1988). Unit is generally massive, making identification of bedding difficult where fracturing is well developed. Cross-lamination is locally distinct and oscillatory and current ripples are present throughout unit. Marble and calcareous quartzite is irregularly present in basal part of formation (Ekren, 1988; Evans and Connor, 1993). Total thickness estimated at about 1,100 m (Ekren, 1988). The Hoodoo Quartzite grades downward into the Yellowjacket Formation (Yy) through a thickness of about 200 m, with thin-bedded white Hoodoo strata intercalated with thin-bedded, dark-gray argillaceous metasandstone and gray, fine-grained metasandstone typical of the Yellowjacket. Transitional zone is reasonably well exposed in upper Lake Creek (about 7 km west of the townsite of Yellowjacket) and in the cirque wall about 0.7 km north of McEleny Mountain (Ekren, 1988; Evans and Connor, 1993). Upper contact is gradational into unit Yaq. The Hoodoo Quartzite is interpreted to be a shallow subtidal to intertidal deposit, winnowed under high-energy conditions as evidenced by the lack of silt and clay and the common presence of high-angle cross-laminations

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yy

Unit Name: Yellowjacket Formation (Mesoproterozoic)

Map Unit Description

Unit (as defined by Ross, 1934, and Tysdal, 2000b; see discussion below) consists of 518 m of calcareous strata, with no base exposed, overlain by 2,225 m of quartzitic clastic rocks. Calcareous beds are gray to dark green and black, containing varying amounts of carbonate and calc-silicate minerals in lenses that intertongue with quartzite. Upper greenschist metamorphism resulted in beds that are banded or mottled, depending on the presence of dark metamorphic minerals. The presence of metamorphic scapolite indicates some of the beds were formerly evaporite horizons (Tysdal and Desborough, 1997). The upper quartzitic part of the section is dark-gray, dark-bluish-gray, or locally white, generally thin bedded quartzite, with lesser intercalations of thin-bedded, dark gray siltite and argillite. Metasandstone commonly consists of about 70 percent quartz, 15 percent biotite (or chlorite altered from biotite), and 15 percent feldspar (Ekren, 1988). Common sedimentary structures include ripple cross-lamination, mud-chips, fluid-escape structures, local herringbone cross-lamination, climbing ripples, mudcracks, and millimeter-scale load casts (Ekren, 1988; Tysdal, 2000b). Some argillite layers show "pull apart" structures probably formed as clay layers dried and shrank. Locally, mud-chips are imbricated in opposite directions, indicating reversal of current directions. These features are most consistent with deposition in a tidal environment, confirming the original shallow-water interpretation of Ross (1934) and later Ekren (1988). Yellowjacket strata grade upward into the conformably overlying Hoodoo Quartzite (Yh) (Ross, 1934; Ekren, 1988; Evans and Connor, 1993).

Because this report uses a revised definition of unit Yy that differs from most recent applications [summarized to 1993 by Evans (1998)], a short summary of the nomenclatural history of this unit it required. Ross (1934) originally included gray, slightly calcareous, shallow-water deposits of metasandstone and siltite near the townsite of Yellowjacket in his description of the reference section (technically, there is no formal type section). Subsequent workers extended use of the Yellowjacket name to other gray quartzites and siltites that are widespread in the eastern Salmon River Mountains and northern Lemhi Range (Vhay, 1948; Ruppel, 1975; Bennett, 1977; Lopez, 1981; Hughes, 1983; Connor and Evans, 1986; Ekren, 1988; Evans and Connor, 1993; Evans, 1998). Recent detailed mapping and stratigraphic studies indicate that the term Yellowjacket Formation should be restricted to the genetically related shallow-water strata originally designated by Ross (1934), which are preserved in a fault-bounded structural block (Tysdal, 2000b; Tysdal and others, 2000). Similar, though not identical, conclusions have been reached by D. Winston (University of Montana) and P.K. Link (Idaho State University) in their attempt to relate the Middle Proterozoic strata of east-central Idaho to the classic Belt Supergroup (Winston and others, 1999). Other rocks to which the Yellowjacket name had been extended (see references cited above) are now correlated with formations of the Lemhi Group (Tysdal, 2000a, b).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yfm

Unit Name: Feldspathic metasandstone (Mesoproterozoic)

Map Unit Description

White to light gray, medium- to coarse-grained feldspathic metasandstone; feldspar is 15 to 45 percent of rock; quartz grains are generally subangular to subrounded. Dark-gray heavy mineral laminae are common in lower parts of beds; mud chips of siltite are present in some beds. Beds commonly range from 30-100 cm thick. and are trough cross bedded, with troughs in sets that decrease in size upward in each bed. Local 1-25 cm thick, discontinuous interbeds of medium-gray siltite. Unit present only northwest of Carmen Creek in northwestern part of Beaverhead Mountains and in the eastern part of the Clearwater Mountains, northeast of the Cabin thrust fault. Unit displays characteristics of fluvial strata in both areas (R.G. Tysdal, unpub. data). Neither the top nor bottom of the unit is exposed. Total thickness is unknown, but it is greater than 2,000 m

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ym

Unit Name: Missoula Group, undivided (Mesoproterozoic)

Map Unit Description

Light-gray, fine- to coarse-grained, arkosic metasandstone composed chiefly of quartz and feldspar (both microcline and plagioclase); matrix ranges from 1-10 percent. Dark-gray heavy minerals are abundant and are concentrated in basal laminae of beds; some heavy-mineral laminae are so concentrated as to form sags and convolute layers. Beds composed of trough cross-laminae are abundant, and commonly are overlain by beds of planar to ripple cross-laminated metasandstone. Fragments of dark-gray siltite (mud-chips) occur at the base of some beds, some forming lenses as thick as 1 m and extending along strike for several meters. Climbing ripples were observed in a few beds. Pebble conglomerate layers occur at the base of some beds, forming lenses as thick as 10 cm and extend at least 50 m along strike. Pebbles commonly are rounded and are1-4 cm in diameter. Clast compositions are mainly vein quartz, but include crystalline metamorphic rocks, granite, and metasandstone. Water-escape structures occur locally. Unit is interpreted as fluvial (Tysdal, unpub. data). Unit is present only along the northeast flank of the northwestern part of the Beaverhead Mountains. Unit is more than 5,000 m thick. Unit was assigned to the Mount Shields Formation (Ruppel and others, 1993)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yhe

Unit Name: Helena and Empire Formations, undivided (Mesoproterozoic)

Map Unit Description

Alternating sequence of quartzitic and calc-silicate strata. A basal, upward-fining, fine-grained, and laminated metasandstone grades upward into calc-silicate argillite, siltite, and quartzite. Basal quartzitic units vary in thickness from 0.1 to 2 m; capped by thin-bedded calc-silicate units 0.1-1 m thick. Calc-silicate rocks are medium to dark green and contain abundant porphyroblasts of actinolite and tremolite. Exposure of this unit is poor but the strata have been correlated to clastic and calcareous units of the Helena and Empire Formations of the Belt Supergroup as exposed in the Anaconda Range, Mont., east of the Salmon National Forest (Ruppel and others, 1993)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ysg

Unit Name: Spokane and Greyson Formations, undivided (Mesoproterozoic)

Map Unit Description

Dark-gray to dark-greenish-gray, well-laminated argillite and silty argillite in uneven beds generally less than 5 cm thick; commonly contains uneven, parallel laminations of white to tan, very fine grained quartzite and siltstone. Apparently overlying is a unit of light-gray to white, fine- to medium-grained quartzite interlayered with minor dark-gray argillite and siltite. Ruppel and others (1993) interpreted these strata as being correlative to the Spokane and Greyson Formations of the Belt Supergroup as seen in the Highland Mountains, Mont., to the east. Unit is poorly exposed at the northern end of the Salmon National Forest but appears to underlie the strata mapped as undivided Helena and Empire Formations (Yhe)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Zm

Unit Name: Mafic intrusive rock (Neoproterozoic?)

Map Unit Description

Dark gray-green to grayish blue-green rock, cleaved; metamorphosed to lower greenschist facies. Some intrusions are diabase, but others are so well cleaved that classification is uncertain. Some of the rock contains yellowish-brown carbonate clots that weather readily, leaving a vuggy surface texture. Forms sills, dikes, and in western part of Lemhi Range, a small plug-like intrusive. Thickness of tabular bodies ranges from 1 to 30 m, generally too thin and discontinuous to show on map; only a very few are shown. Present mainly in the Lemhi Range and eastern part of the Salmon River Mountains. Age is uncertain

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ymg

Unit Name: Megacrystic granite and augen gneiss (Mesoproterozoic)

Map Unit Description

Pink and light-gray, medium- to coarse-grained, porphyritic to coarsely porphyritic, slightly peraluminous granite and augen gneiss underlying large areas in the north-central part of the Salmon National Forest. Composed of 20-40 percent alkali feldspar, 15-25 percent plagioclase, 20-40 percent quartz, 20-30 percent biotite, and locally minor muscovite. Microcline phenocrysts are commonly 1-4 cm long in the strongly foliated augen gneiss but generally range from 4 to 10 cm in the less foliated granite; locally, as long as 15 cm. Phenocrysts typically are rounded oblate spheroids with rapakivi texture and internal growth rings commonly defined by small biotite inclusions. Unit occurs both as plutonic bodies and as sills ranging from 1 to 1,000 m thick. Outcrops weather to spheroidal shapes studded with gray or pink microcline phenocrysts and produce coarse grus with whole microcline phenocryts and augen typically preserved. U-Pb zircon dates yield an age of about 1,370 Ma (Evans and Zartman, 1990; Doughty and Chamberlain, 1996)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yam

Unit Name: Amphibolite and magnetite-hornblende gneiss (Mesoproterozoic)

Map Unit Description

Dark-gray to black, fine- to medium-grained amphibolite and magnetite-hornblende gneiss in north-central part of the Salmon National Forest and extending to the north into Montana (Berg, 1977). Composed of 40-70 percent hornblende, 20-50 percent plagioclase, 5-40 percent biotite, and less than 5 percent quartz (Schmidt and others, 1994). Typically, amphibolite occurs as 1- to 15-m-thick sills with foliation defined by hornblende and biotite; magnetite-hornblende gneiss probably was comagmatic with the amphibolite. Magnetite-hornblende gneiss contains 55-70 percent feldspar, 20-30 percent quartz, 10-20 percent hornblende, and 3-5 percent magnetite (Schmidt and others, 1994). Outcrops of unit Yam are uncommon and weathering produces a dark micaceous soil. Field relations between unit Yam and the megacrystic granite (Ymg) indicate mingling of the two magmas; U-Pb isotopic dating of both units confirms a comagmatic relationship at about 1,370 Ma (Berg, 1977; Evans and Zartman, 1990; Doughty and Chamberlain, 1996)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ybgn

Unit Name: Biotite gneiss (Mesoproterozoic)

Map Unit Description

Medium- to dark-gray, fine- to medium-grained, thinly layered biotite gneiss well exposed in the lower Middle Fork Salmon River and along the main Salmon River west of Shoup (Maley, 1974). Composed of 50-90 percent subrounded to subangular quartz, 5-50 percent biotite, and 0-20 percent feldspar (Schmidt and others, 1994; Lund, Evans, and Esparza, 1983). Biotite-rich and quartz-rich layers alternate and range from 0.5 to 10 cm thick. Metamorphism reached garnet and sillimanite grade with migmatization common along the Middle Fork Salmon River. Locally, gneiss interfingers with unit Yq and is cut by sills of units Ymg and Yam. Some biotite-rich layers contain greater than 50 percent biotite and are similar to biotitites associated with the cobalt-deposit at Blackbird mine (Evans, 1998), suggesting at least part of unit Ybgn is equivalent to identifiable lower-grade strata

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yq

Unit Name: Quartzite (Mesoproterozoic)

Map Unit Description

Light-gray to white, fine- to medium-grained quartzite present in both walls of the Salmon River canyon west of Shoup and northeast of Papoose Creek. Compositionally 80-100 percent subrounded quartz, 0-5 percent biotite, and 0-10 percent feldspar, with local concentrations (=5 percent) of muscovite (Schmidt and others, 1994). Bedding commonly massive except where biotite-rich laminae define thin layers. Rare tourmaline breccias are present as 0.5- to 3-m-thick concordant lenses with angular quartzite clasts surrounded by a matrix of tourmaline. Units Ymg and Yam intrude the quartzite, as do deformed and undeformed pegmatite and aplite. Unit interfingers with unit Ybgn at both outcrop and map scale.

The stratigraphic relationship of units Yq and Ybgn is similar to that of the much less metamorphosed Hoodoo Quartzite and Yellowjacket Formation at their reference section near Yellowjacket (Ross, 1934; Tysdal and others, 2000). In addition, local tourmaline breccias are present in the Hoodoo Quartzite (Evans and Connor, 1993), possibly strengthening the argument for such a correlation. However, if biotitite layers are present in unit Ybgn, this suggests correlation with rocks at Blackbird mine (formerly considered Yellowjacket Formation, but now correlated with the Apple Creek Formation (compare, Evans, 1998; Tysdal, 2000b)). In such a case, unit Yq may correlate with part of the Gunsight Formation (Yg)

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ycsq

Unit Name: Calc-silicate quartzite (Mesoproterozoic)

Map Unit Description

Medium-gray to green, medium-grained sphene-hornblende(?)-biotite-diopside quartzite in a limited area in the northwest Salmon National Forest. Centimeter-scale compositional layering is well developed and accentuated by differential erosion (Schmidt and others, 1994). Dikes and sills of intrusive rocks have obscured the contact relationships with unit Ybgn. Possible correlatives may be calcareous strata of the Yellowjacket Formation or Lemhi Group.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Xg

Unit Name: Basement gneiss (Paleoproterozoic)

Map Unit Description

Predominantly light-gray to red-brown, coarse-grained granite gneiss locally present near Deadman Pass in the Beaverhead Mountains, but widely exposed in Montana immediately east of the Salmon National Forest in the Maiden Peak spur area northeast of Leadore (M'Gonigle, 1994). Average composition is 38 percent microcline, 25 percent quartz, 12 percent orthoclase, 11 percent plagioclase, 12 percent hornblende and (or) biotite, and 2 percent apatite, zircon, ilmenite, and leucoxene. Preliminary U-Pb zircon data suggested an Archean age (reported in M'Gonigle, 1994), but recent work suggests a Paleoproterozoic age of about 2,450 Ma (Kellogg and others, 1999).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ys?

Unit Name: Swauger Formation (uncertain)

Map Unit Description

Light-gray, pale-green, and pale-red-purple, medium- to coarse-grained quartzite. Unit is widespread in the Lemhi Range and present in the Beaverhead Mountains near Leadore and in the Salmon River Mountains west of Salmon. Quartz content typically ranges from 90 to 95 percent; well-rounded, well-sorted, tightly cemented, and glassy grains. Feldspar content seldom exceeds 5-10 percent. A speckled appearance is quite common and results from 0.5 to 3-mm-diameter (usually reddish) spots of hematite, local limonite, and rare chlorite commonly concentrated along cross-laminae. Beds are 0.5-2 m thick and commonly show trough cross-laminations and lesser herringbone cross-laminae. Two-dimensional ripples and dunes are quite well developed in places; dunes have wavelengths of 4-8 m and heights of 0.7-1 m and ripples have wavelengths of 2-15 cm and heights of 0.3-3 cm. Tysdal (2000a) interpreted the bulk of the Swauger to have been deposited in a tidal environment, based on the compositional maturity of the quartzites, presence of herringbone cross-beds, subordinate current cap deposits (de Mowbray and Visser, 1984) on some dunes, rare antidunes, and local flaser and lenticular bedding. The Swauger grades upward into the Lawson Creek Formation. Total thickness about 3,100 m.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yg?

Unit Name: Gunsight Formation (uncertain)

Map Unit Description

The Gunsight Formation was defined by Ruppel (1975) for rocks at Gunsight Peak in the Lemhi Range west-southwest of Leadore, Idaho. McBean (1983) further studied the type section and much of the following description for the Gunsight south of the Lem Peak fault is taken from his work. North of the Lem Peak fault and in the Beaverhead, Salmon River, and Clearwater Mountains, strata previously mapped as the upper unit of the Yellowjacket Formation (unit Yyu of Evans, 1998) are now correlated with the Gunsight (Tysdal, 2000b). Accordingly, the Gunsight is separately described as follows: south of Lem Peak fault (that is, type section), north of Lem Peak fault (that is, mostly former unit Yyu), and in the Beaverhead and Clearwater Mountains.

South of Lem Peak fault-Pale-brown to gray, very fine grained to medium-grained metasandstone typifies most of the type section. Quartz and feldspar are the dominant components, with feldspar content ranging from 25 to 50 percent; matrix content is 0-8 percent. Sedimentary structures include trough and planar cross-beds; parallel ripple and climbing ripple cross-laminations; ripple and climbing ripple laminations; straight-crested, asymmetrical and oscillation ripples; and dewatering structures. In the uppermost 100+ m, where the unit is transitional into the compositionally mature Swauger Formation (Ys), quartz content increases to 80-90 percent. Lower 450 m of unit consist of interbedded siltite, argillite, and very fine grained metasandstone transitional into the underlying siltite of the Apple Creek Formation. Matrix content in this lower part can reach 40 percent. Total thickness is 1,700+ m. McBean (1983) interpreted the formation to have been deposited in a shallow marine setting, but Tysdal (2000a) considered most of the unit to be fluvial. Trough crossbedded metasandstone (as thick as 1-2 m) that fines upward into siltite is indicative of channel and overbank deposits and strongly supports Tysdal's reevaluation. Upper part of formation may be shoreface deposits transitional into marine deposits of the Swauger (Tysdal, 2000a). Lower part of formation, with its intercalated siltite and argillite, probably formed in an intertidal to subtidal environment transitional into the turbidites of the Apple Creek Formation.

North of Lem Peak fault-Light- to dark-gray, very fine grained to medium-grained, feldspathic metasandstone (arkose) typifies this unit in the northern Lemhi Range and Salmon River Mountains. Bed thickness ranges from 10 to 100 cm. Decimeter-thick trough and planar cross-beds are typical; hummocky cross-stratification is present locally in the Salmon River Mountains. Conglomeratic beds exist locally, containing clasts that are angular and rounded. Deposition was probably in fluvial to shallow marine environments, with features such as the local conglomerates probably representing slumping of partially lithified channel margins into tidal(?) channels. Total thickness probably exceeds 4,000 m. In the Salmon River Mountains the unit is transitional downward into the banded siltite unit of the Apple Creek Formation (Yab), and upward into the Swauger Formation (Ys).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ya?

Unit Name: Apple Creek Formation, undivided (uncertain)

Map Unit Description

The Apple Creek Phyllite was defined by Anderson (1961) for foliated rocks near Hayden Creek in the central Lemhi Range. Ruppel (1975) redefined the unit as the Apple Creek Formation and Tietbohl (1981, 1986) studied a diamictite unit within the formation. Tysdal (1996a, b, c, 2000a, b; Tysdal and Moye, 1996) slightly redefined and subdivided the formation into mappable informal subunits, described below. On our geologic map, Tysdal's subunits are used where recent mapping is available; where it is not available or distinctions could not be made in the field, the undivided designation (Ya) is used.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yab?

Unit Name: banded siltite unit of Apple Creek Formation (uncertain)

Map Unit Description

Centimeter-scale layers of light-gray siltite to very fine grained metasandstone alternating with black siltite or argillite characterize the easily identified banded member. The thickness of layers and the percentage of metasandstone versus siltite/argillite vary considerably. Layers range from 0.5 to 10 cm thick and percentages of metasandstone to siltite/argillite range from equal to 95 percent dominance by either component. These couples and couplets of the unit are interpreted to be turbidites (Sobel, 1982; Tysdal, in press). In addition to the visually striking light and dark layering, argillite beds in virtually any outcrop exhibit predominantly (but not exclusively) downward-penetrating dikelets of coarser sediment from the overlying layer. Commonly the dikelets are 'ptygmatically' folded due to compaction of the originally very water laden argillaceous layers. Unit is widespread in the Salmon River Mountains northeast of the Iron Lake fault, and reaches a thickness of at least 2,000 m. Unit apparently thins to the southeast due to erosion so that only a thin sliver is preserved in the footwall of the Poison Creek thrust in the Lemhi Range. Unit is the primary host for the stratabound Blackbird Co-Cu-Au deposit. Base of unit is gradational downward into the coarse siltite unit (Yac), and top grades upward through a relatively abrupt transition into the overlying Gunsight Formation (Yg). As previously noted, in the Lemhi Range unit Yab thins below the Gunsight due to erosion.

Unit was called the "middle subunit of the Yellowjacket Formation" by Connor and Evans (1986), but because the unit lies conformably above the coarse siltite unit of the Apple Creek Formation, Tysdal (in press) assigned it to the Apple Creek Formation. The "banded siltite" name resurrects an informal name that was used originally by Connor and Evans (1986).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yh?

Unit Name: Hoodoo Quartzite (uncertain)

Map Unit Description

White to light-gray (locally brownish gray), medium-grained, thin- to thick-bedded quartzite composed of about 80-90 percent well-rounded quartz, 5-10 percent feldspar (orthoclase, microcline, and albite), and 5-10 percent biotite, chlorite, sericite, and iron oxide (Ekren, 1988). Unit is generally massive, making identification of bedding difficult where fracturing is well developed. Cross-lamination is locally distinct and oscillatory and current ripples are present throughout unit. Marble and calcareous quartzite is irregularly present in basal part of formation (Ekren, 1988; Evans and Connor, 1993). Total thickness estimated at about 1,100 m (Ekren, 1988). The Hoodoo Quartzite grades downward into the Yellowjacket Formation (Yy) through a thickness of about 200 m, with thin-bedded white Hoodoo strata intercalated with thin-bedded, dark-gray argillaceous metasandstone and gray, fine-grained metasandstone typical of the Yellowjacket. Transitional zone is reasonably well exposed in upper Lake Creek (about 7 km west of the townsite of Yellowjacket) and in the cirque wall about 0.7 km north of McEleny Mountain (Ekren, 1988; Evans and Connor, 1993). Upper contact is gradational into unit Yaq. The Hoodoo Quartzite is interpreted to be a shallow subtidal to intertidal deposit, winnowed under high-energy conditions as evidenced by the lack of silt and clay and the common presence of high-angle cross-laminations.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yy?

Unit Name: Yellowjacket Formation (uncertain)

Map Unit Description

Unit (as defined by Ross, 1934, and Tysdal, 2000b; see discussion below) consists of 518 m of calcareous strata, with no base exposed, overlain by 2,225 m of quartzitic clastic rocks. Calcareous beds are gray to dark green and black, containing varying amounts of carbonate and calc-silicate minerals in lenses that intertongue with quartzite. Upper greenschist metamorphism resulted in beds that are banded or mottled, depending on the presence of dark metamorphic minerals. The presence of metamorphic scapolite indicates some of the beds were formerly evaporite horizons (Tysdal and Desborough, 1997). The upper quartzitic part of the section is dark-gray, dark-bluish-gray, or locally white, generally thin bedded quartzite, with lesser intercalations of thin-bedded, dark gray siltite and argillite. Metasandstone commonly consists of about 70 percent quartz, 15 percent biotite (or chlorite altered from biotite), and 15 percent feldspar (Ekren, 1988). Common sedimentary structures include ripple cross-lamination, mud-chips, fluid-escape structures, local herringbone cross-lamination, climbing ripples, mudcracks, and millimeter-scale load casts (Ekren, 1988; Tysdal, 2000b). Some argillite layers show "pull apart" structures probably formed as clay layers dried and shrank. Locally, mud-chips are imbricated in opposite directions, indicating reversal of current directions. These features are most consistent with deposition in a tidal environment, confirming the original shallow-water interpretation of Ross (1934) and later Ekren (1988). Yellowjacket strata grade upward into the conformably overlying Hoodoo Quartzite (Yh) (Ross, 1934; Ekren, 1988; Evans and Connor, 1993).

Because this report uses a revised definition of unit Yy that differs from most recent applications [summarized to 1993 by Evans (1998)], a short summary of the nomenclatural history of this unit it required. Ross (1934) originally included gray, slightly calcareous, shallow-water deposits of metasandstone and siltite near the townsite of Yellowjacket in his description of the reference section (technically, there is no formal type section). Subsequent workers extended use of the Yellowjacket name to other gray quartzites and siltites that are widespread in the eastern Salmon River Mountains and northern Lemhi Range (Vhay, 1948; Ruppel, 1975; Bennett, 1977; Lopez, 1981; Hughes, 1983; Connor and Evans, 1986; Ekren, 1988; Evans and Connor, 1993; Evans, 1998). Recent detailed mapping and stratigraphic studies indicate that the term Yellowjacket Formation should be restricted to the genetically related shallow-water strata originally designated by Ross (1934), which are preserved in a fault-bounded structural block (Tysdal, 2000b; Tysdal and others, 2000). Similar, though not identical, conclusions have been reached by D. Winston (University of Montana) and P.K. Link (Idaho State University) in their attempt to relate the Middle Proterozoic strata of east-central Idaho to the classic Belt Supergroup (Winston and others, 1999). Other rocks to which the Yellowjacket name had been extended (see references cited above) are now correlated with formations of the Lemhi Group (Tysdal, 2000a, b).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yhe?

