U.S. DEPARTMENT OF THE INTERIOR
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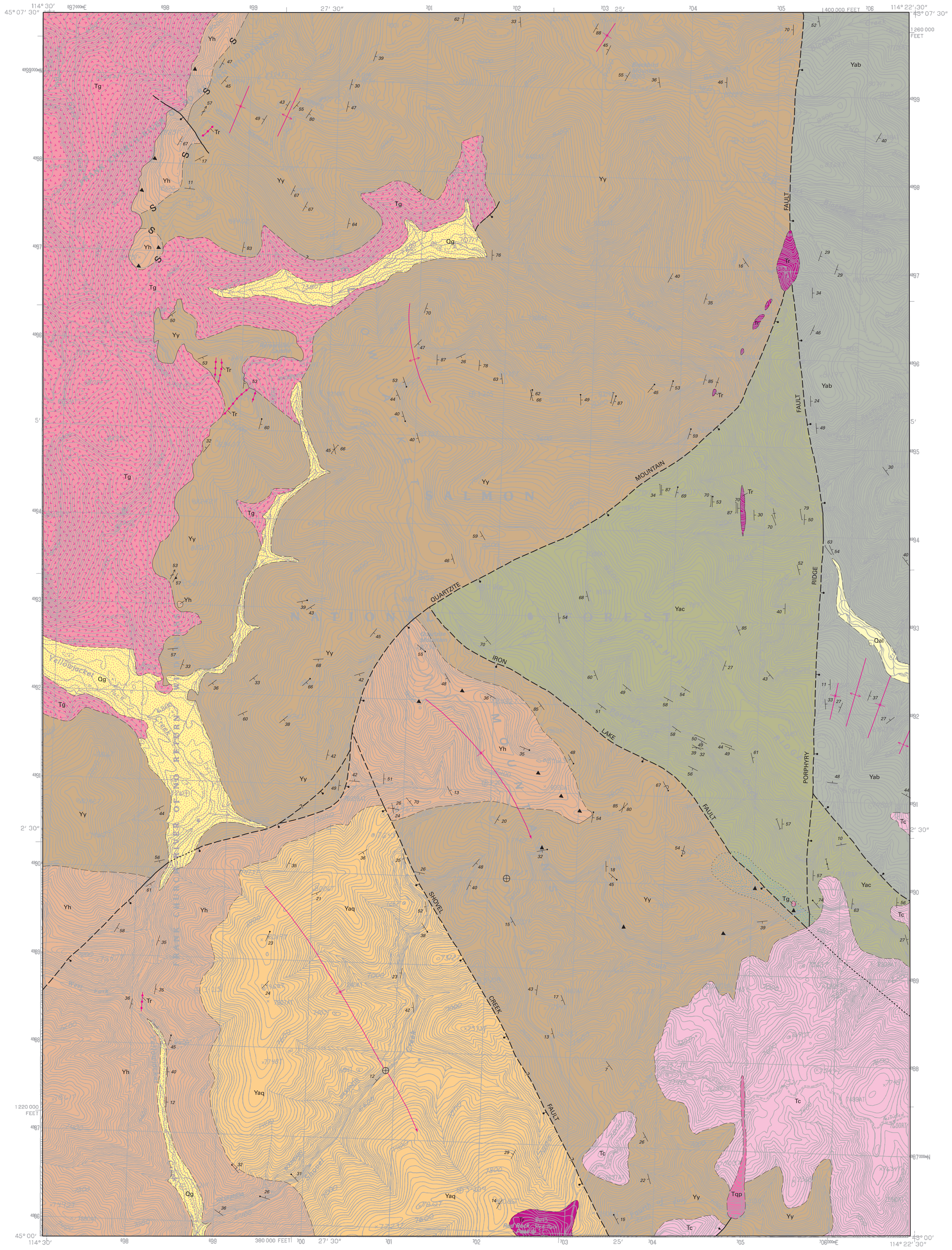
Version 1.0



Base from U.S. Geological Survey, provisional edition 1989.
Transverse Mercator projection.
1,000 meter Universal Transverse Mercator grid, zone 11.
10,000 foot State grid ticks, Idaho, central zone.
1927 North American datum