Unit Name: Helena and Empire Formations, undivided (uncertain)

Map Unit Description

Alternating sequence of quartzitic and calc-silicate strata. A basal, upward-fining, fine-grained, and laminated metasandstone grades upward into calc-silicate argillite, siltite, and quartzite. Basal quartzitic units vary in thickness from 0.1 to 2 m; capped by thin-bedded calc-silicate units 0.1-1 m thick. Calc-silicate rocks are medium to dark green and contain abundant porphyroblasts of actinolite and tremolite. Exposure of this unit is poor but the strata have been correlated to clastic and calcareous units of the Helena and Empire Formations of the Belt Supergroup as exposed in the Anaconda Range, Mont., east of the Salmon National Forest (Ruppel and others, 1993).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: d

Unit Name: Dikes of unknown age or chemistry

Map Unit Description

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Ya

Unit Name: Apple Creek Formation, undivided, brittlely deformed and silicified breccia and cataclasite

Map Unit Description

Description from Apple Creek Formation (coa_id 4748). The rocks in this unit have been tectonically altered and silicified.

The Apple Creek Phyllite was defined by Anderson (1961) for foliated rocks near Hayden Creek in the central Lemhi Range. Ruppel (1975) redefined the unit as the Apple Creek Formation and Tietbohl (1981, 1986) studied a diamictite unit within the formation. Tysdal (1996a, b, c, 2000a, b; Tysdal and Moye, 1996) slightly redefined and subdivided the formation into mappable informal subunits, described below. On our geologic map, Tysdal's subunits are used where recent mapping is available; where it is not available or distinctions could not be made in the field, the undivided designation (Ya) is used.

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): SalmonNF_E_rect, SalmonNF_W_rect

Map Title

Geologic map of the Salmon National Forest and vicinity, east-central Idaho

Map name: Salmon National Forest

Map Unit Symbol: Yg

Unit Name: Gunsight Formation, undivided, brittlely deformed and silicified breccia and cataclasite

Map Unit Description

Description from Gunsight Formation (coa_id 4747). The rocks in this unit have been tectonically altered and silicified.

The Gunsight Formation was defined by Ruppel (1975) for rocks at Gunsight Peak in the Lemhi Range west-southwest of Leadore, Idaho. McBean (1983) further studied the type section and much of the following description for the Gunsight south of the Lem Peak fault is taken from his work. North of the Lem Peak fault and in the Beaverhead, Salmon River, and Clearwater Mountains, strata previously mapped as the upper unit of the Yellowjacket Formation (unit Yyu of Evans, 1998) are now correlated with the Gunsight (Tysdal, 2000b). Accordingly, the Gunsight is separately described as follows: south of Lem Peak fault (that is, type section), north of Lem Peak fault (that is, mostly former unit Yyu), and in the Beaverhead and Clearwater Mountains.

South of Lem Peak fault-Pale-brown to gray, very fine grained to medium-grained metasandstone typifies most of the type section. Quartz and feldspar are the dominant components, with feldspar content ranging from 25 to 50 percent; matrix content is 0-8 percent. Sedimentary structures include trough and planar cross-beds; parallel ripple and climbing ripple cross-laminations; ripple and climbing ripple laminations; straight-crested, asymmetrical and oscillation ripples; and dewatering structures. In the uppermost 100+ m, where the unit is transitional into the compositionally mature Swauger Formation (Ys), quartz content increases to 80-90 percent. Lower 450 m of unit consist of interbedded siltite, argillite, and very fine grained metasandstone transitional into the underlying siltite of the Apple Creek Formation. Matrix content in this lower part can reach 40 percent. Total thickness is 1,700+ m. McBean (1983) interpreted the formation to have been deposited in a shallow marine setting, but Tysdal (2000a) considered most of the unit to be fluvial. Trough crossbedded metasandstone (as thick as 1-2 m) that fines upward into siltite is indicative of channel and overbank deposits and strongly supports Tysdal's reevaluation. Upper part of formation may be shoreface deposits transitional into marine deposits of the Swauger (Tysdal, 2000a). Lower part of formation, with its intercalated siltite and argillite, probably formed in an intertidal to subtidal environment transitional into the turbidites of the Apple Creek Formation.

North of Lem Peak fault-Light- to dark-gray, very fine grained to medium-grained, feldspathic metasandstone (arkose) typifies this unit in the northern Lemhi Range and Salmon River Mountains. Bed thickness ranges from 10 to 100 cm. Decimeter-thick trough and planar cross-beds are typical; hummocky cross-stratification is present locally in the Salmon River Mountains. Conglomeratic beds exist locally, containing clasts that are angular and rounded. Deposition was probably in fluvial to shallow marine environments, with features such as the local conglomerates probably representing slumping of partially lithified channel margins into tidal(?) channels. Total thickness probably exceeds 4,000 m. In the Salmon River Mountains the unit is transitional downward into the banded siltite unit of the Apple Creek Formation (Yab), and upward into the Swauger Formation (Ys).

Map Citation

Evans, K.V., and Green, G.N., 2003, Geologic map of the Salmon National Forest and vicinity, east-central Idaho: U.S. Geological Survey Geologic Investigations Map I-2765, 20 p., 2 sheets, scale 1:100000, http://pubs.usgs.gov/imap/i-2765/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Qag

Unit Name: Glacial and alluvial deposits (Quaternary)

Map Unit Description

Till from continental glaciation, glacial flood deposits, and all alluvial material in modern drainages. Also includes some lacustrine deposits in Colville and Pend Oreille River valleys

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Qls

Unit Name: Landslide deposits (Quaternary)

Map Unit Description

Unconsolidated rubble resulting from slides and land slips. Found mainly around cliffs formed in the Columbia River Basalt Group in the southwestern part of the quadrangle. Identified chiefly by geomorphic forms observed on aerial photographs

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ql

Unit Name: Glacial-lacustrine deposits (Quaternary)

Map Unit Description

Silt, sand, gravel, and probably clay; deposited in glacial and possibly post-glacial lakes occupying Kootenay River valley. Most of unit is poorly indurated, finely to massively bedded, fine-grained silt. Locally, unit contains gravel, sand, and boulders, some presumably ice-rafted

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: QTs

Unit Name: Consolidated alluvial and (or) glacial deposits (Quaternary and (or) Tertiary)

Map Unit Description

Conglomerate, sedimentary breccia, minor arkosic and lithic sandstone, iron oxide-cemented sandstone and conglomerate, and mudstone; poorly indurated. Restricted to southwestern 15-minute block of quadrangle

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tcr

Unit Name: Columbia River Basalt Group (Miocene)

Map Unit Description

Fine-grained tholeiitic basalt flows. Considered to be N2 flows of Grande Ronde Basalt in Colville River drainage, and Priest Rapids Member of Wanapum Basalt elsewhere (Swanson and others, 1979). Maximum thickness estimated to be about 180 m; thins northward

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tcg

Unit Name: Conglomerate (Eocene)

Map Unit Description

Unit consists of Tiger Formation (Park and Cannon, 1943) in Pend Oreille River valley west of Newport, Sandpoint Conglomerate (originally considered to be Cretaceous in age by Harrison and Schmidt, 1971, and Harrison and others, 1972) north of Sandpoint, and unnamed conglomerate (Miller and Clark, 1975) north of Chewelah. Poorly to moderately-well indurated conglomerate, lithic arkose, and siltstone. Composition and sedimentary characteristics highly variable laterally and vertically. Unconformably overlies a variety of rock units. Tiger Formation considered to be syntectonic basin-fill deposits related to Eocene extensional tectonics (Gager, 1984; Harms and Price, 1992); Sandpoint Conglomerate and unnamed conglomerate probably of similar origin

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tcb

Unit Name: Chlorite breccia and cataclastic rocks associated with Newport Fault zone (Eocene)

Map Unit Description

Green to gray brittlely comminuted cataclastic rocks and highly fractured and chloritized rocks formed in footwall of Newport Fault zone. Breccia in upper part of zone is nearly aphanitic; grades downward through decreasing brecciation into unbrecciated, but commonly mylonitized rocks of footwall. Thickness ranges from a few meters along northern parts of both limbs of U-shaped trace to 150 to 250 m along southernmost part

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tcc

Unit Name: Tectonic breccia of Cusick Creek (Eocene)

Map Unit Description

Breccia and gouge derived from bounding rock units; materials range in size from powder to house-size blocks. Exposed only on west side of mountain between Jared and Ruby (fig. 2), but may typify unexposed hanging wall rocks immediately adjacent to Newport Fault along much of its trace

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ts

Unit Name: Sanpoil Volcanics (Eocene)

Map Unit Description

Volcanic flow rocks, breccia, conglomerate, and lithic arkose. All volcanic rocks fall within compositional range from dacite to andesite; average composition is dacite (Joseph, 1990; Waggoner, 1990). Includes rocks comprising Pend Oreille Andesite of Schroeder (1952), unnamed volcanic flows and sedimentary rocks south of Waitts Lake, flow or intrusive andesite northeast of Waitts Lake, isolated outcrops of flow rocks and sedimentary rocks east of Dunn Mountain, and flows and sedimentary rocks west and north of Colville (Pearson and Obradovich, 1977). Unconformably overlies a variety of rock units.

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tot

Unit Name: Olivine trachybasalt (Eocene)

Map Unit Description

Unit of Dings and Whitebread (1965). Olivine, clinopyroxene, and plagioclase in matrix of glass, palagonite, and orthoclase. Dark-gray to black, very fine-grained. Restricted to small area 7 km north of Metaline Falls. Considered to be part of Sanpoil Volcanics on basis of mineralogy and composition by Joseph (1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: To

Unit Name: O’Brien Creek Formation (Eocene)

Map Unit Description

Conglomerate and minor well-bedded tuff. Distinguished from other Eocene conglomerate units by absence of volcanic clasts. Tuff restricted to upper part of formation; both conglomerate and tuff vary greatly in thickness. Biotite from tuff gives potassium-argon age of 53 Ma (Pearson and Obradovich, 1977). Forms discontinuous exposures northwest of Colville and in northwestern part of quadrangle

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Thd

Unit Name: Hypabyssal dikes (Eocene)

Map Unit Description

Mafic dikes of widely varied mineralogic composition and moderately varied chemical and modal composition. Fine-grained, light- to dark-gray; contain phenocrysts of one or more of following: clinopyroxene, hornblende, biotite, plagioclase, potassium feldspar, quartz, and rarely orthopyroxene and olivine. Found throughout quadrangle, but rare to absent within inner parts of Priest River Complex; most too small to show on map. Hornblende and biotite give potassium-argon ages ranging from 48 Ma (Miller, 1974c) to 53 Ma (Yates and Engels, 1968) (both ages recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tsp

Unit Name: Silver Point Quartz Monzonite (Eocene)

Map Unit Description

Hornblende-biotite monzogranite, granodiorite, quartz monzonite, and quartz monzodiorite; porphyritic with groundmass having distinctive bi-modal grain size. Occurs as two non-contiguous plutons. Extremely homogeneous with respect to composition and texture, except for foliate, mafic zone along north side of largest pluton near Davis Lake. Zircon gives slightly discordant uranium-lead age of 52 Ma (Whitehouse and others, 1992); biotite and hornblende give potassium-argon ages of 49 and 48 Ma, respectively, on one sample, and 52 and 48 Ma, respectively, on another (Miller, 1974c, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tam

Unit Name: Quartz monzodiorite of Ahern Meadows (Eocene)

Map Unit Description

Hornblende-biotite quartz monzodiorite to quartz monzonite; on basis of spatial association and mineralogic similarities, probably genetically related to Silver Point Quartz Monzonite (Tsp). Forms single pluton 8 km west of Loon Lake. Distinguished from other plutons by some hornblende having pyroxene cores, average color index of 28, and extremely abundant sphene. Biotite gives potassium-argon age of 50 Ma (Engels, in Miller and Clark, 1975)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tll

Unit Name: Quartz monzonite of Loon Lake (Eocene)

Map Unit Description

Hornblende-biotite quartz monzonite; on basis of spatial association and mineralogic similarities, probably genetically related to Silver Point Quartz Monzonite and quartz monzonite of Ahern Meadows. Forms single pluton northwest of Loon Lake. Distinguished from other plutons by nearly all hornblende having pyroxene cores. Fine-grained, with average color index of 18. Biotite gives potassium-argon age of 51 Ma (Engels, in Miller and Clark, 1975)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tw

Unit Name: Granodiorite of Wrenco (Eocene)

Map Unit Description

Medium- to coarse-grained, highly porphyritic hornblende-biotite granodiorite; hornblende distinctly subordinate to biotite. Sphene and xenoliths abundant. Typically has 1- to 8-cm-long orthoclase phenocrysts. Homogeneous composition in southern half of unit except for felsic phase near margin; heterogeneous mixture of magmatically mixed mafic and felsic rocks in northern part. Texture variable; much of pluton has variably developed foliation, and rocks along northwestern margin have fine-grained matrix. Color index averages about 16. Zircon gives uranium-lead age of 51 Ma (Whitehouse and others, 1992); biotite gives potassium-argon age of 46 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ttp

Unit Name: Quartz monzonite of Trapper Peak (Eocene)

Map Unit Description

Quartz monzonite to monzonite. Chilled, fine-grained margin contains olivine, hypersthene, clinopyroxene, hornblende, and biotite phenocrysts; interior is medium-grained and contains clinopyroxene, hornblende, and biotite, but only sparse hypersthene and no olivine. Age assignment based on mineralogical similarities to other Eocene intrusive rocks, as well as absence of fabric found in surrounding Priest River Complex. Forms single pluton 18 km north of Priest Lake

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Tcs

Unit Name: Coryell plutonic rocks and Sheppard Granite, undivided (Eocene)

Map Unit Description

Fine- to coarse-grained alkalic plutonic rocks that include locally porphyritic syenite, granite, monzonite, monzodiorite, and shonkinite. Form numerous, noncontiguous bodies on both sides of Columbia River in northwest part of quadrangle. Underlies much larger area in Canada. Color index widely variable from 1 to 15. Most of Coryell plutonic rocks fall in compositional range between syenite and monzonite. Sheppard Granite is leucocratic, equigranular granite and syenite containing abundant myrmekite; almost everywhere altered. Sheppard considered by Little (1982) to be a part of Coryell plutonic rocks. Zircon uranium-lead age of Coryell plutonic rocks is 51 Ma (Carr and Parkinson, 1989). Biotite potassium-argon age is 52 Ma (Yates and Engels, 1968, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksm

Unit Name: Sophie Mountain Formation (Cretaceous)

Map Unit Description

Conglomerate with minor sandstone. Clasts from 2 cm to 1 m across include quartzite, greenstone, and fine-grained granitic rock. Thickness unknown, but at least 100 m (Little, 1982). Unconformably overlies rocks of the Rossland Group. Restricted to northwest side of Columbia River in Sandpoint quadrangle. Cretaceous age assignment inferred on basis of platanoid leaves (Little, 1960)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kmm

Unit Name: Monzogranite of Midnight mine (Cretaceous)

Map Unit Description

Medium- and coarse-grained, leucocratic, quartz-rich, muscovite-biotite monzogranite. Forms large body in southwestern part of quadrangle. Color index averages about 5; muscovite:biotite ratio averages about 1:2. Texture is seriate to hypidiomorphic-granular; much of pluton contains sparse, centimeter-long, microcline phenocrysts. Ludwig and others (1981) reported very slightly discordant U-Pb age of 75 Ma on zircon from lithologically similar pluton at Midnight mine 10 km to southwest

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbgm

Unit Name: Muscovite monzogranite of Blue Grouse Mountain (Cretaceous)

Map Unit Description

Medium- and coarse-grained, locally garnet-bearing muscovite monzogranite. Highly evolved petrologically; contains no mafic minerals, plagioclase composition is an3. Forms four small, noncontiguous, east-west-aligned plutons east of Deer Lake. Nonporphyritic, hypidiomorphic-granular. Largest pluton partly surrounded by well-developed greisen zone and associated huebnerite-bearing quartz veins. Muscovite gives potassium-argon age of 80 Ma (Engels, in Miller and Clark, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Klr

Unit Name: Monzogranite of Little Roundtop (Cretaceous)

Map Unit Description

Biotite monzogranite; characterized by very coarse grain size. Average color index of 7. Relatively uniform with respect to composition. Subtlety porphyritic, because 2- to 3-cm-long phenocrysts are only slightly larger than other minerals in rock. Texture variable, caused by ubiquitous, localized concentrations of potassium feldspar phenocrysts. Forms two large plutons east and west of Deer Lake in southwestern part of quadrangle. Rocks indistinguishable from very coarse-grained monzogranite 8 km southwest of quadrangle that gives slightly discordant 206Pb/238U age of 91 Ma on zircon (Ludwig and others, 1981)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kg

Unit Name: Monzogranite of Granite Pass (Cretaceous)

Map Unit Description

Medium- to coarse-grained leucocratic muscovite monzogranite. Averages 6 percent muscovite. Forms single pluton 3 km west of Upper Priest Lake. Locally garnet-bearing; contains minor biotite at a few places near margins. Color index 0 to 3. Texture ranges from seriate too hypidiomorphic-granular; locally has fine-grained, chilled border. Muscovite gives potassium-argon age of 98 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Km

Unit Name: Monzogranite of Middle Creek (Cretaceous)

Map Unit Description

Leucocratic biotite monzogranite; some parts muscovite-bearing. Forms several tabular bodies 6 km east of Ruby in central part of quadrangle. Characterized by extreme textural variation ranging from fine-grained to pegmatitic. Color index averages 5. Deeply weathered, poorly exposed; could actually be series of dikes related to monzogranite of Gleason Mountain (Kgm) or Galena Point Granodiorite (Kgp) rather than coherent pluton. Age considered Cretaceous based on compositional similarity to nearby leucocratic granitic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kli

Unit Name: Leucocratic intrusive rocks (Cretaceous)

Map Unit Description

Medium- to fine-grained monzogranite in small bodies and isolated discontinuous dikes and sills. Mapped 8 km southwest of Colville, but most too small to show on map. Probably includes leucocratic dike rocks associated with numerous Cretaceous plutons. Texture, grain size, and composition variable; most rocks contain muscovite, some are garnet-bearing, none have more than three percent biotite. Considered Cretaceous in age based on spatial association with, and mineralogical similarity to, dated Cretaceous rocks in map region

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kdc

Unit Name: Granodiorite of Dubius Creek (Cretaceous)

Map Unit Description

Medium- to coarse-grained muscovite-biotite monzogranite and granodiorite; more mafic in sparsely exposed eastern part of unit. Forms large two-lobed body 3 km south of Priest Lake (fig. 2). Average color index 10. As mapped, unit could include more than one pluton. Mafic-rich eastern part of northern lobe and muscovite deficient southern lobe could be discrete plutons. Most of unit is even-grained, but locally contains 2- to 4-cm-long microcline phenocrysts. Muscovite and biotite give potassium-argon ages of 102 Ma and 95 Ma respectively, (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kb

Unit Name: Blickensderfer Quartz Monzonite (Cretaceous)

Map Unit Description

Very coarse-grained muscovite-biotite monzogranite and granodiorite; locally porphyritic. Forms single pluton 24 km northwest of Newport. Average color index of 5. Muscovite:biotite ratio noticeably higher than most two-mica rocks in region. Hypidiomorphic-granular; where porphyritic, 2- to 3-cm-long phenocrysts are microcline. Very uniform texture and composition, except along fine-grained southern border. Muscovite and biotite give potassium-argon ages of 102 Ma and 100 Ma, respectively (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kmo

Unit Name: Granodiorite of Molybdenite Mountain (Cretaceous)

Map Unit Description

Muscovite-biotite granodiorite. Forms single pluton 5 km east of Ione, in central part of quadrangle. Coarse-grained but locally variable grain size. Some muscovite to 1 cm across. Average color index of 7. Hypidiomorphic-granular, nonporphyritic. Lithologically resembles, and may be genetically related to, Blickensderfer Quartz Monzonite. Muscovite and biotite both give potassium-argon ages of 103 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ktmc

Unit Name: Two-mica monzogranite of Twentymile Creek (Cretaceous)

Map Unit Description

Medium-grained, seriate, two-mica monzogranite and granodiorite. Forms a single pluton 25 km north of Lake Pend Oreille. Rocks in much of pluton characterized by 5- to 8-mm-wide muscovite grains, distinctly larger than other minerals. Color index about 10. Appears to have distinctly chilled margin against granodiorite of Kelly Pass (Kkp). Age considered Cretaceous based on textural and compositional similarities to nearby Cretaceous two-mica rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Knb

Unit Name: Two-mica monzogranite of North Basin (Cretaceous)

Map Unit Description

Medium- to coarse-grained, seriate, non-porphyritic muscovite-biotite monzogranite or granodiorite. Forms sparse, deeply weathered exposures 8 km southwest of Colville; most of pluton lies west of quadrangle. Color index averages about 12. Assigned Cretaceous age based on textural and compositional similarities to nearby Cretaceous two-mica plutons

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbm

Unit Name: Monzogranite of Big Meadows (Cretaceous)

Map Unit Description

Muscovite-biotite monzogranite and granodiorite. Forms small body 6 km southwest of Priest Lake. Medium-grained; contains sparse, irregularly distributed, potassium feldspar phenocrysts. Internally heterogeneous with respect to texture and composition. Average color index of 7, but ranges from at least 5 to 15. Irregularly foliate. Age considered Cretaceous based on textural and compositional similarities to nearby Cretaceous plutonic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbf

Unit Name: Granodiorite of Bonners Ferry (Cretaceous)

Map Unit Description

Medium- to coarse-grained muscovite-biotite granodiorite. Color index averages 13, higher than many muscovite-bearing plutons. Characterized by abundant epidote; possibly primary. Has subtle foliation in places. Small, but wide-spread exposures suggest pluton underlies much of valley southwest of Bonners Ferry, extending nearly to Moravia. Cretaceous age based on textural and compositional similarities to nearby Cretaceous two-mica plutons

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ktc

Unit Name: Monzogranite of Tango Creek (Cretaceous)

Map Unit Description

Very porphyritic, medium- to coarse-grained biotite monzogranite with ubiquitous trace amounts of muscovite. Forms a single pluton at the north end of Priest Lake. Texture and phenocryst concentration variable; pluton may be texturally zoned. Distinguished by pink potassium feldspar phenocrysts up to 10 cm long. Contains trace amounts of sphene. Biotite gives potassium-argon age of 90 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977), which is considered minimum age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kh

Unit Name: Monzogranite of Hungry Mountain (Cretaceous)

Map Unit Description

Medium- to coarse-grained, porphyritic muscovite-biotite monzogranite. Forms a single, large pluton 8 km west of Priest Lake. Three to 7 cm-long white microcline phenocrysts very irregularly distributed throughout pluton; concentrations of phenocrysts make up 50 percent of rock locally. Color index averages 7. Muscovite and biotite give potassium-argon ages of 97 Ma and 93 Ma, respectively (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kgm

Unit Name: Monzogranite of Gleason Mountain (Cretaceous)

Map Unit Description

Muscovite-biotite monzogranite. Forms two bodies, one intruding the eastern part of the Hungry Mountain pluton 3 km west of Priest Lake, and another flanking the west side of the Hungry Mountain pluton. Characterized by extreme variations in grain size, even in small exposures. Typical rock is medium grained, but contains pods of aplite or pegmatite from 1 cm to several hundred meters across that have diffuse, gradational borders. Color index averages 7. Grades outward through increasing grain-size and concentration of potassium feldspar phenocrysts into monzogranite of Hungry Mountain (Kh). Age considered Cretaceous based on spatial and probable genetic relationship with monzogranite of Hungry Mountain

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksc

Unit Name: Monzogranite of Sand Creek (Cretaceous)

Map Unit Description

Porphyritic medium- to coarse-grained biotite monzogranite. Forms single pluton 3 km west of Sullivan Lake in northwestern part of quadrangle. Pink orthoclase phenocrysts average 3 cm long, but range to 6 cm. Color index averages 8. Biotite gives potassium-argon age of 99 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Klc

Unit Name: Granodiorite of Lightning Creek (Cretaceous)

Map Unit Description

Medium- to coarse-grained biotite granodiorite; contains sparse hornblende. Forms small pluton 6 km east of Lake Pend Oreille. Color index about 15. Even-grained, non-foliate; uniform texture and composition. Contains sparse, but ubiquitous sphene and epidote. Biotite gives potassium-argon age of 72 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977), which is considered minimum age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kw

Unit Name: Granodiorite of Whiskey Rock (Cretaceous)

Map Unit Description

Medium- to coarse-grained biotite granodiorite. Even-grained, non-porphyritic. Color index about 12. Exposed only on eastern shore of Lake Pend Oreille, but aeromagnetic anomaly (Harrison and others, 1972) suggests that it probably underlies much of lake itself. Biotite gives potassium-argon age of 88 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977), which is considered minimum age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Krl

Unit Name: Granodiorite of Rapid Lightning Creek (Cretaceous)

Map Unit Description

Porphyritic medium- to coarse-grained hornblende-biotite and biotite granodiorite. Color index 12 to 16. May consist of more than one pluton, especially in westernmost rocks of unit. Biotite gives potassium-argon age of 75 Ma in western part of unit, and 98 Ma in eastern part (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Knc