SCALE 1:24 000

1 1/2 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

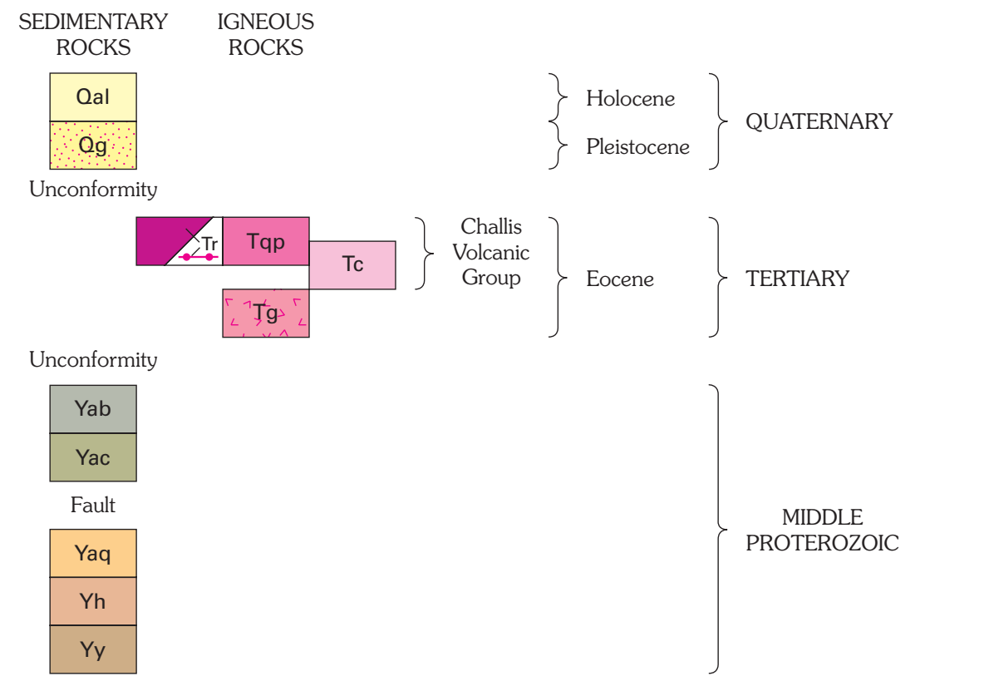
IDAHO
QUADRANGLE LOCATION

Geology mapped by R.G. Tysdal, 1995–97, K.V. Evans, 1981–85, 1989, 1997, and K.I. Lund, 1997
Geologic map digitized by Esther Castellano
Editing and layout by Alessandro J. Donatich
Manuscript approved for publication June 7, 2000

GEOLOGIC MAP OF THE BLACKBIRD MOUNTAIN QUADRANGLE, LEMHI COUNTY, IDAHO

By
R.G. Tysdal, K.V. Evans, and K.I. Lund
2000

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal **Alluvial deposits (Holocene)**—Overbank deposits and unconsolidated clay, silt, sand, and gravel along modern stream courses; includes some colluvium and slope wash

Qg **Glacial deposits, undivided (Holocene and Pleistocene)**—Glacial till, lateral and locally terminal moraines, and glaciofluvial deposits. Includes alluvium locally. Shown only where extensive areas of bedrock concealed

Challis Volcanic Group and related intrusive rocks (Eocene)

Tr **Rhyolite intrusions**—At Red Rock Peak (southern edge of quadrangle), consists of light-gray to pink, columnar-jointed rhyolite that contains 9 percent phenocrysts composed mostly of euhedral alkali feldspar (3–6 mm), minor quartz (1–2 mm), and sparse altered mafic minerals. Unit includes vesicular brown latite that crops out near the triangulation station and helipad. Alkali feldspar yielded a K-Ar date of 44.6±1.5 Ma (Ekren, 1988). Near Quartzite Mountain fault, medium-gray to greenish-gray rhyolite plugs contain less than 10 percent phenocrysts of smoky quartz (1–3 mm), alkali feldspar (1–3 mm), and plagioclase (1–2 mm) in an aphanitic groundmass. Locally, rhyolite is propylitically altered and silicified