Unit Name: Monzogranite of Narcisse Creek (Cretaceous)

Map Unit Description

Medium- to coarse-grained biotite monzogranite, but includes lesser mixed mafic and leucocratic granitic rocks. Forms irregular shaped body 10 km east of Colville. Average color index of 10, but more variable than most Cretaceous plutons. Locally has slight foliation. As mapped, may include more than one pluton in northeastern part of unit. Biotite from rocks 2.5 km east of Black Lake gives potassium-argon age of 100 Ma. (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kwm

Unit Name: White Mud Lake porphyritic body (Cretaceous)

Map Unit Description

Porphyritic, medium- to coarse-grained biotite monzogranite and granodiorite. Forms single pluton 8 km east of Colville. Orthoclase phenocrysts range from 2 to 6 cm, highly concentrated in places. Color index averages 13; contains variable amounts of sphene. May grade into, and be petrogenetically related to, Starvation Flat Quartz Monzonite. Age considered Cretaceous based on compositional similarity to Starvation Flat Quartz Monzonite and other nearby granitic rocks of Cretaceous age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kgp

Unit Name: Galena Point Granodiorite (Cretaceous)

Map Unit Description

Porphyritic medium- to coarse-grained biotite granodiorite and monzogranite. Average color index of 12. Forms large, irregular-shaped mass between Priest Lake and north-south leg of Pend Oreille River. Feldspar phenocrysts range from 2 to 8 cm in length; average 3 cm. Except for phenocryst size, texture and composition very uniform throughout most of pluton. Compositionally similar to, and may grade into, granodiorite of Yocum Lake (Ky), but contact relations poorly exposed and ambiguous. Biotite gives potassium-argon age of 101 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Klcc

Unit Name: Granodiorite of Le Clerc Creek (Cretaceous)

Map Unit Description

Fine-grained, irregularly porphyritic biotite granodiorite. Forms single, small, elongate body 21 km west of Priest Lake in Le Clerc Creek drainage (fig. 2). Grain size variable, including very fine-grained chilled-margin phase. Feldspar phenocrysts small and irregularly distributed. Color index about 10. Trace amount of muscovite; possibly secondary. Age considered Cretaceous based on lithologic similarity to nearby granitic rocks of that age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbc

Unit Name: Monzogranite porphyry of Bodie Canyon (Cretaceous)

Map Unit Description

Fine- to medium-grained, irregularly porphyritic, leucocratic biotite monzogranite. Phenocrysts are potassium feldspar and quartz, some of latter are bipyramidal. Forms small pluton 2 km north of town of Priest River (fig. 2). Grain size, texture, and concentration of phenocrysts highly variable, even at outcrop scale. Deeply weathered and cut by numerous Eocene hypabyssal dikes (Thd). Age considered Cretaceous based on lithologic similarity to nearby granitic rocks of that age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Khm

Unit Name: Granodiorite of Hall Mountain (Cretaceous)

Map Unit Description

Fine- to coarse-grained muscovite-bearing biotite granodiorite. Characterized by abundant epidote and allanite. Forms six non-contiguous plutons between north end of Priest Lake and Ione, Washington (fig. 2). Texture and mafic content locally variable; slightly foliate at margins of some plutons. Average color index of 10, but ranges up to 17. Based on petrologic similarities, probably genetically related to granodiorite of Reeder Creek (Krc). Several plutons have tungsten, molybdenum, or gold geochemical anomalies associated with them (Miller and Theodore, 1982; Miller and Frisken, 1984). Biotite and muscovite give potassium-argon ages of 99 Ma and 96 Ma, respectively (Miller and Frisken, 1984)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Krc

Unit Name: Granodiorite of Reeder Creek (Cretaceous)

Map Unit Description

Medium- and coarse-grained muscovite-bearing biotite granodiorite; generally contains less than 1 percent muscovite. Forms large irregular-shaped pluton around Priest Lake. Characterized by fairly abundant epidote and allanite and irregularly shaped, poikilitic microcline enclosing randomly distributed euhedral plagioclase. Chemical and petrologic similarities and coarser grain size suggest granodiorite of Reeder Creek could be deep-seated equivalent of granodiorite of Hall Mountain. Biotite gives potassium-argon age of 94 Ma (Miller and Engels, 1975, recalculated using current IUGS constants Steiger and Jaeger, 1977), which is considered minimum age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kk

Unit Name: Granodiorite of Kelso Lake (Cretaceous)

Map Unit Description

Biotite granodiorite and hornblende-biotite granodiorite. Chief rock-type is medium- to coarse-grained; strongly inequigranular, slightly porphyritic biotite granodiorite. Forms large body west of Lake Pend Oreille in southernmost part of quadrangle. Locally contains sparse muscovite or acicular hornblende. Color index 8 to 12. Sphene and epidote very abundant. In north and west parts of body, rocks grade into medium- to coarse-grained slightly to moderately foliated hornblende-biotite granodiorite having stubby prismatic hornblende coequal to biotite. In east part, rocks grade into fine-grained hornblende-biotite granodiorite. Hornblende-bearing rocks also carry abundant sphene and epidote and have color index between 15 and 20. Zircon gives uranium-lead age of 88 ±9 Ma, sphene gives 88 ±0.5 Ma (J.L. Wooden, written commun., 1994)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksh

Unit Name: Hornblende-biotite monzogranite and Granodiorite

Map Unit Description

Medium- to coarse-grained, non-porphyritic monzogranite to granodiorite. Average color index of 15, contains abundant sphene. Very homogeneous with respect to texture and composition, except for local mafic-rich parts near contacts on northeast flank of Addy Mountain, and 6 km north of town of Addy. Hornblende and biotite give potassium-argon ages of 99 Ma and 100 Ma, respectively (Engels in Miller and Clark, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977). Includes Arden Pluton.

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksha

Unit Name: Arden pluton

Map Unit Description

Leucocratic biotite monzogranite and muscovite-biotite monzogranite genetically related to unit Ksh, but has slightly coarser grain size, lower color index, no hornblende, and it contains muscovite. Presumably evolved from same magma as Starvation Flat Quartz Monzonite. Average color index of 9. Incompletely exposed contact with hornblende-bearing phase (Ksh) suggests that these two rock types are gradational over a few meters

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kgs

Unit Name: Granitic rocks of Spirit pluton (Cretaceous)

Map Unit Description

Coarse- to fine-grained hornblende-biotite and biotite granodiorite, monzogranite, and quartz monzonite. Forms large, composite pluton 7 km northwest of Ione (fig. 2). Pluton consists primarily of two concentrically zoned phases: (1) feldspar-porphyritic biotite monzogranite in central part, grading outward through seriate porphyritic monzogranite into (2) non-porphyritic biotite monzogranite and quartz monzonite. Subordinate phases include (3) mafic-rich rocks around eastern part of pluton margin and (4) scattered various-sized bodies of leucocratic rocks, especially in central part of pluton. Biotite gives potassium-argon age of 99 Ma (Yates and Engels, 1968, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kco

Unit Name: Granodiorite of Copeland (Cretaceous)

Map Unit Description

Medium- to coarse-grained hornblende-biotite and biotite granodiorite. Forms large pluton east of Copeland (fig. 2). Sphene-bearing. Color index ranges from 13 to 17. Porphyritic in part, containing feldspar phenocrysts 2.5 cm long. Fairly uniform with respect to texture and composition, except in southwestern part of unit. Scattered southwestern exposures devoid of hornblende and may be separate pluton. Hornblende and biotite from northern part of unit give potassium-argon ages of 95 Ma and 90 Ma, respectively (Miller and Engels, 1975; recalculated using current IUGS constants, Steiger and Jaeger, 1977); emplacement age inferred to be about 100 Ma

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kyl

Unit Name: Granodiorite of Yocum Lake (Cretaceous)

Map Unit Description

Medium- to coarse-grained hornblende-biotite granodiorite and monzogranite (fig. 3). Forms large pluton northeast of Ruby (fig. 2). Even-grained to seriate, non-porphyritic; uniform with respect to texture and composition. Average color index about 14. Strongly resembles hornblende-biotite monzogranite and granodiorite phase of Starvation Flat Quartz Monzonite. Hornblende and biotite both give potassium-argon ages of 100 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kru

Unit Name: Granodiorite of Ruby Creek (Cretaceous)

Map Unit Description

Coarse-grained, porphyritic biotite granodiorite. Forms small pluton 8 km north of Upper Priest Lake. Nearly all potassium feldspar is in 2- to 5-cm-long phenocrysts, almost none in groundmass. Contains abundant sphene. Color index averages 20. Biotite gives potassium-argon age of 68 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977), which is considered to be cooling age. Rock type is texturally and compositionally similar to nearby 100-Ma plutons

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kcu

Unit Name: Granitic rocks of Cabinet Mountains, undivided (Cretaceous)

Map Unit Description

Medium- to coarse-grained hornblende-biotite and biotite granodiorite and monzogranite. Form numerous, small, non-contiguous, incompletely mapped bodies in the Cabinet Mountains (fig. 2) that may or may not be genetically related to one another. Age considered Cretaceous based on lithologic similarities to nearby granitic rocks of that age, but could include some Jurassic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpm

Unit Name: Granodiorite porphyry of Packsaddle Mountain (Cretaceous)

Map Unit Description

Hornblende-biotite granodiorite porphyry. Found only on Packsaddle Mountain east of Lake Pend Oreille. Fine-grained matrix enclosing 1-cm-long phenocrysts of plagioclase, quartz, and locally hornblende. One or both mafic minerals partially altered in most rocks. Biotite potassium-argon age is 98 Ma (J. K. Nakata, U.S. Geological Survey, written commun., 1993)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kv

Unit Name: Granodiorite of V-78 Road (Cretaceous)

Map Unit Description

Hornblende-biotite granodiorite; some parts of unit contain no hornblende. Forms small, isolated exposures from Bonners Ferry to Naples; also flanks southeast margin of granodiorite of Kelly Pass (Kkp). Contains sparse microcline phenocrysts averaging 2 cm in length. Contains abundant sphene and epidote. Color index averages about 16. Medium- to coarse-grained. Rock type has well-developed lineation and irregularly developed foliation. Biotite gives potassium-argon age of 89 Ma (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977), which is considered cooling age, not emplacement age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kfl

Unit Name: Fan Lake Granodiorite (Cretaceous)

Map Unit Description

Hornblende-biotite granodiorite ranging to monzogranite; medium- to coarse-grained. Forms large, sparsely exposed pluton around and east of Eloika Lake (fig. 2); extent south of quadrangle unknown. Characterized by large stubby hornblende crystals, abundant sphene, and color index averaging 19. Hornblende and biotite give potassium-argon ages of 97 Ma and 95 Ma respectively, (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977); emplacement age inferred to be about 100 Ma

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kc

Unit Name: Biotite monzogranite of Camden (Cretaceous)

Map Unit Description

Medium-grained biotite monzogranite and granodiorite. Even-grained, non-porphyritic. Forms single, poorly exposed pluton 5 km northeast of Eloika Lake (fig. 2). Biotite is only mafic mineral; average color index of 12. Sphene-bearing, but difficult to see because rocks everywhere deeply weathered. Spatial association and textural similarities suggest genetic relation to Fan Lake Granodiorite (Kfl). Age considered Cretaceous based on relation to Fan Lake Granodiorite

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kse

Unit Name: Granodiorite of Sema Meadows (Cretaceous)

Map Unit Description

Porphyritic hornblende-biotite granodiorite. Forms sparsely exposed pluton 22 km east of Ione. Contains 2.5-cm-long potassium feldspar phenocrysts. Average color index of 18. Medium- to coarse-grained, non-foliated. Contains abundant inclusions. Age considered Cretaceous based on lithologic similarities to nearby granitic rocks of that age, especially granodiorite of Priest Lake (Kgpl)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbu

Unit Name: Granodiorite of Bunchgrass Meadows (Cretaceous)

Map Unit Description

Hornblende-biotite granodiorite. Forms sparsely exposed pluton 17 km east-southeast of Ione. Non-porphyritic, but in all other lithologic aspects similar to, and probably genetically related to, granodiorite of Sema Meadows (Kse). Also lithologically resembles Cretaceous granodiorite of Priest Lake (Kgpl). Age considered Cretaceous based on lithic similarity to nearby granitic rocks of that age, especially granodiorite of Priest Lake

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kcl

Unit Name: Tonalite of Clagstone (Cretaceous)

Map Unit Description

Highly mafic biotite-hornblende tonalite. Forms single pluton just east of Clagstone (fig. 2). Color index about 30. Coarse-grained, moderately too weakly foliate. Contains abundant sphene and epidote, and minor microcline. Compositionally gradational into hornblende-bearing phase of granodiorite of Kelso Lake, but because of age difference, the two bodies are considered distinctly different plutons. Zircon gives uranium-lead age of 90 to 100 Ma; sphene gives age of 94 ±0.5 Ma (J.L. Wooden, written commun., 1994)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kgpl

Unit Name: Granodiorite of Priest Lake (Cretaceous)

Map Unit Description

Medium- to coarse-grained hornblende-biotite granodiorite. Forms sparsely exposed pluton in and west of Priest Lake. Hornblende almost as abundant as biotite. Average color index of 17. Very abundant sphene. Even-grained, non-porphyritic, non-foliate. Very uniform with respect to texture and composition. Zircon gives uranium-lead age of 96 to 103 Ma; sphene gives age of 101 ±0.5 Ma (J.L. Wooden, written commun., 1994)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kmc

Unit Name: Granodiorite of Mill Creek (Cretaceous)

Map Unit Description

Non-porphyritic medium-grained biotite-hornblende granodiorite. Forms small pluton exposed on both sides of Pend Oreille River 19 km north of town of Cusick. Distinguished from most other granitic units by average color index of 23 and by hornblende more abundant than biotite. Mafic content and grain-size highly variable in some parts of pluton. Abundant mafic inclusions. Hornblende and biotite gives potassium-argon ages of 104 Ma and 100 Ma respectively, (R.J. Fleck, written commun., 1989)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kkp

Unit Name: Granodiorite of Kelly Pass (Cretaceous)

Map Unit Description

Highly porphyritic, very coarse-grained biotite-hornblende and hornblende monzogranite and granodiorite. Forms single pluton concentrically enclosing two-mica monzogranite of Twentymile Creek (Ktmc) 1 km east of Naples (fig. 2). Blocky microcline phenocrysts from 3 to 10 cm long make up 25 percent of rock volume in much of body. Color index about 16. Very abundant sphene. Hornblende potassium-argon age is 99 Ma (J. K. Nakata, U.S. Geological Survey, written commun., 1993)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kslc

Unit Name: Granodiorite of Salee Creek (Cretaceous)

Map Unit Description

Biotite-hornblende granodiorite. Forms two bodies divided by granodiorite of Kelso Lake (Kk) on west side of Lake Pend Oreille. Medium- to coarse-grained; non-foliated to well-foliated. Color index 15 to 20. Characterized by hornblende-biotite ratio greater than one. Contains abundant sphene, epidote, and allanite. Feldspars are commonly gray. Zircon gives U-Pb age of 94 ±5 Ma (J.L. Wooden, written commun., 1994). Biotite and hornblende give potassium-argon ages of 83 Ma and 137 Ma, respectively (R. Fleck, written commun., 1993); biotite age considered a cooling age; hornblende age probably reflects excess argon

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpl

Unit Name: Phillips Lake Granodiorite (Cretaceous)

Map Unit Description

Muscovite-biotite granodiorite that forms a large mass west of Pend Oreille River in west-central part of quadrangle. Ranges in composition from tonalite to monzogranite, more potassic in western part. Medium- to coarse-grained, irregularly porphyritic, with poorly formed, small, white phenocrysts of microcline and orthoclase. Color index averages 11. Includes abundant metamorphic rocks; some screens several hundred meters in length. Unit contains very abundant dikes, pods, and small bodies of pegmatite, alaskite, and fine-grained leucocratic two-mica monzogranite. Phillips Lake Granodiorite makes up western part of Priest River Complex. Biotite gives potassium-argon age of 94 Ma, and muscovite from related pegmatite gives age of 101 Ma (Yates and Engels, 1968, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kptc

Unit Name: Granodiorite of Trapper Creek (Cretaceous)

Map Unit Description

Medium-grained muscovite-biotite granodiorite. Forms single body north of Upper Priest Lake. Even-grained, non-porphyritic, except for poorly formed 2-cm-long phenocrysts locally. Color index averages 9. Abundant pegmatite and leucocratic dike rocks, but otherwise slightly more uniform than most other units of Priest River Complex

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kplm

Unit Name: Mixed granitic and metamorphic rocks of Lookout Mountain (Cretaceous)

Map Unit Description

Two-mica granitic rocks with about 5 percent gneiss and amphibolite. Widespread north of Priest Lake. Some granitic rocks contain no muscovite. Highly irregular distribution of metamorphic rocks in unit. Granitic rocks extremely variable with respect to texture, composition, and grain-size. Most rocks in unit are leucocratic, but some are highly mafic; latter probably represent incompletely mixed residue of partial anatectic melt derived from mafic sills in Middle Proterozoic Prichard Formation. Very abundant pegmatite and leucocratic dike rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpgb

Unit Name: Garnet-bearing granodiorite (Cretaceous)

Map Unit Description

Medium-grained two-mica granodiorite, ranging to tonalite. Forms small pluton 10 km north of Upper Priest Lake. Foliate near margins. Characterized by pale tan garnet and abundant epidote. Unlike most other units of Priest River Complex, contains anhedral, embayed sphene. Mineralogy could result from incompletely mixed partial anatectic melt derived from Middle Proterozoic Prichard Formation and mafic sills in that unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpcc

Unit Name: Granodiorite of Caribou Creek (Cretaceous)

Map Unit Description

Medium- to coarse-grained muscovite-biotite granodiorite, but ranges from tonalite to monzogranite. Forms single pluton in Caribou Creek drainage 1 km northeast of Upper Priest Lake (fig. 2). Locally contains sparse potassium feldspar phenocrysts. Color index ranges from 4 to 10. Overall, much more uniform in appearance than most other units of Priest River Complex, but contains discrete areas of pronounced textural and compositional inhomogeneity

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpml

Unit Name: Biotite-rich granodiorite of Marsh Lake (Cretaceous)

Map Unit Description

Medium- and fine-grained biotite granodiorite; ranges to tonalite. Forms small pluton 10 km northeast of Upper Priest Lake (fig. 2). Slightly foliated. Characterized by euhedral allanite with epidote overgrowths. Average color index of 15

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpsl

Unit Name: Granodiorite of Search Lake (Cretaceous)

Map Unit Description

Medium- and locally coarse-grained muscovite-biotite granodiorite. Forms moderate-size pluton 11 km northeast of Upper Priest Lake (fig. 2). Average color index 11. Slightly foliate in northeast part. More uniform in composition and contains lower proportion of leucocratic dike rocks than most other units of Priest River Complex

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kplc

Unit Name: Biotite-rich granodiorite of Lucky Creek (Cretaceous)

Map Unit Description

Biotite granodiorite, but ranges from tonalite to monzogranite. Forms moderate-size pluton at north end of Upper Priest Lake. Distinguished by relatively high color index for unit of Priest River Complex; ranges from 5 to 20, averages 13. Contains large, irregularly shaped mafic inclusions. Texture, composition, and concentration of inclusions extremely variable throughout body

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpkm

Unit Name: Monzogranite of Klootch Mountain (Cretaceous)

Map Unit Description

Medium- to coarse-grained two-mica monzogranite and granodiorite. Forms large pluton east of Priest Lake. Characterized by relatively well-formed, 2.5- to 4-cm-long potassium feldspar phenocrysts that have well-defined crystal shapes. Composition and texture very uniform compared to other units of Priest River Complex. Locally foliate, and shows ductile grain-size reduction within 2 km of Newport Fault. Color index averages about 6

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kph

Unit Name: Two-mica granitic rocks of Horton Creek (Cretaceous)

Map Unit Description

Heterogeneous, mostly leucocratic, two-mica monzogranite and granodiorite; includes abundant pegmatite, alaskite, and leucocratic dike rocks. Forms moderate-size pluton on east side of Priest Lake (fig. 2). Average color index of 6. Very similar to rock types found in mixed granitic rocks of Camels Prairie (Kpcp) unit. Lineate, foliate, and shows ductile grain-size reduction in western part

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpcb

Unit Name: Biotite-rich granodiorite of Cavanaugh Bay (Cretaceous)

Map Unit Description

Biotite granodiorite. Forms moderate-size body east of the southern part of Priest Lake. Fine- to coarse-grained; moderately heterogeneous with respect to texture, very heterogeneous with respect to composition. Color index averages about 14, but ranges to over 20. Lineate, foliate, and shows ductile grain-size reduction in western part

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpcp

Unit Name: Mixed granitic rocks of Camels Prairie (Cretaceous)

Map Unit Description

Mixed leucocratic two-mica granitoid rocks, amphibolite, gneiss, and schist. Forms large, irregularly shaped body between Naples and Priest Lake (fig. 2). About 90 percent of unit is heterogeneous granitic rocks; most abundant rock type is even-grained, leucocratic two-mica monzogranite. Large proportion of granitic rocks are dikes, pods and irregular masses of pegmatite and alaskite

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpms

Unit Name: Mixed granitic and metamorphic rocks of Soldier Creek (Cretaceous)

Map Unit Description

Leucocratic two-mica granitic rocks, schist, amphibolite, and minor gneiss. Forms two large masses, one between Sandpoint and south end of Priest Lake, other 6 km southwest of Sandpoint (fig. 2). About 55 to 75 percent of unit consists of extremely heterogeneous granitic rocks ranging in composition from tonalite to monzogranite; color index between 5 and 10. Differs from unit Kpcp chiefly in proportion of metamorphic rocks. Ratio of metamorphic to granitic rock varies greatly over short distances, but generally is greater south of granodiorite of Wrenco (Tw). Most metamorphic rocks appear to be derived from Middle Proterozoic Prichard Formation and mafic sills in that unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpll

Unit Name: Mixed leucocratic granitic rocks of Lost Creek (Cretaceous)

Map Unit Description

Even-grained leucocratic two-mica granitic rocks, abundant dikes of pegmatite and alaskite, and minor metamorphic rocks. Forms two small bodies, 3 and 11 km southeast of Priest Lake. Granitic rocks similar in composition to those in surrounding mixed granitic and metamorphic rocks of Soldier Creek (Kpms) unit, but consistently contains less than 10 percent metamorphic rocks. Extreme textural and compositional variety in granitic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpbi

Unit Name: Granitic rocks of Big Creek (Cretaceous)

Map Unit Description

Slightly foliate, porphyritic biotite-granodiorite; minor muscovite and garnet. Forms two small bodies 12 km northwest of Sandpoint (fig. 2). Color index about 8. Composition and texture noticeably more uniform than granitic rocks of bounding mixed granitic and metamorphic rocks of Soldier Creek (Kpms) unit, and concentration of pegmatite and alaskite dikes noticeably less

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpsh

Unit Name: Monzogranite of Shorty Peak (Cretaceous)

Map Unit Description

Slightly porphyritic, two-mica, monzogranite and granodiorite. Forms large irregularly shaped body 19 km west of Copeland (fig. 2). Characterized by equant 1- to 2-cm-square potassium feldspar phenocrysts. Color index variable, averaging 10. Mostly medium-grained, but ranges from fine- to coarse-grained. Texture and composition uniform over large areas, and variable over large areas

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpbc

Unit Name: Mixed two-mica rocks of Ball Creek (Cretaceous)

Map Unit Description

Mostly muscovite-biotite granodiorite, but includes some tonalite and monzogranite. Forms large north-south-elongated body 15 km west of Bonners Ferry (fig. 2). Unlike some two-mica units, muscovite easily visible in almost all parts of unit, locally megacrystic. Medium- to coarse-grained. Average color index of 7. Composition and texture generally more variable than bounding units, but not nearly as variable as mixed rocks units

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpfc

Unit Name: Granodiorite of Falls Creek (Cretaceous)

Map Unit Description

Chiefly granodiorite, but includes some monzogranite and minor tonalite. Forms large north-south-elongated body 5 km west of Naples (fig. 2). Medium- to coarse-grained, but contains very abundant fine- to coarse-grained leucocratic dikes and pods. Biotite only mafic mineral; minor muscovite in western part of unit. Contains sparse to moderately abundant epidote. Composition, texture, and concentration of included leucocratic rocks variable in much of unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpsp

Unit Name: Tonalite of Snow Peak (Cretaceous)

Map Unit Description

Tonalite to granodiorite; average composition tonalite. Forms large north-south-elongated body 9 km west of Bonners Ferry (fig. 2). Medium- and coarse-grained; seriate in much of unit. Biotite only mafic mineral; color index higher than most other units in Priest River Complex, ranges from 11 to 17. Muscovite absent, except very locally. Unit characterized by very abundant pale-green epidote with allanite cores and abundant irregularly shaped mafic inclusions ranging from 1 cm to tens of meters across. Composition and texture uniform in much of unit, but variable in places

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kpdc

Unit Name: Mixed granitic and metamorphic rocks of Deep Creek (Cretaceous)

Map Unit Description

Heterogeneous, mafic to leucocratic granitic rocks with screens and inclusions of metamorphic rocks, chiefly schist. Mapped as two small bodies, one 5 km north of Moravia, other 8 km south of Moravia (fig. 2). Unlike most other units of Priest River Complex, some granitic rocks in unit contain hornblende and sphene, and are highly porphyritic locally. As mapped, may include some rocks belonging to granodiorite of Kelly Pass and granodiorite of Bonners Ferry

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Koc

Unit Name: Monzogranite of Otter Creek (Cretaceous)

Map Unit Description

Sillimanite-bearing muscovite-biotite monzogranite. Forms small body 2 km northeast of Eloika Lake (fig. 2). Medium-grained with weakly developed foliation. Color index variable from 5 to 15, but overall texture and composition fairly uniform. Sillimanite forms acicular crystals in biotite and may be restricted to numerous sub-centimeter-size inclusions distributed throughout unit. Some distributed zones of ductile grain-size reduction. Considered to be Cretaceous in age based on compositional similarity to Cretaceous plutonic rocks in quadrangle

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Klgs

Unit Name: Leucocratic granitic rocks of Scotia (Cretaceous)

Map Unit Description

Heterogeneous mixture of alaskite, pegmatite, aplite, and two-mica monzogranite; includes metamorphic rocks derived from Middle Proterozoic Prichard Formation and mafic sills in that unit. Forms scattered bodies east and southwest of Scotia (fig. 2). Foliation, lineation, and ductile deformation common in eastern part of unit. Considered Cretaceous in age, based on compositional similarity to Cretaceous leucocratic two-mica rocks associated with Phillips Lake Granodiorite

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksv

Unit Name: Granodiorite of Spring Valley (Cretaceous)

Map Unit Description

Biotite granodiorite; contains sparse muscovite that may not be primary. Forms a small elongate pluton 3 km southeast of Scotia (fig. 2). Medium- to coarse-grained; nonfoliate to slightly foliate. Relatively uniform with respect to texture and composition; contains fewer leucocratic dike rocks than surrounding units. Considered Cretaceous in age based on compositional similarity to Cretaceous plutonic rocks in quadrangle

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kbr

Unit Name: Monzogranite of Blanchard Road (Cretaceous)

Map Unit Description

Medium- to coarse-grained megacrystic muscovite-biotite monzogranite. Forms large body 8 km northwest of Blanchard (fig. 2). Distinguished by muscovite megacrysts 2 to 3 cm across. Average color index of 8. Southeastern part has well-developed mylonitic foliation and lineation caused by ductile deformation related to early stage of development of Eocene core complex(es) in region. Relatively uniform with respect to texture and composition; composition and texture strongly resembles those of monzogranite of Long Mountain (Klm). Age considered Cretaceous based on lithologic similarity to nearby Cretaceous two-mica rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Klm

Unit Name: Monzogranite of Long Mountain (Cretaceous)

Map Unit Description

Biotite-muscovite monzogranite bearing megacrysts of muscovite and potassium feldspar. Forms large body west of Cocolalla Lake and small body 7 km north of Cocolalla Lake (fig. 2). Megacrysts range from 0 to 20 percent of rock volume; muscovite averages 2 cm across, potassium feldspar 3 cm long. Strongly foliated on northwest, moderately foliated to unfoliated on southeast; variably mylonitic. Pegmatite and aplite dikes abundant. Grades into and intrudes muscovite-biotite monzogranite (Kmg). Relatively uniform with respect to texture and composition; strongly resembles monzogranite of Blanchard Road. Age considered Cretaceous based on lithologic similarity to nearby Cretaceous two-mica rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kag

Unit Name: Granitic rocks of Algoma Lake (Cretaceous)

Map Unit Description

Foliate and lineate muscovite-biotite monzogranite containing sparse microcline porphyroblasts up to 1 cm long. Forms moderate-size body 3 km north of Cocolalla Lake (fig. 2). Color index about 8; rocks contain about 3 percent muscovite. Includes abundant pegmatitic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ksg

Unit Name: Granodiorite of Sawyer (Cretaceous)

Map Unit Description

Biotite granodiorite. Forms small body near Sawyer (fig. 2). Medium-grained; slightly to moderately foliate. Color index ranges from 15 to 25; hornblende locally abundant in mafic parts; muscovite in rocks with lower color index. Contains sphene, epidote, and allanite. Hornblende paleobarometry indicates crystallization at 6.7 Kb (T.D. Hoisch, written commun., 1993). U-Pb isotopic data on zircon inconclusive, but suggests that 90-100 Ma is most probable age. Sphene gives U-Pb age of 65 ±0.5 Ma (J.L. Wooden, written commun., 1994); considered cooling age because of depth of crystallization

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kjl

Unit Name: Granitic rocks of Jewel Lake (Cretaceous)

Map Unit Description

Fine- to medium-grained, leucocratic, gneissic granite. Forms small mass east of Sawyer (fig. 2). Unit comprises several small bodies, all with biotite, most with muscovite, one with megacrystic microcline. Highly foliated throughout. Age considered Cretaceous based on lithologic similarity to nearby Cretaceous two-mica rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kmg

Unit Name: Muscovite-biotite monzogranite (Cretaceous)

Map Unit Description

Medium-grained, subequigranular to equigranular muscovite-biotite monzogranite. Forms small body 3 km east of Edgmere (fig. 2). Micas about equal in amount. Locally has anhedral cm-long potassium feldspar phenocrysts. Slightly to moderately foliated. Gradational into and cut by dikes of monzogranite of Long Mountain (Klm). Age considered Cretaceous based on lithologic similarity to nearby Cretaceous two-mica rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Kphc

Unit Name: Monzogranite of Hunt Creek (Cretaceous)

Map Unit Description

Porphyritic, medium- to coarse-grained, sphene-bearing biotite monzogranite and granodiorite. Forms an elongated series of noncontiguous bodies from 20 km northwest of Copeland (fig. 2) to within 3 km of the southern part of Priest Lake. Color index as high as 20 in northern part of body; progressively more leucocratic and sphene-deficient southward. In southern part of unit, rock has color index between 8 and 14, and contains no sphene. Almost everywhere rock is slightly gneissic, and displays incipient to strong ductile grain-size reduction in thin section. Appears to be older than most other granitoid bodies of Priest River Complex, caught up within, and strung out between, various units of the complex. Discordant zircon indicates age between 90 and 100 Ma (J.L. Wooden, written commun., 1994); Archibald and others (1984) report 94-Ma uranium-lead age on zircon from equivalent(?) unit in Canada

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Jcm

Unit Name: Tonalite and trondhjemite of Continental Mountain (Jurassic)

Map Unit Description

Medium- to coarse-grained biotite tonalite, granodiorite, and trondhjemite. Trondhjemite contains a few percent muscovite and forms small appendage along eastern edge of much larger tonalite and granodiorite pluton. Rocks of larger tonalite and granodiorite body contain trace muscovite. Biotite and some muscovite is interstitial to felsic minerals. Average color index of tonalite 17, of trondhjemite 9. Both rock types have abundant epidote and trace amounts of garnet and hornblende. Most muscovite and epidote is contained within water-clear plagioclase. Texture and mineralogy indicate pluton has been metamorphosed. Zircon gives U-Pb age of 120 Ma; sphene gives 160 ±1.0 Ma (J.L. Wooden, written commun., 1994). Biotite from tonalite gives K-Ar age of 107 Ma; biotite and muscovite from trondhjemite give ages of 101 Ma and 96 Ma, respectively (Miller and Engels, 1975, recalculated using current IUGS constants, Steiger and Jaeger, 1977)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Jlm

Unit Name: Quartz monzodiorite of Lane Mountain (Jurassic)

Map Unit Description

Medium- to coarse-grained highly porphyritic biotite-hornblende quartz monzodiorite and granodiorite. Forms moderate-size pluton south of Waitts Lake (fig. 2). Potassium feldspar phenocrysts to 9 cm long; concentration variable. Groundmass has bi-modal grain size. Average color index 18. Characterized by hornblende-biotite ratio greater than one, very abundant sphene, large phenocrysts, and bi-modal grain size. Hornblende and biotite give potassium-argon ages of 161 Ma and 162 Ma respectively, (R. Fleck, U.S. Geological Survey, written comm., 1988)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: MZPZf

Unit Name: Fault-zone rocks on Eagle Mountain (middle Mesozoic to late Paleozoic)

Map Unit Description

Highly sheared phyllite, carbonate-bearing phyllite, and brecciated carbonate rocks. Found only on Eagle Mountain 6 km northeast of town of Chewelah (fig. 2). All probably derived from Middle Proterozoic Togo, Chamokane Creek, and Wabash Detroit Formations. Abundant brecciated quartz veins found in this unit, some gold-bearing

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Jrg

Unit Name: Greenstone (Early Jurassic)

Map Unit Description

Metamorphosed basalt, basaltic andesite, trachyandesite, flow breccia, and tuff. Mineralogy characteristic of greenschist-facies metamorphism. Lesser amounts of interlayered siltite and conglomerate; highly schistose locally (Beddoe-Stephens, 1982; Little, 1982; Höy and Andrew, 1988; Joseph, 1990). Unit depositionally overlies metasedimentary and metavolcanic rocks (Jrs) unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Jrs

Unit Name: Metasedimentary and metavolcanic rocks (Early Jurassic)

Map Unit Description

Conglomerate, greenschist, argillite, chert, quartzite, wacke, limestone, and minor flow rock and flow breccia (Joseph, 1990); conglomerate and conglomeratic wacke most abundant. Metamorphosed to greenschist facies. West of quadrangle, unconformably overlies Permian Mount Roberts Formation (Roback, 1989). Thickness probably exceeds 400 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: JT_rpl

Unit Name: Monzonite of Long Canyon (Jurassic or Triassic)

Map Unit Description

Pyroxene-hornblende monzonite to quartz monzonite. Forms north-south-elongated pluton 12 km west of Copeland (fig. 2). Extremely heterogeneous with respect to composition, color index, and texture. Pyroxene is hedenbergite; hornblende is ferrohastingsite. Color index ranges from 6 to 20, averaging 8. Very abundant sphene, allanite, and inclusions. Fine- to coarse-grained. Appears to be pre-existing pluton caught-up within younger rocks of Priest River Complex, but is here considered to be part of Priest River Complex. Triassic or Jurassic age based on compositional similarity of pluton to other alkalic bodies of this age, and to compositional dissimilarity with Cretaceous and to Tertiary rocks in region

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: JT_rw

Unit Name: Syenite of Wall Mountain (Jurassic or Triassic)

Map Unit Description

Hornblende quartz syenite. Forms small pluton 10 km east-southeast of Copeland (fig. 2). Fine- to coarse-grained; equigranular to porphyritic. Color index averages 18. Abundant epidote and sphene. Hornblende gives potassium argon age of 131 Ma (R. Fleck, U.S. Geological Survey, written commun., 1988), which is considered to be cooling age because pluton located in area where potassium-argon ages of mineral pairs from other plutons are discordant (Miller and Engels, 1975). Emplacement age inferred to be Triassic or Jurassic based on compositional similarities to other alkalic rocks of this age in region

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: T_rft

Unit Name: Flowery Trail Granodiorite (Triassic)

Map Unit Description

Fine- to coarse-grained hornblende-biotite quartz monzodiorite and quartz monzonite, but ranges to granodiorite. Forms elongate pluton east of Chewelah (fig. 2). Composition and texture highly variable throughout body. Average color index greater than 20. Hornblende and biotite give potassium-argon ages of 198 Ma and 100 Ma, respectively (Engels in Miller and Clark, 1975; recalculated using current IUGS constants, Steiger and Jaeger, 1977). Amount of discordance suggests emplacement age older than 205 Ma; thus age of Flowery Trail is considered to be Triassic in this report

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: T_rs

Unit Name: Metasedimentary rocks (Triassic)

Map Unit Description

Metamorphosed interbedded siliciclastic and carbonate rocks. Found only in few fault-bounded exposures near Huckleberry Range Fault on northwest side of Columbia River. Thin-bedded to massively bedded limestone and dolomite, argillaceous limestone, phyllite, and minor quartzite. These rocks were originally mapped as part of Flagstaff Mountain sequence of Carboniferous(?) age (Yates, 1971). Triassic age based on conodonts (Joseph, 1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ps

Unit Name: Metasedimentary rocks (Permian)

Map Unit Description

Lithic sandstone and wacke with lesser siltstone and chert-bearing fossiliferous limestone, conglomerate, and metavolcanic rocks. Restricted to northwestern part of quadrangle, west of Huckleberry Range Fault. Includes Mount Roberts Formation as defined by Yates (1971). West of Echo, include siliceous and calcareous argillite interbedded with fine- to medium-grained wacke and pods of fossiliferous limestone which are of uncertain affinities, and may or may not be Mount Roberts Formation. Unconformably overlain by Early Jurassic greenstone (Jrv) and Early Jurassic metasedimentary and metavolcanic rocks (Jrs) units. Age based on macrofossils (Roback, 1989) and conodonts (Joseph, 1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: MCu

Unit Name: Sedimentary rocks, undivided (Mississippian to Cambrian)

Map Unit Description

Limestone, dolomite, and carbonaceous shale. Probably includes parts of Metaline Formation, Ledbetter Formation, and unnamed Devonian and Mississippian units. Mapped 4 km northeast of Springdale, and 7 km west-southwest of Arden (fig. 2). Most rocks assigned to this unit are fault-bounded and brecciated; bedding features obliterated

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ml

Unit Name: Limestone (Mississippian)

Map Unit Description

Limestone with lesser dolomitic limestone and dolomite. Found in limited areas north and southwest of town of Springdale. Medium- to pale-gray; thick- to thin-bedded with irregularly discontinuous chert bands. Thickness about 200 m, but upper and lower contacts not exposed and section could be internally faulted. Mississippian age assignment based on conodonts Bactrognathus sp., Hindeodus aff. H. cristulus (Youngquist and Miller), Hindeodus aff. H. crassidentatus (Branson and Mehl), Kladognathus sp. indet., Ozarkodina sp. indet. (Waggoner, 1990) contained in unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: MDs

Unit Name: Dolomite and slate (Mississippian and Devonian)

Map Unit Description

Upper 170 m of unit is light-gray dolomite interbedded with maroon and pale-green argillite, which conformably overlies 175 m of pale-gray, coarse-grained, bedded dolomite. Lower 200 m is medium-grained, mottled dark-gray, sparsely sandy dolomite. Found in limited areas on east side of Colville Valley south of town of Chewelah. Age assignment inferred on presumed stratigraphic position below fossiliferous Mississippian limestone (Ml) unit and above fossiliferous Devonian dolomite and limestone (Ddl) unit

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ddl

Unit Name: Dolomite and limestone (Devonian)

Map Unit Description

Light-gray and cream-colored dolomite interbedded with medium-gray argillaceous or carbonaceous limestone. Stratigraphic relationships and thickness uncertain. Found only in limited outcrops northwest of town of Metaline and on single hill 3 km east of town of Valley. Near Valley, unit contains Late Devonian brachiopods Cytrospirifer sp., and Tenticospirifer (Miller and Clark, 1975) and Late Devonian conodonts Plamatolepsis quadrantinodosa inflexa Muller, Pelekysgnathus ? sp. indet., Polygnathus semicostatus Branson and Mehl, Polygnathus sp. Indet. (Waggoner, 1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ds

Unit Name: Metasedimentary rocks (Devonian)

Map Unit Description

Argillite, phyllite, and slate, much of it carbonaceous, calcareous, and siliceous; interbedded with minor greenstone, metawacke, and quartzite; grades southwestward into metawacke, quartzite, metaconglomerate, and lesser phyllite, argillite, and slate. Forms 10-km-wide belt straddling Columbia River and continuing southward to near Colville. Both fine- and coarse-grained facies contain numerous pods and beds of limestone, some barite-bearing and some fossiliferous (Yates, 1964; Yates, 1971; Joseph, 1990). Interbedded metavolcanic rocks include metaflow rocks and metatuff. Interlayered metavolcanic rocks, which are locally shown as separate unit (Dv), are more abundant southwestward. Unit assigned Devonian(?) and Carboniferous(?) ages by Yates (1964; 1971), and Devonian(?) and Carboniferous(?) and Ordovician(?) to Carboniferous ages by Joseph (1990). Considered Devonian in age here because all contained fossils, chiefly conodonts, indicate Devonian age for both facies of unit, but may possibly include some Ordovician rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Dv

Unit Name: Metavolcanic rocks (Devonian)

Map Unit Description

Greenstone and chloritic phyllite of probable volcanic origin. Mapped chiefly north and south of Echo (fig. 2) and northwest of Columbia River. Composed of albite, chlorite, actinolite, epidote, and carbonate minerals (Yates, 1971; Joseph, 1990). Part of unit may be pyroclastic. Assigned to Devonian because unit bounded by fossiliferous Devonian metasedimentary rocks (Ds) unit, but may possibly include some Ordovician rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Sc

Unit Name: Quartz-granule conglomerate (Silurian)

Map Unit Description

Conglomerate and minor slate. Found only in a restricted area 6 km north of Metaline Falls (fig. 2). Angular to well-rounded quartz- and chert-bearing conglomerate; contains clasts of mudstone in fine-grained matrix. Interbedded slate contains graptolites (Joseph, 1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Sms

Unit Name: Metasedimentary rocks (Silurian)

Map Unit Description

Thin-bedded sandy, calcareous siltstone, argillite, limestone, and fossiliferous packstone. Found only in a restricted area 6 km north of Metaline Falls (fig. 2). Argillite contains monograptids and limestone conodonts. Sharply overlain by quartz-granule conglomerate (Sc) unit (Joseph, 1990)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ol

Unit Name: Ledbetter Formation (Ordovician)

Map Unit Description

Dark-gray carbonaceous shale, slate, and limestone; minor quartzite and chert interbeds. Massively bedded to thinly laminated; most lamination inconspicuous. At most places, highly deformed internally, including single and multiple cleavage(s), small-scale folds, and faults with unknown sense and amount of offset. Thickness estimated to be between 670 m and 760 m (Dings and Whitebread, 1965). Ordovician age based on abundant graptolites contained in unit (Park and Cannon, 1943; Carter, 1989a, 1989b), conodonts (Hogge, 1982), and trilobites, (Schuster, 1976)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: OCgc

Unit Name: Phyllite and quartzite of Gardiner Creek (Ordovician or Cambrian)

Map Unit Description

Medium- to dark-gray phyllite, white to brown vitreous quartzite, and minor interbeds of sandy, dark-brown dolomite. Mapped only in a small area 4 km northwest of Jared (fig. 2). Unit is about 60 percent phyllite and 40 percent quartzite. Correlation with other units in quadrangle questionable, Lithologically, unit most closely resembles Cambrian upper part of Late Proterozoic and Cambrian Addy Quartzite, but it may, in fact, overlie Metaline Formation(OFm), and be Ordovician in age

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: OCm

Unit Name: Metaline Formation (Ordovician and Cambrian)

Map Unit Description

Limestone, dolomite, shaly limestone, limestone conglomerate, and carbonate-bearing quartzite. Internal stratigraphy of formation in Metaline area differs markedly from that of unit in area west of Addy. In Metaline area, upper part of formation consists of 0 to 600 m of massively bedded, fine-grained, gray limestone; middle 1200 to 1400 m is dominantly light gray and white, fine to medium grained, bedded dolomite; and lower 300 to 900 m is thin bedded, dark-gray limestone interbedded with lesser black shale (Joseph, 1990). In Addy area, upper 600 m of unit is similar to lower thin-bedded part in Metaline area; middle part of formation is dolomite similar to middle part in Metaline area, but is only about 800 m thick; lower part of formation is about 830 m of alternating zones of thin-bedded, fine-grained limestone, and thick-bedded, coarse-grained limestone and limestone conglomerate. Included in lower part of unit is 210-m-thick zone of dark-gray, coarse-grained dolomite and dolomite breccia and 150 m of sandy limestone, carbonate-bearing quartzite, pebble conglomerate, and argillite making up the lower part of formation. Age assignment based on contained trilobites (Park and Cannon, 1942), conodonts (Repetski and others, 1989), and graptolites (Carter, 1989a)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Csu

Unit Name: Sedimentary rocks, undivided (Cambrian)

Map Unit Description

Limestone, dolomite, quartzite, and shale. Probably includes parts of (Middle Cambrian) undivided, Rennie Shale and Lakeview Limestone (Flr) and (Middle? Cambrian) Gold Creek Quartzite (Fgc). Mapped only in southernmost part of quadrangle west of Lake Pend Oreille

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Clr

Unit Name: Rennie Shale and Lakeview Limestone, undivided (Middle Cambrian)

Map Unit Description

Fossiliferous greenish-gray fissile shale and light- to dark-gray well-bedded to massive limestone and dolomite. Shale and limestone contain Middle Cambrian trilobites and brachiopods. Shale about 30 m thick; limestone at least 610 m thick (Harrison and Jobin, 1963). Found only in Packsaddle Mountain area on east side of Lake Pend Oreille and in thin fault slice 7 km north-northeast of Moyie Springs (fig. 2)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Cgc

Unit Name: Gold Creek Quartzite (Middle? Cambrian)

Map Unit Description

White, pink, tan, and purple, slightly feldspathic, medium- to coarse-grained quartzite; locally conglomeratic. Bedding ranges from massive to thin bedded; most is thick bedded. Thickness of unit about 120 m (Harrison and Jobin, 1963). Found only in Packsaddle Mountain area on east side of Lake Pend Oreille

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Cmp

Unit Name: Phyllite

Map Unit Description

Gray phyllite; in lower part, calcareous in upper part. Thin bedded to laminated, but bedding poorly preserved in most of unit except where quartzite beds or lenses are present

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Cmc

Unit Name: Carbonate rocks

Map Unit Description

Early Cambrian archaeocyathid-bearing limestone at base (Reeves Limestone Member; Yates, 1964) at base of Maitlen Phyllite and zones of probably discontinuous limestone beds distributed irregularly throughout formation

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: CZq

Unit Name: Quartzite (Cambrian and Late Proterozoic)

Map Unit Description

White, purple, pink, gray, and tan, vitreous quartzite with interbedded siltite and argillite. Includes Gypsy Quartzite in northern part of quadrangle, and Addy Quartzite everywhere else (Lindsey and others, 1990). Addy averages about 1,400 m thick west of Jumpoff Joe Fault, but probably less east of fault. Gypsy ranges from 1,350 to 1,855 m in thickness east of Newport-Flume Creek Fault; is about 30 percent thinner west of fault. Upper part of Addy contains Early Cambrian trilobite Nevadella addyensis and brachiopod Kutorgina sp (Okulitch, 1951). Lindsey and others (1990) note abundant body and trace fossils in roughly same part of formation

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zt

Unit Name: Three Sisters Formation (Late Proterozoic)

Map Unit Description

Quartzite, conglomeratic quartzite, conglomerate, and phyllite. Lower part consists of phyllite with scattered quartzite and grit beds; upper part is quartzite, conglomeratic quartzite, and conglomerate. Clast types include quartzite, argillite, chert, vein quartz, and rare volcanic rock. Most appear to be derived from formations of Deer Trail Group, but there is a conspicuous absence of carbonate clasts. Thickness about 2,000 m east of Newport-Flume Creek Fault, about 1,000 m west of fault. Not found south of Ione either because of non-deposition or removal by Late Proterozoic erosion

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zm

Unit Name: Monk Formation (Late Proterozoic)

Map Unit Description

Conglomerate, megabreccia, diamictite, limestone, feldspathic and lithic quartzite, siltite, argillite, carbonaceous argillite, and locally, greenstone. Clast types in conglomerate, megabreccia, and diamictite include quartzite, dolomite, argillite, chert, vein quartz, and volcanic rock; most clast lithologies recognizable from formations of Deer Trail Group. Extremely variable lithostratigraphy and thickness over short distances, probably due to highly varied depositional conditions caused by syndepositional faulting

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zl

Unit Name: Leola Volcanics (Late Proterozoic)

Map Unit Description

Greenstone, derived from lava flows, tuff, volcanic breccia, and volcaniclastic rocks; much is phyllitic. Composition is tholeiitic basalt (Miller, 1983a). Thickness of flows range from a few meters to several tens of meters. Pillow structure present, but subtle and difficult to recognize. Maximum thickness 1,850 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zhg

Unit Name: Greenstone member

Map Unit Description

Greenstone, derived from lava flows, tuff, volcanic breccia, and volcaniclastic rocks; much is phyllitic. Composition is tholeiitic basalt (Miller and Clark, 1975). Thickness of flows range from a few meters to several tens of meters; separated by flow breccia consisting of light-green angular clasts averaging 5 mm to 5 cm across in dark-green matrix. Pillow structure fairly abundant, especially in lower part of member, but pillows subtle and difficult to recognize. Thickness averages 975 m. Includes intrusive rocks that are similar to massive flow rocks but coarser grained; some is gabbroic

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zhc

Unit Name: Conglomerate member

Map Unit Description

Diamictite, conglomerate, sandy siltite and argillite, and lithic quartzite. Clasts in diamictite and conglomerate appear to be derived almost totally from formations of Deer Trail Group. Pale-green and pale-gray matrix-supported diamictite and conglomerate are most common lithologies. Maximum thickness in Huckleberry Mountain area (fig. 2), 480 m; thins and pinches out eastward and northeastward