Tqp **Porphyry intrusion**—Pink porphyry that typically contains smoky quartz phenocrysts as large as 3–4 mm, tabular alkali feldspar and sparse plagioclase as large as 6–8 mm, and sparse flakes or books of biotite as large as 3 mm; groundmass of quartz and alkali feldspar is dense and micrographic or microgranular and cryptocrystalline (Ekren, 1988)

Tc **Volcanic rocks, undivided**—Consists mainly of tuff of Ellis Creek intercalated with potassium-rich basalt flows; at base, locally hosts phenocryst-rich dacite lavas that contain abundant plagioclase, biotite, and hornblende (Ekren, 1988)

Tg **Granite of Bighorn Crags pluton (Eocene)**—Pink to pinkish-gray hornblende-biotite syenogranite. Within exposed deeper part of pluton, on west side of map area, rocks are medium- to coarse-grained equigranular, contain about 10 percent mafic minerals, and display a potassium feldspar to plagioclase ratio of about 2:1. In chill-zone facies near roof and especially in upper part of Musgrove Creek, several varieties of porphyritic granite, granite porphyry, and porphyritic rhyolite contain potassium feldspar and plagioclase phenocrysts as long as 0.75 cm in a fine-grained matrix. In western part of quadrangle, the Yellowjacket Formation (Yy) is a hornfels near the pluton; in zone as far as 10 cm from the granite, the Yellowjacket is recrystallized and new minerals formed. A bleached and silicified zone extends 10–15 cm outward from contact. Minor narrow, 1- to 3-cm-wide zones of brecciation of country rocks also formed during emplacement. Ductile deformation in country rocks near eastern contact in the Yellowjacket Creek drainage suggests that pluton may have intruded near an older, top-to-east ductile fault. Granite is exposed along gently east dipping eastern roof zone of the Bighorn Crags pluton. On the basis of roof geometry and the presence of Eocene dikes (Tr) in eastern part of quadrangle, granites probably underlie the sedimentary rocks of much of map area

Apple Creek Formation (Middle Proterozoic)—Divided into four informal units in descending order: banded siltite (Yab), coarse siltite (Yac), diamictite, and fine siltite. Only upper two units are present within quadrangle, each of which is shown separately on map and described separately below. In the Salmon River Mountains, Connor and Evans (1986), Connor (1990), and Evans and Connor (1993) assigned strata correlative with the banded siltite unit and the conformably underlying coarse siltite unit to their middle and lower subunits, respectively, of the Yellowjacket Formation. Connor (1990) correlated the lower subunit with similar strata in the Lemhi Range. Tysdal (2000) determined that the lower subunit was not part of the Yellowjacket as defined originally by Ross (1934) and reassigned the strata to the coarse siltite unit of the Apple Creek Formation. Mapping of Tysdal (1996a, b) and Tysdal and Moye (1996) in the Lemhi Range previously had defined the coarse siltite unit, and the successively underlying diamictite and fine siltite units, and correlated them with the Apple Creek Formation. The Apple Creek originally was named and mapped by Anderson (1961) near Hayden Creek (see "Index map") in northern part of Lemhi Range

Yab **Banded siltite unit**—Beds of light-gray, coarse-grained siltite that grade upward into dark-gray biotitic siltite and argillite, giving rock a banded appearance; metamorphosed to biotite-grade greenschist facies. Light-gray siltite beds are planar to ripple crosslaminated; they typically are sharply based and locally eroded into underlying strata, producing slight angular truncation of underlying laminae. Beds commonly are 2–10 cm thick, although graded beds as thick as 0.75 m occur locally. Some sequences as thick as 10 m are composed of repeated graded siltite layers 0.5–1 cm thick. Unit is characterized by abundant load casts 0.5–1 cm across, and by "dikelets" (named by Connor and Evans, 1986), each of which is a tabular-shaped feature that projects downward from a siltite bed of the same composition. In cross section, "dikelets" typically are 0.5–2 cm high and 1–5 mm wide at the top; the third dimension generally is unknown, but ranges from at least 1 to 5 cm. "Dikelets" are widely distributed within unit and occur in several-meter-thick zones of beds. Conformable above the coarse siltite unit to the east (Connor and Evans, 1986), where the base is exposed. Thickness east of quadrangle estimated at 2,000 m by Evans and Connor (1993)