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zsc

Unit Name: Conglomerate member

Map Unit Description

Phyllitic, matrix-supported diamictite and conglomerate and minor lithic quartzite; most of lower part is pale-tan and most of upper part is pale-green. Concentration of clasts ranges from only a few percent of rock volume to about 70 percent. Clast size ranges from centimeters to meters across; shape ranges from angular to moderately well-rounded. Bedding in member is readily apparent only where lithic quartzite is interbedded

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zsp

Unit Name: Phyllite member

Map Unit Description

Pale-gray, pale-green, and pale-tan phyllite. Contains very sparse lithic clasts to 1 cm in length and nearly ubiquitous, mm-size, round quartz grains. Bedding indistinct or unrecognizable in most of member. Northeast of Sullivan Lake, forms thick, northeastward-thinning sedimentary wedge bounded by conglomerate

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zsl

Unit Name: Sandy limestone member

Map Unit Description

Brownish-gray to pale-gray, slightly dolomitic limestone containing numerous, round, millimeter-size quartz grains and a moderate, but variable, amount of argillaceous material. Medium to thick bedded. Thickness estimated to be about 150 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Zsg

Unit Name: Greenstone member

Map Unit Description

Massive and phyllitic greenstone; numerous 1- to 10-m-thick bodies too small to show at scale of map. No diagnostic primary features preserved; greenstone bodies could represent intrusive sills, flow rocks, or pyroclastic rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: ZYmi

Unit Name: Mafic intrusive rocks in upper part of Belt Supergroup (Late and Middle Proterozoic)

Map Unit Description

Medium- to fine-grained mafic-rich sills; intrude Wallace Formation and along Wallace Formation-Snowslip Formation contact. Lithologically indistinguishable from 1,433-Ma mafic intrusive rocks (Ymi) that are restricted to Prichard Formation, but considered by Harrison and others (1992) to be 1,100 or 800 Ma in age. Sills found only two places in quadrangle, 6 km north-northeast of Leonia and 6 km east-northeast of Moyie Springs; at both places they intrude Wallace Formation of Middle Proterozoic Belt Supergroup

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ydtu

Unit Name: Undivided part (Middle Proterozoic)

Map Unit Description

Argillite, phyllite, and quartzite. Rocks of Deer Trail Group lacking distinguishing characteristics needed to assign them to individual formations because of poor exposure, metamorphism, or deformation

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yb

Unit Name: Buffalo Hump Formation (Middle Proterozoic)

Map Unit Description

Interbedded vitreous quartzite and dark-gray to greenish-gray, massively bedded to faintly laminated argillite. Much of quartzite is coarse grained and cross bedded; some contains thin quartzite-pebble beds. East of Sullivan Creek, thickness and proportion of quartzite in unit may be greater than it is southwest of Chewelah. Unit southwest of Chewelah contains maroon, argillaceous, fine-grained quartzite in lower part that strongly resembles quartzite of Bonner Formation of Belt Supergroup. Maximum thickness of unit about 550 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ys

Unit Name: Stensgar Dolomite (Middle Proterozoic)

Map Unit Description

Southwest of Chewelah, formation consists of tan, pink, gray, and maroon dolomite with minor interbedded maroon and gray argillite. About ninety percent of formation is dolomite that contains relatively little non-carbonate material; relative purity is basis to distinguish unit from Wabash Detroit Formation. Near Idaho-Washington border, formation is white, tan, and gray dolomite containing much higher proportion of silt and argillaceous material and much higher proportion of interbedded gray phyllite. Fault-bounded Stensgar Dolomite in this area difficult to distinguish from undivided Wabash Detroit Formation and Chamokane Creek Formation (Ywcu). Formation is host to large deposits of magnesite, probably of remobilized syngenetic origin (Campbell and Loofbourow, 1962; Miller and Whipple, 1989). Thickness of Stensgar southwest of Chewelah averages 250 m; near Idaho-Washington border, appears to be about 300 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ym

Unit Name: McHale Slate (Middle Proterozoic)

Map Unit Description

Formation is almost entirely argillite. West of Chewelah, lower third of unit is medium- to dark-gray argillite; upper two-thirds is pale-greenish-gray and lavender-gray argillite or phyllitic argillite. Thickness averages 370 m. Near Idaho-Washington border, unit is entirely dark-gray phyllite. Thickness appears to be about 300 m, but unit here is everywhere faulted or internally deformed by intense cleavage

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ywd

Unit Name: Wabash Detroit Formation (Middle Proterozoic)

Map Unit Description

Thin- to thick-bedded, gray and white, impure dolomite with abundant thin interbeds of pale-green and gray argillite and carbonate-bearing siltite; locally, unit contains altered greenstone in upper part that may be volcanic flow rocks. Near Idaho-Washington border, rocks of unit are included with Chamokane Creek Formation because deformation and homogenization by faulting and multiple cleavages have destroyed sedimentary features used to distinguish the two units. Thickness southwest of Chewelah averages 240 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ywcu

Unit Name: Wabash Detroit Formation and Chamokane Creek Formation, undivided (Middle Proterozoic)

Map Unit Description

Highly sheared and faulted dolomite, dolomitic quartzite, argillite, and quartzite. Close-spaced faults and multiple cleavages, especially in Idaho-Washington border area, have destroyed sedimentary and lithologic features used to distinguish Wabash Detroit Formation from Chamokane Creek Formation. Thickness unknown

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yc

Unit Name: Chamokane Creek Formation (Middle Proterozoic)

Map Unit Description

Carbonate-bearing quartzite and siltite, interbedded with dolomite, and argillite. West of Chewelah, contains a 150-m-thick zone of interbedded vitreous quartzite and argillite. Vitreous quartzite zone present in section near Idaho-Washington border, but thickness uncertain. Very poorly exposed. Thickness of composite sections in both areas about 600 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yt

Unit Name: Togo Formation (Middle Proterozoic)

Map Unit Description

Medium- and dark-gray argillite with subordinate green argillite and green and gray siltite. Also contains rare, thin, beds of quartzite and dolomite in lower part of unit. West of Chewelah, minimum thickness about 800 m, but unit highly deformed internally and base of formation everywhere faulted. In section near Idaho-Washington border, Togo Formation is found mostly in extremely deformed fault-bounded blocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yl

Unit Name: Libby Formation (Middle Proterozoic)

Map Unit Description

Laminated black argillite and white siltite in lower part of unit, green cherty argillite, siltite, and silty limestone and dolomite in upper part. About 550 m thick, but unknown thickness removed by erosion (Harrison and Jobin, 1963). Found only in Clark Fork-Eastport sequence

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ybmh

Unit Name: Bonner Formation, Mount Shields Formation, and argillite of Half Moon Lake, undivided (Middle Proterozoic)

Map Unit Description

Altered and bleached argillite, siltite, and lesser quartzite. Mapped as undivided unit only on one ridge east of Pend Oreille River in Newport sequence, where alteration and poor preservation of sedimentary features preclude assignment of rocks to specific formations

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ybo

Unit Name: Bonner Formation (Middle Proterozoic)

Map Unit Description

Maroon, pale-purple, and pale-green siltite, argillite, and quartzite. As mapped, unit in southern part of Clark Fork-Eastport sequence includes quartzite member of Striped Peak Formation (Harrison and Jobin, 1963). Unit mostly quartzite there; about 80 percent thin-bedded, coarse siltite in Newport sequence. In Clark Fork area, about 210 m thick; in Newport sequence, about 190 m thick; not present in Chewelah sequence

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yms

Unit Name: Mount Shields Formation (Middle Proterozoic)

Map Unit Description

Argillite, siltite, quartzite, dolomite, and dolomitic siltite. As mapped, unit in southern part of Clark Fork-Eastport sequence includes lower three members of Striped Peak Formation (Harrison and Jobin, 1963); thickness about 400 m. In northern part of sequence, thickness is about 620 m. In Newport sequence, thickness about 420 m; not present in Chewelah sequence

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yhm

Unit Name: Argillite of Half Moon Lake (Middle Proterozoic)

Map Unit Description

Dark- to medium-gray, laminated argillite, thin-bedded siltite, and thick- to thin-bedded quartzite. As mapped, unit includes laminated argillite and siltite member of Wallace Formation at Clark Fork, Idaho (Harrison and Jobin, 1963); about 120 m thick there. About 155 m thick northeast of Bonners Ferry; about 350 m thick north of Newport; and about 650 m thick at Chewelah

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yshs

Unit Name: Shepard Formation and Snowslip Formation, undivided (Middle Proterozoic)

Map Unit Description

Schist, calc-silicate rock, dolomitic marble, argillite, siltite, and dolomite. Sequence may contain unrecognized faults. Thickness unknown. Found only on mountain 16 km due north of town of Cusick

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ysh

Unit Name: Shepard Formation (Middle Proterozoic)

Map Unit Description

Pale green, white, tan, pale-gray, and maroon, stromatolitic and oolitic dolomite, dolomitic siltite, and siltite. North of Newport, contains some dark, chlorite-green siltite beds. As mapped, unit in Clark Fork area includes upper calcareous member of Wallace Formation (Harrison and Jobin,1963). Thickness in Clark Fork area, about 300 m; northeast of Bonners Ferry, about 380 m; north of Newport, about 360 m; east of Chewelah, about 430 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yssw

Unit Name: Shepard Formation, Snowslip Formation, and Wallace Formation, undivided (Middle Proterozoic)

Map Unit Description

Argillite, siltite, and porous quartzite. West of Fan Lake, all rocks hydrothermally altered, bleached, and deeply weathered. Sedimentary features used to distinguish formations are destroyed. East of Packsaddle Mountain, poor exposure and complex structure preclude specific formational assignment (Harrison and Jobin 1965). Thickness unknown

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yss

Unit Name: Snowslip Formation (Middle Proterozoic)

Map Unit Description

Green, and medium- and dark-gray, argillite and siltite, and minor quartzite; locally, all rock-types may contain carbonate minerals. In Clark Fork area, lower part of formation contains limestone and calcareous argillite and siltite. As mapped, formation there is most of argillite member and all of argillite, siltite, and limestone member of Wallace Formation as defined by Harrison and Jobin (1963). Thickness at Clark Fork, about 1,920 m; northeast of Bonners Ferry, about 880 m; north of Newport, about 380 m; east of Chewelah, about 1,400 m thick. Clark Fork and Chewelah sections may be thickened by faults

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ywr

Unit Name: Wallace Formation and Ravalli Group, undivided (Middle Proterozoic)

Map Unit Description

Quartz-feldspar-muscovite-biotite schist and calc-silicate rock. No primary sedimentary features preserved; thickness unknown. Mapped only in area south of Calispell Peak, 24 km northeast of Chewelah

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yw

Unit Name: Wallace Formation (Middle Proterozoic)

Map Unit Description

Dolomite, dolomitic limestone, and carbonate-bearing siltite and quartzite with abundant thin interbeds of dark-gray argillite. In Clark Fork area, includes lower calcareous member and lower part of argillite member of Wallace Formation as defined by Harrison and Jobin (1963). Thickness in Clark Fork area, about 760 m; northeast of Bonners Ferry, about 1400 m; north of Newport, about 730 m; and east of Chewelah, about 800 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ye

Unit Name: Empire Formation (Middle Proterozoic)

Map Unit Description

Pale-green siltite, quartzite, argillite, dolomite, and carbonate-bearing siltite. Thickness northeast of Bonners Ferry, between 200 m and 580 m; north of Newport, 320 m. Included with St. Regis Formation east of Chewelah, and with Wallace Formation at Clark Fork

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yru

Unit Name: Undivided part (Middle Proterozoic)

Map Unit Description

Siltite, quartzite, and argillite. Mapped as undivided only between Lake Pend Oreille and Cocolalla Lake (fig. 2). Probably includes part or all of each formation of Ravalli Group (St. Regis, Revett, and Burke Formations). Moderately metamorphosed close to plutons. Thickness unknown, but probably cut by more faults than shown on map

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ysr

Unit Name: St. Regis Formation (Middle Proterozoic)

Map Unit Description

Maroon to purple siltite, argillite, and lesser quartzite. Unit characterized by ripple marks, mud cracks, mud-chip breccia, cross lamination, and fluid-escape structures. Thickness in Clark Fork area, from 180 to 335 m; northeast of Bonners Ferry, from 250 to 470 m; north of Newport, about 275 m; east of Chewelah, about 450 m as mapped (including Empire Formation)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yr

Unit Name: Revett Formation (Middle Proterozoic)

Map Unit Description

Quartzite and minor siltite; white, tan, light-gray, pink, and maroon. Formation northeast of Bonners Ferry and east of Chewelah contains larger proportion of finer grained rocks than formation in Clark Fork area. At Newport, much of formation is fine grained, maroon quartzite Thickness in Clark Fork area, about 610 m; northeast of Bonners Ferry, from 570 m to 750 m; north of Newport, about 750 m; and east of Chewelah, 950

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ybk

Unit Name: Burke Formation (Middle Proterozoic)

Map Unit Description

Siltite with minor argillite and quartzite. Most of formation is uniform, medium- to pale-gray siltite in even beds ranging in thickness from a few centimeters to about 20 cm. Upper part of formation contains zone, up to 150 m thick, of lavender siltite and argillite containing abundant ripple marks and mud-chip breccia; strongly resembles strata of typical St. Regis Formation (Ysr). Thickness in Clark Fork area, about 975 m; northeast of Bonners Ferry, about 1360 m; north of Newport, about 850m, and east of Chewelah, about 1,100 m

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ymi

Unit Name: Mafic intrusive rocks (Middle Proterozoic)

Map Unit Description

Medium- to fine-grained sills and dikes of diabase composition intruding Prichard Formation. Composed of hornblende, biotite, plagioclase, quartz, and opaque minerals. Most bodies are sills, but discordance of intrusions appears to increase progressively with depth in Prichard Formation. Zircon from sill near Bonners Ferry, Idaho gives uranium-lead age of 1,433 Ma (Zartman and others, 1982). Sills and dikes are lithologically indistinguishable from sills and dikes (ZYmi) in Wallace Formation, which represent younger periods of intrusion at 1,100 and 800 Ma (Harrison and others, 1992). Some sills in Prichard Formation could belong to the two younger sill groups

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Yp

Unit Name: Prichard Formation (Middle Proterozoic)

Map Unit Description

Interbedded quartzite, siltite, and argillite; color ranges from white and pale-gray for quartzite, pale- to medium-gray for siltite, and medium- to dark-gray for argillite. Entire formation contains pyrite, highest concentration in argillites; oxidation of pyrite causes almost all rock surfaces in Prichard Formation to be iron-stained. Thickness in Clark Fork area, about 6,000 m (Cressman, 1989); northeast of Bonners Ferry, about 5,500 m; north of Newport, about 5,200 m; and east of Chewelah, about 4,100 m; all thicknesses include mafic sills. Undetected faults are probably present in all sections

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ypm

Unit Name: Prichard Formation, metamorphosed (Middle Proterozoic)

Map Unit Description

Medium- to coarse-grained feldspar-quartz-muscovite-biotite schist and hornfels, locally containing aluminosilicates, intruded by two-mica granitic rocks of Priest River Complex. Contains bodies of medium- to coarse-grained amphibolite and garnet amphibolite derived from mafic intrusive rocks in Prichard Formation. East of Chewelah, contact with relatively unmetamorphosed Prichard Formation is gradational zone several hundred meters wide; generally placed where bedding in Prichard cannot be distinguished from metamorphic foliation. Much of unit within 4 km of Newport Fault shows incipient to strong mylonitization

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ynl

Unit Name: Newman Lake Gneiss (Middle Proterozoic?)

Map Unit Description

Biotite-quartz-plagioclase-potassium feldspar orthogneiss. Contains traces of muscovite. Fine- to coarse-grained; much of unit is megacrystic. Foliation, lineation, grain-size-reduction, and tectonic rounding of megacrysts present in most of unit; caused by intense ductile deformation. Numerous pods composed of metamorphosed Prichard Formation and associated amphibolite are distributed throughout easternmost 300 to 500 m of unit. Possible age for Newman Lake Gneiss ranges from Proterozoic to Eocene; older age is preferred because of regional association of gneiss with metamorphosed Prichard Formation, and lithologically similar orthogneiss (gneiss of Leclede, Ylg) of known Middle Proterozoic age to north

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: Ylg

Unit Name: Gneiss of Laclede (Middle Proterozoic)

Map Unit Description

Medium- to coarse-grained, megacrystic biotite orthogneiss. Composition ranges from monzogranite to granodiorite. Color index ranges from 8 to 13. Highly foliate and lineate throughout. Includes small areas of extremely heterogeneous gneiss, possibly paragneiss, on south side of Pend Oreille River and 5 km east of Priest River (fig. 2). Zircon from typical orthogneiss gives uranium-lead age of 1,578 Ma (Evans and Fischer, 1986)

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Sandpoint_rect

Map Title

Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana

Map name: Sandpoint 250K

Map Unit Symbol: sgg

Unit Name: Schist, gneiss, and leucocratic granitic rocks (age unknown)

Map Unit Description

Coarse-grained quartz-feldspar-muscovite-biotite schist and gneissic rocks that include minor amphibolite bands and pods. Mapped only around Davis Lake (fig. 2). Intruded by texturally and compositionally heterogeneous leucocratic granitic rocks. Schist and gneiss could be metamorphosed Middle Proterozoic Belt Supergroup, but appear to be more thoroughly recrystallized, contain a higher proportion of granitic material, and are uniformly, strongly deformed; unit could be pre-Belt crystalline rocks

Map Citation

Miller, F.K., Burmester, R.F., Powell, R.E., Miller, D.M., and Derkey, P.D., 1999, Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, Idaho and Montana (revision 1.0): U.S. Geological Survey Open-File Report 99-144, 71 p., 1 sheet, scale 1:250000, http://wrgis.wr.usgs.gov/open-file/of99-144/.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qal

Unit Name: Alluvium

Map Unit Description

silt, sand, and gravel along stream valleys; silt and peat in filled ponds and lakes

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qd

Unit Name: Sand dunes

Map Unit Description

reworked glaciofluvial and glaciolacustrine sand and silt; all dune areas north or west of Spokane; elongate in northeast direction; formed by prevailing southwesterly winds

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qgy

Unit Name: Younger glacial deposits

Map Unit Description

morainal till around the southwest end of Pend Oreille Lake. Remainder is glaciofluvial deposits of sand and gravel within valleys of Spokane and Little Spokane Rivers and Chamokane Creek. Some older glacial deposits such as sand and silt exposed under younger deposits in banks of Spokane River near western margin of map included where their outcrop is small. Middle and late Pinedale in age (Richmond and others, 1965)

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qls

Unit Name: Landslide deposits

Map Unit Description

areas of slump along valley walls, or surrounding the so-called bluffs, and prairies north of Spokane. Consists of broken basalt and tuff of Columbia River Group and of siltstone and sandstone of the Latah Formation. In part covered or mantled by younger glacial deposits and at some places by older glacial deposits and at other places by valley fill. Most landslides appear to be stabilized by the buttressing of younger deposits

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qgf

Unit Name: Glacial flood deposits

Map Unit Description

gravel, very poorly sorted, predominantly as constructural bars within scabland channels southwest of Spokane. Small remnants along margin of Rathdrum Prairie and Spokane Valley not delineated. In channeled scablands, material mostly basalt gravel and rubble from boulders 5 feet or more in diameter to sand size, usually subrounded to angular; remainder glacial debris. In some bars sorting and roundness appears better developed

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name Spokane 250K

Map Unit Symbol Qgo

Unit Name Older glacial deposits

Map Unit Description

glaciofluvial and glaciolacustrine deposits of silt, sand, and gravel, usually stratified and well sorted; includes some kame deposits and morainal material along margins of Spokane Valley and Rathdrum Prairie to northeast and in their tributary valleys. Masked in places by thin veneers or remnants of flood deposits. Lacustrine deposits (stippled) include sand and silt capping plateau west of Chamokane Creek, flats around Deer Park and on to east beyond the Little Spokane River, and sand with some gravel within the drainages of Latah and Deep Creeks. Bull Lake and early Pinedale in age (Richmond and others, 1965)

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Qp

Unit Name: Palouse Formation

Map Unit Description

Loess deposits of tan to brown silt and fine sand, includes a number of overlapping soil zones of differing ages, some of which have well-developed clay and caliche layers; mantles the basalt plateau and the lower, gentler slopes of hills and ridges of pre-Tertiary rock that protrude above the top surface of the basalt flows and border the flows on the eastern side. Maximum thickness 250+ feet (Ringe, 1970) in southwest and thins toward east and northeast. Thin veneer of loess that is not delineated also covers scablands and flood deposits within them

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: QTg

Unit Name: Older gravel deposits

Map Unit Description

poorly consolidated gravel, sand, and silt capping terraces and some flat ridge crests or other gently sloping surfaces. Accumulation of some deposits began after outpouring of basalt flows of the Columbia River Group which dammed stream drainages; some result from blocking of drainage to west by glacial material in Pleistocene time. Deposits all of local origin

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Tcl

Unit Name: Columbia River Group and Latah Formation

Map Unit Description

flows of dense, dark, tholeiitic basalt, usually from 50 to 150 feet thick, and all essentially flat lying. Include pillow-palagonite tuff complexes that increase in abundance toward basin margin to north and east. Chemical and modal analyses indicate that the capping flows are of the olivine-bearing late Yakima type (Waters, 1961, p. 602), whereas the underlying flows are of the olivine-poor Yakima type. In the St. Joe-St. Maries Rivers drainage the basal flows are of the Picture Gorge type. Included with the basalt and not shown separately are the interlayered or underlying lacustrine beds of the Latah Formation. These are poorly indurated siltstone, claystone, sandstone, and minor conglomerate that are tan to gray in color, thin bedded, and in part laminated, in places contain abundant impressions of Miocene leaves (Chaney, 1959). Mainly restricted to the northern and eastern peripheral areas of the basalt field. Exposed thickness of Columbia River Group ranges from the wedge-out of top flows where they impinge against the mountains and ridges, to as much as 1,000 feet in some exhumed valleys. Twice as much or more may be buried at places along west margin of map

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Ti

Unit Name: Dikes and other small intrusive bodies

Map Unit Description

dikes and smaller irregular bodies of porphyritic andesite to rhyodacite in northwestern part of map. These intrude metamorphosed Paleozoic(?) sedimentary rocks and granitic rocks; dikes have a predominant northwest to north trend. Probable intrusive equivalents of the volcanic Gerome Andesite of Becraft and Weis (1963) or of other early Tertiary granitic intrusive rocks. In southeast part of map medium- to fine-grained diabase dikes. Only two shown, but others occur along west-northwest-trending faults like the St. Joe

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: TMzg

Unit Name: Granitic rocks

Map Unit Description

plutons to batholithic complexes predominantly of quartz monzonite to granodiorite composition, but including differentiates ranging from diorite to alaskite. Most of rocks are medium- to coarse- grained and in large part porphyritic, but also include some sill-like bodies of fine-grained quartz monzonite intruded into the high-grade metamorphic rocks northeast and southeast of Spokane. Most show clean magmatic characteristics; others, like the stock exposed along St. Joe River at east edge of map, are made up largely of hybrid material including numerous inclusions of the invaded rock. Some, such as the small pluton south of Wolf Lodge Bay on Coeur d'Alene Lake, have apophyses and dikes of porphyries associated with them, but most such offshoots are too small to show on map. Radiometric ages of rocks in the quadrangle and other intrusive rocks in adjacent areas (Engels) indicate time span of emplacement from middle Mesozoic to early Tertiary

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Pzs

Unit Name: Sedimentary rocks, mostly metamorphosed

Map Unit Description

quartzite, usually micaceous, calc-silicate hornfels, mica schist, phyllite, and argillite; occurs in isolated hills and ridges that protrude above the surface of the basalt flows in northwest corner of map area. Generally poorly exposed so that stratigraphic and structural relations are obscure. In part continuous with and correlated with similar rocks in adjacent Turtle Lake quadrangle (Becraft and Weis, 1963). There the section of such rocks is presumed Paleozoic, generally trends north to northwesterly, dips steeply to the east, and may total thousands of feet in thickness

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Cl

Unit Name: Lakeview Limestone

Map Unit Description

light- to dark-gray, thin- to thick-bedded, blocky limestone; includes blocky gray dolomite unit in upper part; contains some silty to sandy layers and zones. No continuous unfaulted sections, but indicated thickness of at least 2,000 feet with top eroded. Metamorphosed to marble or hornfels adjacent to granitic intrusives

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: Crg

Unit Name: Rennie Shale and Gold Creek Quartzite

Map Unit Description

Rennie Shale - a fissile olive-colored fossiliferous shale, about 100 feet thick; exposed only infrequently and generally poorly so. Lies conformably between the Gold Creek Quartzite and the overlying Lakeview Limestone and is here mapped with the Gold Creek Quartzite.