Yac **Coarse siltite unit**—Gray-green, medium- to coarse-grained siltite and fine-grained sandstone; metamorphosed to biotite-grade greenschist facies. Fine-grained siltite and argillite are uncommon. Graded bedding characterizes unit, with many beds composed of repeated graded layers 0.5–1 cm thick. Distinctive erosionally based graded beds, as thick as 50 cm, occur intermittently throughout unit and are composed of light-gray, quartz-rich, coarse-grained siltite to fine-grained metasandstone that grade upward into dark-gray siltite; beds are structureless in lower part and ripple to plane-bedded in upper part. Zones of convolute lamination occur sporadically within unit. Climbing ripples are present locally, and in some beds grade upward into siltite that displays water-escape structures. Current ripples and syneresis cracks common. Base not exposed in quadrangle. Thickness to east estimated at 3,300 m by Connor and Evans (1986). Stratigraphic relationship to the unnamed argillaceous quartzite unit (Yaq) is uncertain; contact is a fault (see "Structure" section)

Yaq **Unnamed argillaceous quartzite unit (Middle Proterozoic)**—Medium-gray to gray-green biotitic siltite, and interbeds of fine-grained quartzite and quartz-rich metasandstone; metamorphosed to biotite-grade greenschist facies. Siltite is thin bedded, planar laminated to ripple crosslaminated; quartzite and quartz-rich metasandstone beds are most abundant in lower strata of unit. Flaser and lenticular bedding are common, particularly in lower part. Lower 100+ m of unit is transitional with the underlying Hoodoo Quartzite (Yh). Upper strata of unit eroded; no thickness has been measured, but we estimate preserved thickness of more than 400 m

Yh **Hoodoo Quartzite (Middle Proterozoic)**—Light-gray to white, locally brownish gray to medium gray quartzite and orthoquartzite; contains minor feldspar, biotite, and sericite; metamorphosed to biotite-grade greenschist facies. Bedding commonly is indistinct. Internal features range from indistinct to well defined; steeply inclined crosslamination of dunes (megaripples) is common. Oscillatory, current, and locally linguoid ripples are present. Beds generally are tightly cemented, hence the unit forms ledges and cliffs. South of quadrangle, Ekren (1988) reported lower exposed strata contain local thin units of marble interbedded with calcareous metasandstone; quartzite beds a few centimeters thick, with little or no calcite, alternate with strata that contain more calcite and calc-silicate minerals than quartz. At McEleny Mountain, about 6 km directly west of southwest corner of quadrangle, lower strata of the Hoodoo contain calcareous metasandstone interbedded with quartzite. The Hoodoo conformably overlies the Yellowjacket Formation. However, the contact is locally sheared in areas of intense deformation because of the high ductility contrast between the resistant orthoquartzite of the Hoodoo and the readily deformed siltite of the Yellowjacket. Ross (1934) reported 1,085 m (3,560 ft) of Hoodoo in a measured section that extended into sourthern part of quadrangle, along Yellowjacket and Shovel Creeks

Yy **Yellowjacket Formation (Middle Proterozoic)**—Formation as defined originally by Ross (1934), consisting only of strata that lie beneath the Hoodoo Quartzite. Interbedded dark-gray and gray-green siltite and less abundant dark-gray to locally light gray fine-grained quartz-rich biotitic sandstone; meter-thick sequences of siltite are locally interlayered with 2- to 10-mm-thick layers of argillite. Strata are metamorphosed to biotite-grade greenschist facies. The most characteristic feature is ripple crosslamination. Other common features include mudchips, fluid-escape structures, local herringbone crosslamination, climbing ripples, mudcracks, and syneresis cracks. Load casts 0.5–1 cm thick also present. Calcareous metasandstone, marble (metalimestone), calc-silicate beds, and scapolite-rich beds are present in western part of quadrangle, along ridge that extends south from Remenclau Saddle to the large meadow along Yellowjacket Creek. Similar rocks occur in lower strata of principal reference ("type") section of Ross (1934), along Yellowjacket Creek south of quadrangle, where they are interbedded with metasandstone (Ross, 1934; Ekren, 1988). Some of the calcareous rocks there form discrete lenses (Carter, 1981). Scapolitic rocks there and in quadrangle are rich in sodium and are interpreted as metaevaporites by Tysdal and Desborough (1997). Base of formation is not exposed in quadrangle and has not been observed in central Idaho. A thickness of about 2,743 m (9,000 ft) was reported by Ross (1934) along Yellowjacket and Shovel Creeks, in the principal measured section, which extended into southern part of quadrangle