Gold Creek Quartzite - white to pinkish vitreous coarse-grained quartzite; contains some pebble conglomerate always present at base; usually thick bedded and commonly cross-bedded; about 500 feet thick

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCl

Unit Name: Libby Formation

Map Unit Description

dominantly medium-gray to olive-colored siltite or laminated siltite and argillite. Very thinly laminated dark argillite makes up the lowest part of section in northeast corner of map and parts of uppermost beds exposed near the south-central edge of the map and also is interspersed at many other places. Several carbonate-bearing zones as much as several hundred feet thick occur in the southern areas of outcrop; usually dolomitic siltite or argillite but includes some massive beds of blue-gray dolomite and some stromatolite layers. Contains rare chert laminae in the northeast, but none in the south. Mud-chip breccia and ripple marks are common structural features; mud cracks are rare. Characteristically weathers in a blocky habit. Many of exposures in south altered to a punky, bleached rock of faded olive-green to rusty-tan color. Maximum thickness of eroded remnants in northeast is a possible 2,000 feet and in south maximum thickness varies from estimated 5,000 to 7,500 feet. Unknown amount of upper part eroded away. At some places in south is regionally metamorphosed to extent that secondary biotite is formed

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCsp

Unit Name: Striped Peak Formation

Map Unit Description

changes significantly from north to south in both thickness and lithology. At north a distinctive multi-unit consisting of a basal mixed siltite, argillite, and quartzite member of red and green color overlain successively by a tan dolomitic member, a very thinly laminated dark-gray argillite-siltite member, and capped by a dark-red arkosic quartzite unit (Harrison and Jobin, 1963). Combined thickness totals nearly 2,000 feet and is about equally divided among the four units. Basal unit thickens and overlying units wedge out southward. South of Coeur d'Alene River predominantly gray to green to purplish-red siltite with beds or layers of lighter colored quartzite; partings or interlaminations of darker argillite common,; carbonate-bearing rocks interspersed throughout section, but in minor amounts, usually as lenticular pinkish dolomite segregations, but occasionally as dolomitic bed or relatively thin zone. Medium- to coarse-grained, light-gray to reddish, feldspathic quartzite 500+ feet thick forms a persistent zone throughout the southwestern area of exposure; it occurs about 1,000 feet below the top of the formation. Mud cracks, ripple marks, and mud-chip breccia in red to green-colored rocks; salt casts and channeling are much less common structures. Several stromatolite layers occur in northern exposure areas. Micaceous sheen on bedding surfaces is characteristic at most outcrops. Altered to a punky and bleached rock of faded red to cream or rusty-tan color at many places in southwestern outcrops. Maximum thickness at southern edge of map 5,000+ feet. Transition into overlying Libby Formation, and into underlying upper part of Wallace Formation occurs through fairly narrow zones

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCw

Unit Name: Wallace Formation undivided

Map Unit Description

in Medical Lake area southwest of Spokane rock is poorly exposed in isolated hills that stand up above the top of basalt surface and usually show a wide range of effects from metamorphism. Varies from gray fissile laminated argillite or phyllite to calc-silicate hornfels or granofels, sugary quartzite, mica schist, biotite-quartz-plagioclase gneiss, and migmatite

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCwu

Unit Name: Upper part of Wallace Formation

Map Unit Description

very thinly bedded dark-gray argillite or thinly laminated dark-gray argillite and light-gray siltite; a few beds or thin zones of lighter colored siltite scattered through unit. Carbonate-bearing zone several hundred feet thick near center or toward the top and appears to persist throughout area; consists of greenish-gray to gray to dark-gray interbedded to interlaminated dolomitic argillite to siltite with some gray dolomite to dolomitic limestone beds, similar to basal unit of the lower part of Wallace. At some places dark-gray argillite, also contains carbonates. At most exposures rocks are noticeably fissile, and fairly regularly bedded. In southeastern corner of map, metamorphosed to phyllite and mica-garnet schist; some contains abundant scapolite. Thickness 2,500 to 3,000 feet. Lower contact gradational

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name Spokane 250K

Map Unit Symbol pCwl

Unit Name Lower part of Wallace Formation

Map Unit Description

two distinguishable members, undifferentiated on map. Upper unit consists predominantly of alternating black argillite and light-gray to greenish-gray siltite or quartzite, latter usually carbonate bearing; near southwestern margin of map area quartzite and siltite become dominant in zones hundreds of feet thick. Interspersed in sequence are layers of zones of rock like that in the Wallace units above and below. Lower unit, green to greenish-gray or gray, usually carbonate-bearing, interbedded or interlaminated argillite and siltite; contains many bluish-gray dolomite and dolomitic limestone beds. Blocky weathering, molar-tooth structure, and rusty-tan-weathering rind are characteristic [sic]. Mud cracks (nondesiccate in origin) and ripple marks common; fine-textured cross-bedding evident on etched surfaces of some siltite and quartzite beds. Irregularity in bedding and minor folds characteristic. In southeast corner of map metamorphosed to a hornblende (or diopside) - plagioclase hornfels, granofels, or gneiss and mica schist; in part scapolite bearing. Thickness estimated to vary from 5,000 to 7,000 feet; thinnest in and around Coeur d'Alene district

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCsr

Unit Name: St. Regis Formation

Map Unit Description

dark-red, purplish-red, green, or greenish-gray, interbedded or interlaminated, usually very thin- to thin-bedded argillite and siltite; contains some quartzite beds in basal part and becomes more argillitic toward top. Some carbonate-bearing beds in upper part. Mud cracks, mud-chip breccia, and ripple marks very common. Thickens from less than 1,000 feet at north edge to about 2,000 feet in southern part of map. Gradational into units above and below. Weathers into platy or flaggy fragments

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCr

Unit Name: Revett Formation

Map Unit Description

blocky, white to light-gray, thick-bedded, fine- to medium-grained, vitreous quartzite; somewhat feldspathic. Gray to greenish-gray, thin- to thick-bedded siltite with partings and interbeds of argillite common in upper and lower parts; siltite may be dominant rock type over zones tens of feet thick. Cross-bedding in vitreous quartzite common, and a rusty speckling due to weathering of small round carbonate segregations in some vitreous beds characteristic. Thickness from 2,000 to 3,000 feet. Transitional over hundreds of feet into units above and below

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCrb

Unit Name: Revett and Burke Formations, undivided

Map Unit Description

units lumped together where individual identity questionable in metamorphic terrane south of St. Joe fault at east edge of map, or in areas west of south end of Coeur d'Alene Lake; also south and west of Spokane where rocks are poorly exposed in isolated hills and ridges. Metamorphosed rocks vary from white coarse-grained vitreous quartzite to micaceous quartzite and mica schist. In isolated hills mostly light- to greenish-gray siltite to white vitreous quartzite; a few exposures are of rock metamorphosed to micaceous quartzite or mica schist. Some outcrops bleached and punky

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCb

Unit Name: Burke Formation

Map Unit Description

light- to medium-gray to greenish-gray, thin- to thick-bedded siltite with partings and interbeds of argillite. Some light-gray to white quartzite in scattered beds and zones. At some places, mostly peripheral to Coeur d'Alene mining district and in the lower middle part of section, rocks are reddish purple to lavender in color. Ripple marks are common in places; some cross-bedding. At many exposures has a faded weathered rind that contrasts with darker fresh rock. Fine magnetite octahedral pepper many of siltite beds. Transitional into formations above and below. Range in thickness from 2,800 to 4,500 feet; at most places is between 3,000 and 3,500 feet

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name Spokane 250K

Map Unit Symbol pCp

Unit Name Prichard Formation undivided

Map Unit Description

Formation was mapped as a single unit in western part of Coeur d’Alene district near Kellogg, and also where rocks are highly metamorphosed as those northeast to southeast of Spokane and in the southeast corner of the map area. The upper transitional zone and argillitic rocks have not been mapped separately from the predominantly siltite to quartzite below in the western part of the Coeur d’ Alene district. The metamorphosed rocks consists mainly of mica schist, quartz-plagioclase-biotite gneiss and quartzite. In area east of Spokane, the Prichard consists of gneiss, medium to coarse grained and in greater abundance than schist; sillimanite widespread here, and a decrease in metamorphic grade below sillimanite isograd noted only at northern margin and in peripheral rocks to south and southwest; migmatitic rocks also quite common in this region and at places underlie large areas such as along southern margin of Spokane Valley near Post Falls, and south from the vicinity of Dishman. In this area includes the Hauser Lake Gneiss (Weis, 1968). Mica (mostly biotite) schist is more common than gneiss in metamorphic rocks in southeast corner of map area; kyanite is a minor but common constituent in many layers, and small amounts of garnet are almost ubiquitous; migmatite, as irregular zones and veinlets, is a minor constituent (Hietanen 1963b)

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCpu

Unit Name: Upper part of Prichard Formation

Map Unit Description

dark- to medium- gray, very thin-bedded argillite commonly interlaminated with light-gray siltite and also containing some siltite beds. Grades upward into interbedded and interzoned argillite, siltite, and quartzite sequence 500 to 1,000+ feet thick, which forms the transition zone into siltitic and quartzitic units above. Argillite is rust stained on weathered surfaces; occasional ripple marks in upper part. Total thickness from 2,500 to 3,500 feet

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCpl

Unit Name: Lower part of Prichard Formation

Map Unit Description

predominantly medium- to light-gray, thin- and regularly bedded siltite, laminated in part; some argillite in laminae and beds. Some beds or zones of gray to white quartzite of lenticular habit. Disseminated pyrrhotite concentrated within certain laminae characteristic, and its weathering results in a persistent rusty-red rind on fracture surfaces. Thickness 7,500+ feet; base not exposed

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCpq

Unit Name: Quartzite

Map Unit Description

medium- to coarse-grained, in part vitreous, but mostly micaceous; in zones to hundreds of feet thick with some interlayered, more micaceous rock. Shown separately only in the more highly metamorphosed rocks

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCpp

Unit Name: Porphyroblastic gneiss

Map Unit Description

a variety of gneiss in which feldspar porphyroblasts up to two inches in length are characteristic; cataclastic features common throughout; shears and mylonite zones roughly parallel foliation of gneiss. It has been named Newman Lake Gneiss (Weis, 1963)

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_I768_rect

Map Title

Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana

Map name: Spokane 250K

Map Unit Symbol: pCqd

Unit Name: Quartz diorite or amphibolite

Map Unit Description

Quartz diorite, dark-green, fine- to coarse-grained, hornblende-plagioclase-quartz-biotite rocks intruded as sills into Prichard Formation. As much as 1,000 feet thick; only larger bodies shown on map. Amphibolite, a foliate hornblende-rich rock similar in composition to quartz diorite but occurring in more highly metamorphosed parts of the Prichard Formation. Latter shown only in southeast corner of map, but present also northeast and southeast of Spokane in highly metamorphosed rocks as sill-like bodies 5 to 100 feet thick

Map Citation

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Investigations Series I-768, 1 sheet, scale 1:250,000.

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Qa

Unit Name Alluvium

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Qp

Unit Name: Peat deposits

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Qd

Unit Name Dunes

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Qls

Unit Name: Landslide deposits

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Ql

Unit Name: Loess

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Qgl

Unit Name Glaciolacustrine deposits

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Qgd

Unit Name: Glacial drift

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Qfg

Unit Name Flood deposits, gravel

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Qglf

Unit Name Glaciolacustrine and flood deposits

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol PLMcg

Unit Name Conglomerate

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Mvwp

Unit Name Wanapum Basalt, Priest Rapids Member

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol MvgN2

Unit Name Grande Ronde Basalt, magnetostratigraphic unit N2

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Mcl

Unit Name Latah Formation

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Cymm

Unit Name: Metasedimentary rocks, undivided

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Cyq

Unit Name: Quartzite near Edwall

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Yqbh

Unit Name Buffalo Hump Formation

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Yq

Unit Name Quartzite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Ymmm

Unit Name: McHale Slate

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Ymsw

Unit Name Wallace Formation

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Ymsr

Unit Name: Ravalli Group

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Eida

Unit Name: Hypabyssal dikes

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Eigdt

Unit Name Biotite-hornblende-bearing intrusive rock near Tumtum

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Eiqms

Unit Name Silver Point Quartz Monzonite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Eiatr

Unit Name: Mount Rathdrum granite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol TKiaa

Unit Name Alaskite, pegmatite, and aplite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol TKia

Unit Name Biotite-bearing intrusive rock

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: TKiac

Unit Name: Biotite-bearing intrusive rock in Corkscrew Canyon

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol TKiamc

Unit Name Intrusive rock near Mud Creek

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol TKiaf

Unit Name Biotite-bearing intrusive rock near Four Mound Prairie

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Kiam

Unit Name Intrusive rock near the Midnite mine

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Kigdf

Unit Name: Fan Lake granodiorite (Miller, 1974c)

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Kigdw

Unit Name Granodiorite near Wellpinit

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Kiato

Unit Name: Muscovite-biotite-bearing intrusive rock near Otter Creek

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Kiats

Unit Name: Mount Spokane granite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Kiatls

Unit Name Muscovite-biotite-bearing intrusive rock near the Little Spokane River

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Kogn

Unit Name: Newman Lake Gneiss

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: Kogs

Unit Name: Orthogneiss near Mount Spokane

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol Kogsm

Unit Name Muscovite-megacryst-bearing granite near Mount Spokane

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: pCam

Unit Name: Amphibolite

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol pCbgh

Unit Name Hauser Lake Gneiss

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol pChm

Unit Name Heterogeneous metamorphic rocks

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name: SpokaneOF98_115

Map Unit Symbol: pCqz

Unit Name: Quartzite near Freeman

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol pCbgm

Unit Name Gneiss of Mica Peak

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol pCscr

Unit Name Gneiss near Round Mountain

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): Spokane_OF98_115_rect

Map Title

Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map

Map name SpokaneOF98_115

Map Unit Symbol pCbgc

Unit Name Gneiss near Cable Peak

Map Unit Description

Map Citation

Johnson, B.R., and Derkey, P.D., 1998, Digital geologic map of the Spokane 1:100,000 quadrangle, Washington and Idaho: a digital database for the 1990 N.L. Joseph map: U.S. Geological Survey Open-File Report 98-115, 13 p., 1 digital sheet, scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of98-115/

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Qa

Unit Name: ALLUVIAL DEPOSITS (HOLOCENE)

Map Unit Description

Stream deposits in modern drainages.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Qg

Unit Name: GLACIAL DEPOSITS (QUATERNARY)

Map Unit Description

Poorly sorted and poorly stratified, unconsolidated deposits principally of glacial origin. Includes till in lateral and ground moraines as well as outwash and minor modern stream alluvium.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Tsm

Unit Name: SEDIMENT (MIOCENE)

Map Unit Description

Unconsolidated, poorly sorted, fluvial sediment 70 to 330 m above the present stream levels. Ranges in size from clay to boulders and is derived from local sources (Hosterman, 1956).

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Kms

Unit Name: MONZONITE AND SYENITE (CRETACEOUS)

Map Unit Description

Small stocks of hornblende monzonite, porphyritic hornblende monzonite, alkali-feldspar syenite, and pyroxene syenite (Schlack, 1989). Age determinations have yielded conflicting dates, but emplacement ages of about 100 Ma are likely (Marvin and others, 1984; Schlack, 1989).

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ysp

Unit Name: STRIPED PEAK FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Interbedded quartzite and argillite with some arenaceous dolomitic beds; usually thinly bedded (Hobbs and others, 1965). Colors range from purplish-gray and very pale pink to gray and green. Mud cracks and ripple marks common.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ywu

Unit Name: WALLACE FORMATION, UPPER MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Predominantly thinly laminated medium- to dark-gray argillite; some interbedded light-gray quartzite and arenaceous dolomite (Hobbs and others, 1965).

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ywml

Unit Name: WALLACE FORMATION, MIDDLE AND LOWER MEMBERS, UNDIVIDED (MIDDLE PROTEROZOIC)

Map Unit Description

Light-gray dolomitic and calcareous quartzite interbedded with medium- to dark-gray argillite (Hobbs and others, 1965). Some impure dolomite beds near top. Ripple marks, small scale cross-bedding, and molar-tooth and ovoid structures in some layers. Mapped as Ywl by Hobbs and others (1965).

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ysr

Unit Name: ST. REGIS FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Thick-bedded impure to pure quartzite at base, grading upward to interbedded and interlaminated impure quartzite and argillite that comprise bulk of formation (Hobbs and others, 1965). Characteristically thin bedded and many layers laminated. Predominantly purplish red and grayish red; argillite is darker. Some carbonate-bearing beds, mostly in upper part. Ripple marks, mud cracks, and mud-chip breccia in some layers.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Yr

Unit Name: REVETT FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Thick-bedded white to light-gray quartzite containing interbedded impure and nearly pure quartzite in upper and lower parts, and a few widely spaced argillite partings (Hobbs and others, 1965). Cross-bedded and laminated in part.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ybk

Unit Name: BURKE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Light- to greenish-gray fine-grained impure quartzite with lesser amounts of nearly white to light-gray nearly pure to pure quartzite (Hobbs and others, 1965). Beds predominantly 5 to 20 cm thick. Ripple marks and pseudoconglomerate are common.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ypu

Unit Name: PRICHARD FORMATION, UPPER MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Light-gray to nearly white pure to impure quartzite interbedded with laminated argillite (Hobbs and others, 1965). Quartzite beds 5 to 45 cm thick. Ripple marks and graded bedding are common.

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): ThompsonFallsID_rect

Map Title

Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho

Map name: Thompson Falls, ID 100K

Map Unit Symbol: Ypl

Unit Name: PRICHARD FORMATION, LOWER MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Banded dark-gray argillite, laminated in part; weathers rusty red (Hosterman, 1956).

Map Citation

Lewis, R.S., and Derkey, P.D., 1999, Digital geologic map of part of the Thompson Falls 1:100,000 quadrangle, Idaho: U.S. Geological Survey Open-File Report 99-438, 32 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-438/.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Qal

Unit Name: ALLUVIAL DEPOSITS (HOLOCENE)

Map Unit Description

Gravel, sand, silt, and clay in flood plains and low terraces along present drainage. Includes alluvial fans.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Qs

Unit Name: LANDSLIDE DEPOSITS (HOLOCENE)

Map Unit Description

Angular blocks of bedrock in finer grained matrix; mixed, at places, with glacial debris.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ql

Unit Name: LAKE SEDIMENTS (PLEISTOCENE)

Map Unit Description

Buff to lavender varved clay and silt containing a few lenses of gravel and scattered dropstones. Tends to form vertical cliffs along present stream courses; old surfaces are gently rolling; eroded surfaces tend to show a badlands topography. Sediments represent bottom deposits of Glacial Lake Missoula, which was filled several times during the Pleistocene to a maximum altitude of 4,200 ft when ice dammed the mouth of the Clark Fork River (Pardee, 1910; Alden, 1953; Bretz and others, 1956).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Qg

Unit Name: GLACIAL, FLUVIOGLACIAL, AND FLOOD DEPOSITS (PLEISTOCENE)

Map Unit Description

Includes till (ground and end moraines), outwash, and other glaciofluvial deposits and flood-related deposits. Particularly abundant and thick in drainages and basins connecting to or north of the Flathead-Clark Fork River system. Torrential gravel deposits related to catastrophic emptying of Glacial Lake Missoula are in perched valleys at places along the Clark Fork River, form large point bars as terraces, form giant ripples, and show coarse cross-bedding convex upstream at the mouths of many tributaries to the Clark Fork northwest of Thompson Falls, Mont.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: QTg

Unit Name: GRAVELS (QUATERNARY AND TERTIARY)

Map Unit Description

Older deposits of gravel, sand, and silt capping low-level terraces a few tens to three hundred feet above present stream level and some high-level ridges or gently sloping surfaces as much as 1,000 ft above present stream level.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ts

Unit Name: SEDIMENTARY ROCKS (TERTIARY)

Map Unit Description

Semiconsolidated to consolidated conglomerate interlayered with shale, coal, and volcanic ash.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Td

Unit Name: DIORITIC INTRUSIVE ROCKS (TERTIARY)

Map Unit Description

Lamprophyre, diorite, and gabbro dikes and small plutons; particularly abundant in southwest where they are most commonly intruded along faults or axial-plane cleavage in chevron folds in the Wallace Formation. Thicker dikes are altered and sheared parallel to their borders; potassium-argon (K-Ar) ages of minerals in such dikes give spuriously old ages (Marvin and others, 1984).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Tv

Unit Name: VOLCANIC ROCKS (TERTIARY)

Map Unit Description

In northeast: rhyodacite vent agglomerate, volcanic conglomerate and breccia containing thin interbeds of crystal tuff, andesitic to dacitic crystal tuff characterized by large hexagonal crystals of biotite, and minor basalt. In southeast: andesitic to dacitic welded crystal tuff and a few dikes; phenocrysts in tuff are commonly fragmented and consist of smoky quartz, sanidine, plagioclase, and minor biotite.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Tg

Unit Name: GRANITIC PLUTONS AND PLUGS (TERTIARY)

Map Unit Description

Intrusive rocks ranging in composition from granodiorite to granite. Most are biotite or hornblende-biotite seriate porphyritic granodiorite; some plutonic phases contain muscovite; and a few have significant amounts of granite pegmatite. Also includes andesite porphyry in volcanic center in northeast. These rocks range in age from about 35 m.y. to about 50 m.y. (Marvin and others, 1984).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name Wallace 250K

Map Unit Symbol Tcr

Unit Name COLUMBIA RIVER BASALT GROUP (TERTIARY)

Map Unit Description

Exposed in one small area near the St. Joe River at the west edge of the map.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Kg

Unit Name: FELSIC PLUTONS (CRETACEOUS)

Map Unit Description

Mostly porphyritic hornblende-biotite quartz monzonite and granodiorite. These rocks range in age from about 70 m.y. to 120 m.y. (Marvin and others, 1984). Some of these plutons have been offset by faulting.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ks

Unit Name: SYENITE (CRETACEOUS)

Map Unit Description

Mostly medium- to coarse-grained aegirine-hornblende-mica-bearing feldspathic rocks in a complex of plutons that include syenite, fenite, and quartz syenite. About 105 m.y. old (Marvin and others, 1984).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Cs

Unit Name: CAMBRIAN SEDIMENTARY ROCKS, UNDIVIDED

Map Unit Description

Used in the southeast and in cross sections. Includes, in descending order, Red Lion Formation (shale, limestone, and dolomite), the Hasmark Dolomite, the Silver Hill Formation (shale and limestone), and the Flathead Quartzite. Rests unconformably on the Pilcher, Garnet Range, and McNamara Formations of Proterozoic age. Total thickness is about 2,700 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Cl

Unit Name: LIMESTONE AND DOLOMITE (CAMBRIAN)

Map Unit Description

Unit mapped in north-central area. Unnamed gray to tan dolomite. Consists of a lower dolomudstone about 1,020 ft thick, a middle laminated shaly unit about 280 ft thick, and an upper dolomudstone about 1,200 ft thick that has an erosional top (Aadland, 1977). Total thickness exposed is about 2,500 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Csq

Unit Name: SHALE AND QUARTZITE (CAMBRIAN)

Map Unit Description

Unit mapped in north-central area. About 300 ft of olive fissile shale (Wolsey or Gordon Shale) that contains trilobites and brachiopods of early Middle Cambrian age (Keim and Rector, 1964). Underlain by red to maroon quartzite at base grading up into buff quartzite (Flathead Quartzite). Base of quartzite has sparse trace fossils. Quartzite thickness about 30 ft. Disconformably overlies Libby Formation of Proterozoic age; micaceous and hematitic weathered zone in upper few feet of Libby. Disconformity has thin secondary chert zone along it.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: ZYd

Unit Name: MAFIC SILLS AND DIKES (LATE AND MIDDLE PROTEROZOIC)

Map Unit Description

Dioritic to gabbroic rocks that commonly show alteration of mafic minerals. Sills and dikes range in thickness from less than 3 ft to 1,500 ft. Thicker sills tend to have wide (600 ft) contact-metamorphosed zones around them. Sills commonly persist for many kilometers; some maintain approximately the same stratigraphic position, whereas others cut up through the section. Dikes are rare. Only the larger or more persistent sills and dikes are shown. Intrusion occurred at least twice (at about 1,400 m.y. and 800 m.y.; Harrison, 1972).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ypi

Unit Name: PILCHER QUARTZITE (MIDDLE PROTEROZOIC)

Map Unit Description

Mostly red to light pink, cross-bedded, micaceous and feldspathic fine-grained quartzite containing thin, shaly, argillitic layers in the upper part. Pre-Flathead erosion has removed all the Pilcher in places, and a complete section is nowhere present. The maximum exposed thickness is about 1,770 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ygr

Unit Name: GARNET RANGE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Predominantly gray-green micaceous siltite containing beds and zones of fine-grained quartzite and dark-green to black argillite; calcareous at places. Red argillite and siltite zones are rare and scattered through upper two-thirds of formation. Lower part is predominantly black or dark-green laminated argillite and siltite, calcareous at places, and contains a few stromatolite beds, oolite beds, and black or green chert in chips and layers. Most of the unit shows mud chips, mud cracks, ripple marks, small-scale cross-beds, and cut-and-fill structures. Red weathered zone a few feet thick is present beneath Flathead Quartzite where Flathead rests on Garnet Range. Anomalous amounts of chalcopyrite in places in lower black argillite; chalcocite and bornite in a few green strata. Thickness is about 8,200 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yl

Unit Name: LIBBY FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Consists mostly of interlaminated argillite and siltite and, in the upper part, quartzite. Contains three informal members. Upper member is mostly black interlaminated argillite and siltite and contains abundant mud-crack casts, ripple marks, and soft-sediment structures. Green fine- to medium-grained cross-bedded quartzite and siltite become common in upper half. A zone of red interlaminated argillite and siltite occurs in the north-central part of the quadrangle near the top of the section about 300 ft below the erosional unconformity that terminates the unit. Red weathered zone is present at top of Libby beneath the unconformity. Middle member is mostly evenly laminated dark-green argillite and light-green siltite and contains mud chips, chert chips and beds, cut-and-fill structures, and ripple marks. Anomalous amounts of chalcocite or bornite occur in a few beds. Lower member is black and white or green interlaminated argillite and siltite and contains scattered beds of dolomite and stromatolites. Maximum exposed thickness of Libby is about 5,500 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ym

Unit Name: MC NAMARA FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Interbedded, laminated and interlaminated red and green argillite and siltite; ripple marks, mud cracks, scours, and small-scale cross-bedding common; rare salt casts. Distinctive, very fine grained, dense, mostly pale-green but locally red siltites are common in beds generally less than 8 in. thick. A few chert beds are present, and rounded chert grains and chips are common. A few green strata contain anomalous amounts of chalcocite and bornite. Thickness is about 3,600 ft in the southeast. In the north-central area, the unit is mostly green laminated argillite containing only sparse red argillite, sparse chert, and rare stromatolites; thickness about 300 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ybo

Unit Name: BONNER QUARTZITE (MIDDLE PROTEROZOIC)

Map Unit Description

Red to pink, micaceous, arkosic, cross-bedded, fine- to medium-grained quartzite containing red argillite interclasts: tabular and trough cross-beds and climbing ripples common. Interbeds of red laminated argillite increase in abundance to west and north. Northernmost exposures contain scattered beds of planar-laminated green fine-grained quartzite as much as 30 ft thick. Ranges in thickness from about 1,400 ft in the southeast to about 500 ft in the north-central area.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ysp

Unit Name: STRIPED PEAK FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Type locality for the Striped Peak Formation (Ransome and Calkins, 1908) is on Striped Peak, a few kilometers southwest of Wallace, Idaho. Here, and at more extensive exposures about 10 km southwest of the peak, the formation (Ysp) consists of four informal members. The upper member consists of interbedded red and green laminated argillite and siltite that contains mud chips, ripple marks, mud cracks, and salt casts. The erosional remnant of this member on Striped Peak is about 300 ft thick, but it is about 2,300 ft thick a few kilometers to the southwest. The member below is a buff-weathering stromatolitic dolomite about 200 ft thick. The third member down section is a red, medium-grained, planar-bedded, stromatolitic dolomite containing some dolomite cement and streaks and is about 650 ft thick. The basal member is interbedded argillite, siltite, and quartzite that are dominantly red in color but contain some green strata; mud cracks, ripple marks, and small-scale cross-beds are common; the member is about 1,000 ft thick. Anomalous amounts of copper sulfides occur at places in green beds of the lower part of the Striped Peak and in the carbonate members. The Striped Peak as originally defined is the red rock sequence above black argillites of the upper part of the Wallace Formation. Using this definition, Anderson (1930) called red strata above the Wallace and below the Libby Formation in the Clark Fork, Idaho, area the Striped Peak Formation (fig. 2). In the Clark Fork area, the sequence of members seen at Striped Peak is found in the lower 600 ft of section (fig. 2); above this, Harrison and Jobin (1963) mapped: a dolomite member about 400 ft thick characterized by boxwork structure, stromatolites, and oolites; a black interlaminated argillite and siltite member about 300 ft thick; and a red arkosic, planar-bedded, fine- to medium-grained quartzite member about 650 ft thick. All these units are included in the Striped Peak Formation (Ysp) mapped in the northwestern part of the area.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yspp

Unit Name: Dolomite and black laminated argillite members of the Clark Fork section

Map Unit Description

In the north-central area, range from 0 ft to 400 ft in thickness and are mapped between the Mount Shields Formation, equivalent to the Striped Peak at Striped Peak, and the Bonner Quartzite, equivalent to the quartzite member of the Striped Peak at Clark Fork. These two members, along with some beds in the upper part of the Wallace Formation, commonly contain several hundred parts per million of boron (Harrison and Grimes, 1970)-a feature unique to the western facies in this part of the stratigraphic section.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yms

Unit Name: MOUNT SHIELDS FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Consists of three informal members. The upper member is interbedded laminated argillite and siltite; dominantly red with minor green strata in the lower part, but dominantly green argillite and siltite containing dolomitic beds near the top. Red strata commonly contain salt casts, mud cracks, mud chips, and ripple marks. Some green strata contain anomalous amounts of chalcocite and bornite or, more rarely, chalcopyrite. Ranges in thickness from about 3,300 ft in the south, where upper green-bed zone is about 100 ft thick, to about 1,000 ft in the north where upper green-bed zone is about 330 ft thick: Middle member is red fine-grained arkosic planar-bedded quartzite containing at places tan dolomitic lenses, streaks, and cement; has a zone of red stromatolite beds near top. Ranges in thickness from about 3,300 ft in the southeast to about 650 ft in the north. Basal member is interbedded siltite, quartzite, and argillite; dominantly red in color but contains some green argillite and siltite; mud cracks, mud chips, ripple marks, and cut-and-fill structures abundant. Argillite is commonly in partings between planar beds of micaceous arkosic siltite and quartzite. Ranges in thickness from about 3,300 ft in the southeast to about 1,000 ft in the north.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ysh

Unit Name: SHEPARD FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Predominantly thinly and evenly laminated, green and pale-green dolomitic argillite; weathers readily into tan platy rubble. Stromatolite heads or beds are scattered through the section but particularly in lower part. A few green strata have anomalous amounts of copper sulfides. Near middle of unit contains a zone about 300 ft thick that has two or more thin (10-ft-thick) beds of red interlaminated argillite and siltite. Ranges in thickness from about 1,200 ft in the southeast to about 2,200 ft in the north. Unit is missing in the west.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ysn

Unit Name: SNOWSLIP FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Interbedded red and green interlaminated argillite and siltite contains mud cracks, mud chips, and ripple marks. Dolomitic beds scattered through section. Commonly has green-bed zone at base. Chlorite and muscovite on bedding planes. Green beds at places contain anomalous amounts of disseminated chalcocite and bornite. In northern area contains an interlaminated black and white argillite unit about 390 ft thick. Thickness of Snowslip ranges from about 1,600 to 1,800 ft. Unit is missing in southwest and west.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ywu

Unit Name: Upper member

Map Unit Description

The upper member of the Wallace, as exposed on the south side of Striped Peak and on Foolhen Mountain, was divided into three lithologic units by Shenon and McConnel (1939). The middle unit can be further subdivided, so that in those localities the upper member of the Wallace consists of, from youngest to oldest: (1) an upper zone of black, thinly laminated argillite similar to the lower zone but including beds showing intricate small folds from soft-sediment deformation; (2) a zone of dolomite, stromatolites, and oolites containing interbeds of green dolomitic argillite; (3) a zone of green planar-laminated argillite and siltite that is pyritic and dolomitic; and (4) a lower zone of thinly laminated black argillite containing some green laminated argillite, moderately abundant desiccation cracks, and cut-and-fill structures. The uppermost contact is fairly sharp and is marked by the appearance of green or red siltites and quartzites of the overlying Striped Peak Formation. The lowermost contact of the upper member grades into the alternating beds of black argillite and white siltite of the middle member of the Wallace. Lithologic units and their proportions vary in the upper member. To the north, the characteristic black laminated argillite is interbedded in various proportions with green laminated argillite and with minor amounts of red laminated argillite. In the type locality, the upper member is overlain by the basal unit of the Striped Peak (equals Mount Shields), but in other areas it is overlain by either the Snowslip or Shepard Formation. Ranges in thickness from 0 ft in the southeast to about 5,000 ft in the northwest.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yw

Unit Name: Middle and lower members, undivided

Map Unit Description

Middle member: Characteristic lithology is uneven and wavy bedded; black argillite alternates with slightly dolomitic white siltite or very fine grained quartzite layers that range from an inch to 20 in. in thickness; this is the unit exposed in the type locality of the Wallace in road cuts and valleys at the town of Wallace, Idaho. Also included are some beds of black laminated argillite, green interlaminated argillite and siltite, and dolomitic argillite. Zones of dolomitic argillite and siltite similar to rocks of the lower member, some of which show vertical ribbons of calcite ("molar tooth structure"), are commonly a few feet thick but may dominate in zones 1,300 ft thick. To the south and southeast, sedimentary breccias of high carbonate content are common and are associated with large slump folds in zones as thick as 60 ft. The breccias consist of angular fragments of quartzite and blocks of typical middle Wallace lithology suspended in a silty matrix and cemented by calcite, dolomite, iron-carbonate, and quartz; these breccias are commonly dotted by crystals or pseudomorphs of scapolite or shortite(?). Thicker breccias and slumped zones tend to be near the base, but occur throughout the middle member in the southwestern and south-central part of the area. The brecciated and slumped zones are well displayed in road cuts along Trout Creek south of Superior, Mont. Unit contains rare salt casts. Metamorphosed rocks in the south-central area have light-gray scapolite crystals speckled through black argillite. The contact with the lower member is gradational and is placed where the green laminated dolomitic argillites begin to dominate the section. Thickness ranges from about 7,000 ft in the south to about 4,400 ft in the north.

Lower member: Dominantly green interlaminated dolomitic argillite and siltite, some of which contains irregular vertical ribbons ("molar tooth structure") and pods or irregular blobs of calcite. Most of the unit contains some carbonate, either as impure beds or cement. Beds containing stromatolites are scattered through the section. Unit also contains a few interbeds having lithologies similar to those characteristic of the middle and upper members. Lower contact is sharp where underlain by the quartzite member or by purple laminated argillites of the St. Regis, but is gradational where green laminated argillite occurs at the top of the St. Regis. Rocks typical of the unit are well exposed in cirques at the head of drainages on both sides of the Idaho-Montana line in the south-central area. Thickness ranges from about 8,200 ft in the south to about 500 ft in the north part of the map area.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ywm

Unit Name: Middle member

Map Unit Description

Characteristic lithology is uneven and wavy bedded; black argillite alternates with slightly dolomitic white siltite or very fine grained quartzite layers that range from an inch to 20 in. in thickness; this is the unit exposed in the type locality of the Wallace in road cuts and valleys at the town of Wallace, Idaho. Also included are some beds of black laminated argillite, green interlaminated argillite and siltite, and dolomitic argillite. Zones of dolomitic argillite and siltite similar to rocks of the lower member, some of which show vertical ribbons of calcite ("molar tooth structure"), are commonly a few feet thick but may dominate in zones 1,300 ft thick. To the south and southeast, sedimentary breccias of high carbonate content are common and are associated with large slump folds in zones as thick as 60 ft. The breccias consist of angular fragments of quartzite and blocks of typical middle Wallace lithology suspended in a silty matrix and cemented by calcite, dolomite, iron-carbonate, and quartz; these breccias are commonly dotted by crystals or pseudomorphs of scapolite or shortite(?). Thicker breccias and slumped zones tend to be near the base, but occur throughout the middle member in the southwestern and south-central part of the area. The brecciated and slumped zones are well displayed in road cuts along Trout Creek south of Superior, Mont. Unit contains rare salt casts. Metamorphosed rocks in the south-central area have light-gray scapolite crystals speckled through black argillite. The contact with the lower member is gradational and is placed where the green laminated dolomitic argillites begin to dominate the section. Thickness ranges from about 7,000 ft in the south to about 4,400 ft in the north.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ywl

Unit Name: Lower member

Map Unit Description

Dominantly green interlaminated dolomitic argillite and siltite, some of which contains irregular vertical ribbons ("molar tooth structure") and pods or irregular blobs of calcite. Most of the unit contains some carbonate, either as impure beds or cement. Beds containing stromatolites are scattered through the section. Unit also contains a few interbeds having lithologies similar to those characteristic of the middle and upper members. Lower contact is sharp where underlain by the quartzite member or by purple laminated argillites of the St. Regis, but is gradational where green laminated argillite occurs at the top of the St. Regis. Rocks typical of the unit are well exposed in cirques at the head of drainages on both sides of the Idaho-Montana line in the south-central area. Thickness ranges from about 8,200 ft in the south to about 500 ft in the north part of the map area.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ywq

Unit Name: Quartzite member

Map Unit Description

White, sugary quartzite consisting mostly of quartz and plagioclase plus very minor amounts of chlorite and sericite. Ranges in grain size from medium sand to silt. Thinly laminated but blocky; mostly planar bedding and long tabular cross-bedding; some festoon cross-bedding. Contains thin zones of black argillite at places. Occurs at base of formation, but also is intertongued and interlensed with both middle and lower members. Tongues and lenses have some calcite, dolomite, or iron carbonate cement, as well as thin beds lithologically similar to the surrounding rocks. Contacts with other units are fairly sharp. This member occurs only in the southwest where it is well exposed along Boulder Creek and on hills to the north; tongues and lenses are well exposed along Sisters Creek and at Simmons Peak. Ranges in thickness from 0 ft to about 2,500 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yh

Unit Name: HELENA FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

This formation is the eastern and more carbonate-rich facies of the "middle Belt carbonate." Predominantly dolomite, dolomitic siltite, and dolomitic argillite. Characterized by 3- to 10-foot-thick cycles that begin on a cut surface and consist of gray or green dolomitic argillite, fine-grained quartzite, and siltite that grade upward into impure dolomite, which is overlain by dense orange-weathering dolomite. Irregular calcite ovoids and ribbons commonly change from horizontal pods to vertical pods and, at some places, to vertical ribbons in the impure dolomitic beds. Stromatolites and oolites are present. Upper part has zones as much as 150 ft thick that are similar to the middle member of the Wallace Formation and consist of abundant black argillite irregularly interlayered with dolomitic siltite; these zones commonly display soft-sediment deformation structures. Pyrite and minor chalcopyrite scattered throughout unit. Thickness about 8,800 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ye

Unit Name: EMPIRE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Mostly thinly and evenly laminated light and dark-green dolomitic argillite or argillite and siltite. Flattened ovoids of pink or white calcite commonly weather out and leave distinctive zones of subhorizontal voids in the exposures. Mud chips and pebbles, mud cracks, and ripple marks are common. A few shallow channels are filled by subrounded plates of limestone (rip-up clasts). Contains red argillite zones near middle of unit. Pyrite common; anomalous amounts of chalcopyrite, chalcocite, and bornite in a few strata, particularly near base. Thickness from 0 ft in the west to about 1,200 ft in the east.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ysr

Unit Name: ST. REGIS FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Alternating beds of dark-purple and dark-green interlaminated argillite and siltite. Lower part has beds of light-purple siltite and very fine grained quartzite; upper part is dolomitic. Abundant deformed mud-crack casts, mud chips, and ripple marks. Some green strata contain anomalous amounts of copper sulfides. Type locality is at the headwaters of the Saint Regis River. Thickness ranges from about 1,000 to 3,000 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ys

Unit Name: SPOKANE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Three lithologic units can be found in most areas. The upper unit is about 400 ft thick and is similar to lower unit, but has more green beds and contains medium-grained white quartzite beds as much as 4 in. thick. In many areas, one or more of the green beds contains anomalous amounts of chalcocite and bornite. Middle unit is about 900 ft thick and consists of alternating beds of purple argillite and pink to purple-gray, very fine grained feldspathic quartzite or coarse siltite; quartzite beds show planar cross-bedding and are as much as 50 ft thick. The lower unit is about 1,700 ft thick and is dominantly purple to purple-gray, thinly laminated argillite or argillite and siltite; mud cracks, ripple marks, fluid-escape structures, mud-chip breccias, small ball-and-pillow structures, and flute casts are common. Some dolomite cement and scattered siderite specks. A few beds of pale-purple siltite and quartzite. Green dolomitic argillite layers a few feet thick occur near base and top; some contain anomalous amounts of copper sulfides.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yr

Unit Name: REVETT FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Characterized in its type locality (Coeur d'Alene district) by white medium-grained cross-bedded quartzite interbedded with white siltite and green laminated argillite. Quartzite shows horizontal lamination, planar cross-bedding, festoon cross-bedding, and climbing ripples; channels, load casts, and soft-sediment structures are common; heavy mineral laminations are present on cross-beds at many places. Argillitic rocks contain mud cracks, mud chips, and ripple marks. Northeast and east from type locality, unit contains progressively less quartzite and more siltite and argillite, much of which is purple or purple gray. Consists in most areas of three lithologic units: upper and lower units dominated by quartzite, and a middle unit containing quartzite interbedded with abundant argillite and siltite. Hematitic banding in quartzite and siltite commonly forms pseudocross-bedding that transects true bedding. Zone of abundant white quartzite trends north from type locality and contains, at places, anomalous amounts of silver and copper sulfide that reach ore grade in a few localities. Thickness of Revett ranges from about 500 ft to 2,500 ft.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Yb

Unit Name: BURKE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Several lithologic units can be identified at many places and commonly include the following four:

(1) an upper zone similar to the one underlying it, except it contains white to purple-gray fine- to medium-grained quartzite beds 3-6 ft thick that increase in abundance upward;

(2) a zone of green-gray to purple-gray interbedded blocky argillite and siltite that contain mud cracks and mud chips;

(3) a zone dominated by parallel- and thinly laminated gray to purple-gray siltite in blocky planar beds that have minor argillite partings or beds; and

(4) a lower zone of green parallel-laminated interbedded argillite and siltite that are generally in beds about 2 in. to 20 in. thick and give a blocky-flaggy outcrop (upper part of this zone has purple-gray interbeds of argillite and siltite).

Siltites are commonly speckled by tiny euhedral magnetite crystals. Anomalous amounts of chalcocite occur near the top of the lower zone and in zone (2). Thickness ranges from about 2,500 ft in the type locality near Burke, Idaho, to about 3,450 ft in the north and northeast to the thickest known section of about 7,500 ft in the southeast.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ypu

Unit Name: Upper part

Map Unit Description

The upper part, as used here, includes a transition zone, as originally used by Hobbs and others (1965), consisting of pyritic black and gray laminated, wavy and lenticularly bedded argillite and siltite that contain thin blocky beds of pyritic green argillite and siltite, cut-and-fill structures, and ripple marks, plus a lower zone of pyritic, evenly laminated, black and gray argillite and siltite in planar couplets that range from 0.5 in. to 1 in. in thickness; the basal 650 ft contains some beds of planar-laminated quartzite. Base of this part is the top of the gray micaceous quartzite sequence that is present throughout the area and marks the top of the lower part of the Prichard Formation. Some mappers have limited the upper part to the transition zone only, whereas others have placed the transition zone in the Burke Formation; we have not changed their contacts in this compilation. Thickness of the unit ranges from about 1,970 ft to 5,250 ft, depending in large part on whether only the transition zone was mapped as the upper part of the Prichard.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Ypl

Unit Name: Lower part

Map Unit Description

Consists of seven lithologic units. The informal members identified by Cressman (1981, 1982) in the area of Plains, Mont., include from top to bottom:

(1)Planar-laminated medium-gray fine-grained micaceous quartzite interbedded with olive-gray siltite and medium-light-gray argillite; quartzite beds grade to argillite in top 0.5-1 in. Thickness 1,640 ft.

(2)Interlaminated and very thinly interbedded dark-gray and light-gray argillite and siltite; pyrite or pyrrhotite laminae are present locally. Black tourmaline-bearing chert bed as much as 12 in. thick is present locally. Argillite pebble conglomerate that contains scattered clasts of galena-sphalerite is present locally in lower part. Thickness from 3,200 ft to 3,600 ft.

(3)Interlaminated siltite and argillite interbedded with some quartzite, particularly in lower part; cross-bedding, scour-and-fill structures, mud cracks, and mud-chip breccias common. Thickness 2,710 ft.

(4)Platy-weathering olive-gray silty argillite that contains abundant chlorite porphyroblasts and sparse garnet; some interbedded quartzite in lower part and interbedded siltite in upper part. Thickness about 950 ft.

(5)Medium-gray fine-grained quartzite in beds 1-2 ft thick; planar laminated in part; cross-lamination in upper part of some beds; beds grade to argillite in top 0.5-1 in. Thickness 250 ft to 360 ft.

(6)Graded siltite-argillite couplets several tenths of an inch to an inch thick; siltite is dark gray; argillite is light gray. Some black argillite laminations contain felted masses of tourmaline. About 15 percent of the member consists of slump folds in composite slump sheets that average 2.5 ft thick. Thickness about 3,280 ft.

(7)A member similar in lithology to member above but without slump folds. About 1,970 ft exposed.

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Xan

Unit Name: ANORTHOSITE (EARLY PROTEROZOIC)

Map Unit Description

Massive coarse-grained light-bluish-gray anorthosite consisting entirely of andesine-bytownite; some foliated anorthosite is dominantly plagioclase but also contains hornblende, epidote, chlorite, and garnet (Hietanen, 1963).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): Wallace_geo_rect

Map Title

Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho

Map name: Wallace 250K

Map Unit Symbol: Xgn

Unit Name: GNEISS AND SCHIST (EARLY PROTEROZOIC)

Map Unit Description

Highly folded and interlayered biotite-quartz-plagioclase gneiss, quartz gneiss, amphibolite, granite orthogneiss, and mica schist. These rocks are a minimum of 1,600 m.y. old (Marvin and others, 1984).

Map Citation

Harrison, J.E., Griggs, A.B., and Wells, J.D., 1986, Geologic and structure maps of the Wallace 1° X 2° quadrangle, Montana and Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-1509-A, scale 1:250000.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Qa

Unit Name: ALLUVIAL DEPOSITS (HOLOCENE)

Map Unit Description

Stream deposits in modern drainages.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Qog

Unit Name: OLDER GRAVELS (QUATERNARY)

Map Unit Description

Unconsolidated deposits on terraces above the modern drainages. Some may be glacial outwash deposits.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Qg

Unit Name: GLACIAL DEPOSITS (QUATERNARY)

Map Unit Description

Poorly sorted and poorly stratified, unconsolidated deposits principally of glacial origin. Includes till in lateral and ground moraines as well as outwash and minor modern stream alluvium.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Tsm

Unit Name: SEDIMENT (MIOCENE)

Map Unit Description

Unconsolidated, poorly sorted, fluvial sediment preserved in erosional remnants 250 to 350 m (800 to 1150 ft) above the present river bottoms. Includes beds of cobble gravel, sand, and orange-weathering clay. Slumps are common.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Tcr

Unit Name: COLUMBIA RIVER BASALT GROUP (MIOCENE)

Map Unit Description

Small exposure of basalt in the extreme western part of the map area.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Tdp

Unit Name: PORPHYRITIC DACITE DIKES (EOCENE)

Map Unit Description

Gray dikes that contain plagioclase, biotite, and hornblende phenocrysts in an aphanitic groundmass

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Tgd

Unit Name: HORNBLENDE-BIOTITE GRANODIORITE (EOCENE)

Map Unit Description

Light-gray, medium- to coarse-grained, equigranular to porphyritic granodiorite. The Roundtop pluton contains about 20 percent quartz, 50 percent zoned euhedral plagioclase, 15 to 25 percent orthoclase, and 5 to 15 percent hornblende and biotite combined (Hietanen, 1968). Fabric is weak to absent in most places, but gently-dipping igneous flow foliation is present in the central part of the pluton and strongly developed contact-parallel mylonitic foliation and lineation is present in the southern part (Steve Box, pers. comm., 1997). Age is 52±7 Ma by U-Pb methods on zircon (Marvin and others, 1984). The Herrick stock contains biotite, minor hornblende, and plagioclase that is in part strongly zoned (Holland, 1947). The Herrick stock is deeply weathered except along the St. Joe River canyon. Hornfels has formed adjacent to this intrusion and forms a resistant ridge along its northeast side.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: TKgb

Unit Name: GABBROIC AND DIORITIC DIKES AND SILLS (CRETACEOUS OR EOCENE ?)

Map Unit Description

Medium- to fine-grained, equigranular hornblende-pyroxene gabbro and diorite. Hornblende is present as either rims on pyroxene or completely replacing pyroxene and olivine is present at a few localities (Hietanen, 1963; 1968). Plagioclase constitutes about 30 to 40 percent of the rock and has all anorthite content of 45 to 74 percent. Some exposures are highly altered, but others, particularly in the southwest part of the area , are unaltered. Typically intruded along or near fault zones. Includes the Wishard Sill of Pardee (1911) which is exposed along the state line from Wishard Peak northwest to beyond Dominion Peak. Age is highly uncertain, as no reliable radiometric dates are available. Hietanen (1968) assigned them a Tertiary age. Harrison and others (1986) assigned only the southern exposures this age, and thought the Wishard sill was Proterozoic. A whole-rock K-Ar age of 575±4 Ma on the Wishard sill (Marvin and others, 1984) may represent a partially reset Proterozoic age, or an incorrect old age resulting from excess argon.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Kgd

Unit Name: BIOTITE GRANODIORITE (CRETACEOUS)

Map Unit Description

Light-gray, medium- to coarse-grained, massive to foliated, (muscovite-) biotite granodiorite. Pegmatite dikes and biotite schlieren are common in the intrusion along the Little North Fork of the Clearwater River (Hietanen, 1963). None of these rocks have been reliably dated, but the presence of a foliation, muscovite, and an abundance of pegmatites suggest a Cretaceous age.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Kog

Unit Name: ORTHOGNEISS (CRETACEOUS)

Map Unit Description

Gray, medium-grained, strongly foliated (hornblende-) biotite tonalite, granodiorite, and quartz diorite. Contains euhedral epidote interpreted to be magmatic in origin. Foliation is mylonitic at several localities. No reliable dating of these rocks exists, but a Cretaceous age is likely given the degree of fabric development.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yan

Unit Name: ANORTHOSITE (MIDDLE PROTEROZOIC?)

Map Unit Description

White to light-gray, foliated to massive, medium- to coarse-grained anorthosite. Contains bimodal plagioclase populations (andesine and bytownite) and minor amounts of hornblende, biotite, and chlorite (Hietanen, 1963). Weathers more readily than surrounding metasedimentary rocks. Hietanen (1963) speculated that the anorthosite formed by metamorphic rather than igneous processes.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yam

Unit Name: AMPHIBOLITE (MIDDLE PROTEROZOIC)

Map Unit Description

Dark-gray, foliated or lineated hornblende-plagioclase rocks, typically garnet-bearing. May in part be metamorphosed carbonate-bearing rocks, but most are thought to be metamorphosed igneous sills and dikes (Hietanen, 1963).

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysp

Unit Name: STRIPED PEAK FORMATION, UNDIVIDED (MIDDLE PROTEROZOIC)

Map Unit Description

Quartzite-dominated interval in the northwestern part of the area where subdivision into members has not been attempted.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysp3

Unit Name: STRIPED PEAK FORMATION, MEMBER THREE (MIDDLE PROTEROZOIC)

Map Unit Description

Red to light-gray, decimeter-- to meter-scale beds of fine- to medium-grained parallel-laminated quartzite. Informally termed member three in this report. Exposed at the type section on Striped Peak where approximately 305 m (1,000 ft) is exposed. The upper part is truncated by faulting, so this represents a minimum thickness. Laterally equivalent to the Bonner Quartzite, described to the cast (Harrison and others, 1986). Contains abundant K-feldspar (18-23 percent) and lesser amounts of plagioclase (6-7 percent) based on two samples stained for feldspar.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysp2

Unit Name: STRIPED PEAK FORMATION, MEMBER TWO (MIDDLE PROTEROZOIC)

Map Unit Description

Red and subordinate green siltite and argillite interbedded with minor amounts of quartzite and carbonate. Beds are typically centimeter to millimeter scale. Informally termed member two in this report. Exposed at the type section on Striped Peak where it is approximately 105 m (350 ft) thick. Laterally equivalent to member 3 of the Mt. Shields Formation, described to the east (Harrison and others, 1986).

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysp1

Unit Name: STRIPED PEAK FORMATION, MEMBER ONE (MIDDLE PROTEROZOIC)

Map Unit Description

Red or gray fine- to very fine-grained quartzite and subordinate amounts of siltite, argillite, and carbonate. At Cedar Mountain, north of Avery, unit consists of fine-grained quartzite in tabular, decimeter- to meter-thick beds with green siltite and argillite along partings. Lower part of unit there grades upwards from Ywu3 with increasing 5 to 10 cm white quartzite beds and dark green siltite, increasing ripple-drift cross lamination and rippled tops and more common mud cracked surfaces. Some beds are graded and there seem to be thinning and fining-upward cycles, Rocks highest in section are 20 to 40 cm thick flat-laminated quartzites with rippled tops and rarer mud-cracked thin argillite caps. Carbonate is present in some thin (~5 cm) zones at or near bedding surfaces. Entire member exposed at the type section on Striped Peak where it is approximately 245 m (800 ft) thick. Informal unit designated here is laterally equivalent to Mt. Shields Formation, members 1 and 2, described to the east (Harrison and others, 1986). A single sample of quartzite from Striped Peak stained for feldspar contained about 20 percent plagioclase and no K-feldspar.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywu3

Unit Name: WALLACE FORMATION, UPPER MEMBER THREE (MIDDLE PROTEROZOIC)

Map Unit Description

Carbonate-free microlaminated and wavy couplets of siltite and argillite. Most argillite is light green but some is black. Mapped and described by Hobbs and others (1965) in part of the Coeur d’Alene mining district, and by Vance (1981) south of the district. Vance (1981) estimated a thickness of about 400 m (1300 ft) on the northeast side of Foolhen Mountain. May be equivalent to Wallace 5 of Clark Fork section (Harrison and Jobin, 1963) or upper Shepard (Burmester, 1986; Lemoine and Winston, 1986).

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywu2

Unit Name: WALLACE FORMATION, UPPER MEMBER TWO (MIDDLE PROTEROZOIC)

Map Unit Description

Rock is typically microlaminated dark-green siltite and light-green argillite, and dolomitic siltite beds 2 to 5 cm thick. Thin quartzite lenses and starved ripples produce a lenticular sediment type. More quartzitic in southeast part of area where unit contains an abundance of load casts on bed bottoms. Vance (1981) estimated a thickness of about 210 m (700 ft) on the northeast side of Foolhen Mountain. Likely correlates with Wallace 4 of Clark Fork section (Harrison and Jobin, 1963). May be equivalent to the middle or lower part of Shepard Formation (Lemoine and Winston, 1986).

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywu1

Unit Name: WALLACE FORMATION, UPPER MEMBER ONE (MIDDLE PROTEROZOIC)

Map Unit Description

Dark-gray, thinly laminated argillite and siltite in the lower part grading upward to green thinly laminated argillite and siltite. Rare, thin (2-5 cm) coarse siltite or very fine-grained quartzite layers have ripple-drift cross lamination and ripple tops. Upwards, bedding becomes thinner and more planar with the highest gray rocks being microlaminated white-weathering siltite and black (biotitic?) argillite with characteristic planar partings. Above that, dark green siltite and light green argillite becomes more abundant and thickly and unevenly laminated, with more thin rippled quartzite beds and mud chips and mudcracked surfaces. Top is gradational into Ywu2 with siltite and argillite becoming more microlaminated. Equivalent to the Snowslip Formation in the Missoula area to the northeast (Winston, 1986). Unit lacks the red argillite and siltite of the Snowslip, and the gray thinly laminated lower part is missing from the Snowslip to the northeast. An estimated a thickness of about 460 in (1500 ft) on Foolhen Mountain, south of the Coeur d’Alene district (Vance, 1981) is probably a minimum because the lower contact is not exposed there.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywml

Unit Name: WALLACE FORMATION, MIDDLE AND LOWER MEMBERS, UNDIVIDED (MIDDLE PROTEROZOIC)

Map Unit Description

Unit in the Coeur d’Alene mining district (Ywl of Hobbs and others, 1965) where subdivision into separate members has not been attempted. Also includes structurally complex rocks in the southwest part of the map area.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywm

Unit Name: WALLACE FORMATION, MIDDLE MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Characterized by pinch and swell couplets (Winston, 1986) of white quartzite that grade upward into black argillite caps. The quartzite is fine- to very fine-grained, commonly calcareous, with hummocky to low-angle cross-stratification and scoured or loaded basal contacts. Centimeter-scale beds of silty, molar-tooth limestone and dolostone are widespread. Zones of tan-weathering calcareous siltite to very fine-grained quartzite with black, non-calcareous argillite caps (black and tan rock type) are locally common. Microlaminated white siltite to black argillite is present, although not dominant. Minor zones with horizontal pods of non-resistant calcareous siltite are present low in the section. Amalgamated, decimeter beds of quartzite grading to cm-scale, tan, non-resistant, calcareous siltite and thin black argillite caps occur in some intervals, and commonly underlie or are interspersed with zones of sedimentary breccia. The breccia typically consists of rounded to angular, pebble- to boulder-sized calcareous quartzite clasts in orange-weathering calcitic siltite matrix with abundant soft-sediment deformation features. Outcrops of the breccia are commonly silicified and form prominent hoodoos. Several breccia zones mapped by Nord (1967) as fault breccias are interpreted here as sedimentary breccia.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ywl

Unit Name: WALLACE FORMATION, LOWER MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Characterized by wavy, even, thin laminations and less common couplets of green siltite with light green to white argillite caps. Lenticular couplets locally common. Intervals of "tri-color" white quartzite, dark green siltite, and pale green argillite alternate with the laminated green siltite-argillite lower in the unit. Carbonate is present in the lower part as punky-weathering, molar tooth silty limestone beds up to 1 m in thickness. Zones of horizontal pods of silty carbonate are common in the upper part of the unit; the carbonate is non-resistant and normally weathers out, leaving distinct voids. Pinch and swell couplets of white and quartzite and black argillite increase in abundance toward the top of the unit, as do thin intervals of the "black and tan" rock type, characteristic of Ywm.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysw

Unit Name: SCHIST AND PHYLLITE OF THE UPPER WALLACE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Gray to brown muscovite-biotite schist and phyllite that is coarsest in the southern part of the area and grades into argillite and siltite to the north and east. Micas grow to about 5 mm, but grain size in biotite quartzite (siltite part of protolith) remains small. Lowest rocks are scapolite-rich, graded dark-gray to black siltite and argillite in even to wavy couplets. Growth of scapolite may have destroyed microlaminae. Rocks commonly show metamorphic succession from tabular chloritoid, increasing size garnets, staurolite, then kyanite (Lang and Rice, 1985a). Compositional layering is typically parallel to foliation, but locally is folded isoclinally with centimeter- to outcrop-scale wavelengths. Mapped as schist within the Wallace Formation by Hietanen (1968). Unit is the metamorphic equivalent of Ywu1. Contact with Ywu1 drawn at the garnet isograd.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yqm

Unit Name: QUARTZITE OF THE MIDDLE WALLACE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Medium-grained, thin-bedded quartzite that contains minor amounts of calc-silicate minerals (primarily actinolite and diopside) and thin layers of phyllitic black argillite or schist that locally contain scapolite. The lower contact west of the Roundtop pluton appears to be gradational with downward decreasing quartzite content and bedding thickness and increasingly even bedding style. Equivalent to less-metamorphosed rocks of Ywm and Ywml units. Mapped by Hietanen (1968) as quartzite unit of Wallace Formation.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysr

Unit Name: ST. REGIS FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Thick-bedded impure to pure quartzite at base, grading upward to interbedded and interlaminated impure quartzite and argillite that comprise bulk of formation (Hobbs and others, 1965). Characteristically thin bedded to laminated. Predominantly purplish red and grayish red; argillite is darker. Some carbonate-bearing beds, mostly in upper part. Ripple marks, mud cracks, and mud-chip breccia in some layers. Rocks at Ward Peak along the state line, tentatively assigned to Ysr, are green siltite and light green to white argillite with lesser amounts of wavy, decimeter-scale quartzite beds. Abundant white rounded argillite rip-up clasts are present, some with unusually equant dimensions. These rocks resemble Ywl, but are assigned to Ysr because of quartzite beds, scarcity of carbonate, and the presence of abundant rip-ups. Similar rocks arc described and mapped (where exposures permitted) as uppermost St. Regis in the Coeur d Alene mining district (Ysg unit of Hobbs and others, 1965). Along Gold Creek the St. Regis is characterized by rounded mud-chip rip-ups and evenly bedded, cm-scale white quartzite grading up into cm-scale black argillite caps.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yr

Unit Name: REVETT FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Thick-bedded white to light-gray quartzite containing interbedded impure and nearly pure quartzite in upper and lower parts, and a few widely spaced argillite partings (Hobbs and others, 1965). Cross-bedded and laminated in part.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ybk

Unit Name: BURKE FORMATION (MIDDLE PROTEROZOIC)

Map Unit Description

Light- to greenish-gray fine-grained impure quartzite with lesser amounts of nearly white to light-gray nearly pure to pure quartzite (Hobbs and others, 1965). Beds predominantly 5 to 20 cm thick. Ripple marks and pseudoconglomerate are common.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ysrv

Unit Name: SCHIST OF THE RAVALLI (?) GROUP (MIDDLE PROTEROZOIC)

Map Unit Description

Muscovite-rich schist, thin quartzite intervals, and minor calc-silicate rocks. Garnet present but neither abundant nor ubiquitous. Exposures west of Granite Peak show increasing amounts of quartzite down section, assuming the relict NE-dipping bedding is upright. Unit probably is equivalent to the St. Regis Formation of the Ravalli Group, but may include part of the Revett Formation. Tentatively assigned to the Ravalli Group on the basis of stratigraphic position.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yqrv

Unit Name: QUARTZITE OF RAVALLI (?) GROUP (MIDDLE PROTEROZOIC)

Map Unit Description

Mostly fine-grained, sugary and friable white feldspathic quartzite with muscovitic partings and rare, thin biotite quartzite tops. Minor fine- to medium-grained (1-2 mm) biotite-muscovite schist. Unit is probably equivalent to the Revett Formation of the Ravalli Group, but may include part of the Burke and St. Regis Formations. Tentatively assigned to the Ravalli Group on the basis of stratigraphic position. Thickness is about 800 m (2500 ft) west of Granite peak where this unit includes what Hietanen (1968) mapped as Wallace quartzite. It is not assigned here to the Wallace because features expected of metamorphosed Wallace were not found. Among these are relict pinch and swell bedding, evidence of carbonate such as scapolite or calc-silicate mineral assemblages, and schist and quartzite proportions and thicknesses similar to siltite-argillite and quartzite observed in the Wallace lithologies to the north.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ypu

Unit Name: PRICHARD FORMATION, UPPER MEMBER (MIDDLE PROTEROZOIC)

Map Unit Description

Light gray to nearly white impure to pure quartzite interbedded with laminated argillite (Hobbs and others, 1965). Quartzite beds 5 to 45 cm thick. Ripple marks, mud cracks, and graded bedding are common.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Ys

Unit Name: SCHIST (MIDDLE PROTEROZOIC?)

Map Unit Description

Typically dark, rusty-weathering coarse-grained (5 mm micas) biotite-muscovite-feldspar-quartz schist. Commonly crenulated; locally garnetiferous or sillimanite-bearing [sic]. Also contains as discontinuous layers fine-grained (muscovite)-biotite-feldspar quartzite with moderately-developed foliation. This quartzite is similar to unit described below but generally represents less than 10 percent of the Ys unit. Includes rocks assigned by Hietanen (1968) to Prichard Formation. Some of the unit at Monumental Buttes originally assigned to the Prichard Formation (Hietanen, 1963) but later assigned to the Boehls Butte Formation and thought to be pre-Belt in age (Hietanen, 1984). Correlation with specific Belt Supergroup (or older) units is too speculative at the present time, but most are probably metamorphic equivalents of the Prichard Formation.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yq

Unit Name: QUARTZITE (MIDDLE PROTEROZOIC?)

Map Unit Description

Gray to white, coarse- to medium-grained quartzite. Includes rare garnetiferous and calc-silicate concentrations. Mapped by Hietanen (1968) as quartzite of the Prichard Formation and later subdivided to include quartzite of Boehls Butte Formation (Hietanen, 1984). Most is probably quartzite of the Prichard Formation, but present understanding of stratigraphy and structure in the area precludes assignment to a formation.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: Yc

Unit Name: CALC-SILICATE ROCKS (MIDDLE PROTEROZOIC?)

Map Unit Description

Bluish gray-green, medium- to coarse-grained rocks rich in diopside, hornblende, or both (Hietanen, 1963). Quartz, plagioclase, tremolite, scapolite, and calcite are also present.

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): WallaceID_rect

Map Title

Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

Map name: Wallace, ID 100K

Map Unit Symbol: d

Unit Name: Dike

Map Unit Description

Map Citation

Lewis, R.S., Burmester, R.F., McFaddan, M.D., Derkey, P.D., and Oblad, J.R., 1999, Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho (online version 1.0): U.S. Geological Survey Open-File Report 99-390, 46 p., scale 1:100000, http://wrgis.wr.usgs.gov/open-file/of99-390/.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qs

Unit Name: Detrital deposits

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qci

Unit Name: Cemented ice-contact deposits localized by hot springs

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qh

Unit Name: Hot-spring deposits

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qhe

Unit Name: Hydrothermal-explosion deposits

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpci

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Gibbon River flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcf

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Solfatara Plateau flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcy

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, West Yellowstone flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpct

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Trischman Knob dome

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpck

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Douglas Knob dome

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcg

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Grants Pass flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcn

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Nez Perce Creek flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpch

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Hayden Valley flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcl

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Summit Lake flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcp

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Pitchstone Plateau flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpce

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Elephant Back flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcw

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, West Thumb flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpca

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Aster Creek flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcr

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Bechler River flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcd

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Dry Creek flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcm

Unit Name: Plateau Rhyolite, Central Plateau Member, Central Plateau Area, Mary Lake flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcb

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Buffalo Lake flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpcc

Unit Name: Plateau Rhyolite, Central Plateau Member, Madison Plateau Area, Spring Creek flow

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpr

Unit Name: Plateau Rhyolite, Roaring Mountain Member

Map Unit Description

Spans the age range of Central Plateau Member

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qps

Unit Name: Plateau Rhyolite, Shoshone Lake Tuff Member

Map Unit Description

Ash flows

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpo

Unit Name: Plateau Rhyolite, Obsidian Creek Member, rhyolite flows and domes

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpom

Unit Name: Plateau Rhyolite, Obsidian Creek Member, rhyolite-basalt mixed lavas

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpu

Unit Name: Plateau Rhyolite, Upper Basin Member

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qo

Unit Name: Osprey Basalt

Map Unit Description

Includes some gravel

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qmr

Unit Name: Madison River Basalt

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qf

Unit Name: Falls River Basalt

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qsl

Unit Name: Swan Lake Flat Basalt

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qml

Unit Name: Basalt of Mariposa Lake

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qso

Unit Name: Sediments

Map Unit Description

Interlayered with Plateau Rhyolite

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qpm

Unit Name: Plateau Rhyolite, Mallard Lake Member

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qyl

Unit Name: Lava Creek Tuff of Yellowstone Group

Map Unit Description

Welded ash flows

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Quf

Unit Name: Undine Falls Basalt

Map Unit Description

Includes some gravel

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qmj

Unit Name: Mount Jackson Rhyolite

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qtn

Unit Name: Sediments and basalts of the Narrows

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qlc

Unit Name: Lewis Canyon Rhyolite

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qyh

Unit Name: Huckleberry Ridge Tuff of Yellowstone Group

Map Unit Description

Welded ash flows

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qjb

Unit Name: Junction Butte Basalt

Map Unit Description

Includes some gravel

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Qbc

Unit Name: Rhyolite of Broad Creek

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: QTh

Unit Name: Heart Lake Conglomerate

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Ta

Unit Name: Absaroka Volcanic Supergroup

Map Unit Description

Andesitic volcaniclastic rocks. Intrusive rocks: Plugs, laccoliths, dikes, sills, and irregular bodies of several ages. Age relations not known for all rocks, but some (on Bunsen Peak) older than part of Sepulcher Formation; others (on Meldrum Mountain

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Ti

Unit Name: Absaroka Volcanic Supergroup and related intrusive rocks, rhyodacite, quartz latite, quartz monzonite, and granodiorite in the Gallatin Range

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tid

Unit Name: Absaroka Volcanic Supergroup and related intrusive rocks, dacite

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tia

Unit Name: Absaroka Volcanic Supergroup and related intrusive rocks, andesite dikes

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Twi

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, Wiggins Formation

Map Unit Description

Light colored adesitic vocaniclastic rocks with andesite lava flows in upper part

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: To

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, Two Ocean Formation

Map Unit Description

Dark colored andesitic volcaniclastic rocks of alluvial facies; andesitic lava flows locally in lower part and on Eagle Peak

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tli

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, intrusive rocks of Two Ocean and Langford Formations

Map Unit Description

Andesite, diorite, and quartz monzonite

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tl

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, Langford Formation

Map Unit Description

Dominantly light-colored andesitic volcaniclastic rocks and andesite lava flows

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlp

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, Langford Formation, Promontory Member

Map Unit Description

Tongues of dark-colored rocks of alluvial facies

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlf

Unit Name: Absaroka Volcanic Supergroup, Thorofare Creek Group, Langford Formation, andesite lava flows

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tt

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Trout Peak Trachyandesite, lava flows, breccia, and conglomerate

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Ttp

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Trout Peak Trachyandesite, Pacific Creek Tuff Member

Map Unit Description

Light colored rhyodacite ash-flow tuff

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tti

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Trout Peak Trachyandesite, dikes

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tm

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Mount Wallace Formation

Map Unit Description

Dominantly andesitic and basaltic lava flows; lesser volcanic sediments

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tms

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Mount Wallace Formation, Slough Creek Tuff Member

Map Unit Description

Light-colored ash-flow tuff

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tch

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Crescent Hill Basalt

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tw

Unit Name: Absaroka Volcanic Supergroup, Sunlight Group, Wapiti Formation

Map Unit Description

Dark colored andesitic and basaltic volcaniclastic rocks and lava flows

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Ts

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation

Map Unit Description

Dominantly light-colored andesitic rocks

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tsf

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation, Fortress Mountain Member

Map Unit Description

Dark colored alluvial facies

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tsd

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation, Daly Creek Member

Map Unit Description

Light colored alluvial and vent facies

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlc

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation, Lost Creek Tuff Member

Map Unit Description

light colored rhyodacite ash-flow tuff

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tec

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation, Elk Creek Basalt Member (also a member of Lamar River Formation)

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tsc

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Sepulcher Formation, principally nonvolcanic conglomerate, fanglomerate, and breccia facies

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlr

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Lamar River Formation, volcaniclastic rocks

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlrf

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Lamar River Formation, andesite flows

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlri

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Lamar River Formation, Sulphur Creek stock and associated dikes

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tlrb

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Lamar River Formation, bodies of intrusive breccia

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Tc

Unit Name: Absaroka Volcanic Supergroup, Washburn Group, Cathedral Cliffs Formation

Map Unit Description

Light-colored andesitic volcaniclastic rocks

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: TKv

Unit Name: Volcanic rocks

Map Unit Description

Basalt lava flows, andesitic tuff, and epiclastic sandstone, siltstone, and claystone. Occurs only in northwestern part of the park

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: TKp

Unit Name: Pinyon Conglomerate

Map Unit Description

Sandstone and conglomerate

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kl

Unit Name: Landslide Creek Formation, Everts Formation, Eagle Sandstone, Telegraph Creek Formation, Cody Shale, and Frontier Sandstone

Map Unit Description

Sandstone and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kh

Unit Name: Harebell Formation

Map Unit Description

Sandstone, siltstone, and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kb

Unit Name: Bacon Ridge Sandstone

Map Unit Description

Sandstone and siltstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kc

Unit Name: Cody Shale

Map Unit Description

Shale and sandstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kf

Unit Name: Frontier Formation

Map Unit Description

Sandstone and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kmk

Unit Name: Mowry Shale, Thermopolis Shale, and Kootenai Formation

Map Unit Description

Sandstone and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Kmt

Unit Name: Mowry and Thermopolis Shales

Map Unit Description

Shale, siltstone, and sandstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: KJm

Unit Name: Cloverly and Morrison(?) Formations

Map Unit Description

Sandstone and claystone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Jm

Unit Name: Morrison Formation

Map Unit Description

Sandstone, and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Je

Unit Name: Ellis Group

Map Unit Description

Sandstone, shale, and limestone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Js

Unit Name: Sundance and Gypsum Spring Formations

Map Unit Description

Sandstone, shale, and limestone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: TRt

Unit Name: Thaynes(?), Woodside, and Dinwoody Formations

Map Unit Description

Shale, limestone, and sandstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: TRc

Unit Name: Chugwater and Dinwoody Formations

Map Unit Description

Siltstone, shale, and sandstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Ps

Unit Name: Shedhorn Sandstone

Map Unit Description

Sandstone, dolomite, and chert

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Pp

Unit Name: Phosphoria Formation and related rocks

Map Unit Description

Sandstone, dolomite, and chert

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: PPq

Unit Name: Quadrant Sandstone and Amsden Formation

Map Unit Description

Sandstone and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: PPMt

Unit Name: Tensleep Sandstone and Amsden Formation

Map Unit Description

Sandstone, limestone, and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Mm

Unit Name: Madison Group

Map Unit Description

Limestone and dolomite

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: DOt

Unit Name: Three Forks Formation, Jefferson Formation, and Bighorn Dolomite

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Dd

Unit Name: Darby Formation

Map Unit Description

Dolomite

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: OCb

Unit Name: Bighorn(?) Dolomite, Gallatin Limestone, and Gros Ventre Formation

Map Unit Description

Limestone, dolomite, and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Cs

Unit Name: Snowy Range Formation and Pilgrim Limestone

Map Unit Description

Limestone and shale

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: Cp

Unit Name: Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone

Map Unit Description

Shale, limestone, and sandstone

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: pCg

Unit Name: Gneiss and schist

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.

Geologic map unit descriptions

MrSID® filename(s): YellowstoneNP_rect

Map Title

Geologic map of Yellowstone National Park

Map name: Yellowstone

Map Unit Symbol: OW

Unit Name: Open water

Map Unit Description

Map Citation

U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Investigation Series Map I-711, 1:125,000.