INTRODUCTION

The Blackbird Mountain quadrangle lies in the western part of the Salmon National Forest and is important to the study of the Forest for the following reasons. (1) The quadrangle contains the western part of the cobalt-bearing Blackbird mining district. The steeply dipping Quartzite Mountain fault, a major fault that transects the quadrangle, delimits the western extent of the mining district and the western extent of the stratabound cobalt-bearing rocks of the Apple Creek Formation. These observations are important to the mineral and environmental assessment of the Salmon National Forest. (2) The map area is critical to determination of the spatial and relative timing relationships of structure, stratigraphy, and intrusive and extrusive rocks in this and other areas of the forest. (3) Some areas of the quadrangle were mapped by Tysdal (2000) to aid reconciliation of conflicting interpretations of Middle Proterozoic stratigraphy in the Lemhi Range and the Salmon River Mountains. The map portrays details that could not be shown in the page-size text illustration in that report.

Metric units are used throughout this report, except where the original measurement was in English units. The English unit then is given in parentheses following the metric unit.

STRUCTURE

Major structural features shown on the geologic map are briefly described in this section. Relationships with mineralization and the timing of deformation and emplacement of intrusive and extrusive rocks also are presented. None of the stratigraphic units of the conformable Proterozoic succession, Yellowjacket–Hoodoo–argillaceous quartzite, have been found in depositional contact with other Proterozoic strata. However, the general structural relationships displayed in this quadrangle, in combination with those displayed on the map of Ekren (1988, pl. 2), strongly suggest that the Yellowjacket Formation and associated strata were thrust over the Apple Creek Formation and associated strata. The normal faults depicted in the Blackbird Mountain quadrangle acted to dismember this thrust sheet. Assuming older-over-younger thrusting, the Yellowjacket–Hoodoo–argillaceous quartzite sequence is older than the Apple Creek Formation. The correlation diagram of Ekren (1988, pl. 2) showed the Yellowjacket and associated strata to be older than the Apple Creek Formation and to be in structural contact with the Big Creek–Apple Creek sequence. Within the Blackbird Mountain quadrangle, however, Ekren (1988, pl. 1) mapped Apple Creek strata as Yellowjacket, whereas southeast of the quadrangle he included contiguous Apple Creek within the footwall of the Iron Lake fault. Nevertheless, he concluded that the Yellowjacket–Hoodoo–argillaceous quartzite sequence is older than the Apple Creek and associated strata, and we concur with this interpretation.

QUARTZITE MOUNTAIN FAULT

The Quartzite Mountain fault extends from the vicinity of the townsite of Yellowjacket on the south, through the Blackbird Mountain quadrangle (Tysdal, 2000), and appears to connect with a north-trending fault segment mapped by Evans and Connor (1993). The southern part of this fault was mapped originally by Ekren (1988). Strata west of the fault are of the Yellowjacket Formation and locally the Hoodoo Quartzite. North from the Iron Lake fault, strata east of the Quartzite Mountain fault are Apple Creek Formation.

The Quartzite Mountain fault forms the western limit to northwest-trending faults—the Shovel Creek, Iron Lake, and Porphyry Ridge faults abut or intersect the Quartzite Mountain fault (see "Generalized geologic map"). Northwest-trending stratigraphic units are truncated by it. Syndepositional cobalt-bearing rocks of the Blackbird mining district, determined by distribution of the Apple Creek Formation, are truncated on the west by the Quartzite Mountain fault and, on the south, by the Iron Lake fault. The Quartzite Mountain fault may form the western limit of the Trans-Challis fault system in this area. Bennett (1984) and Kiilsgaard and others (1986) defined the system as a 30-km-wide assemblage of northeast-striking, high-angle normal faults that crosses central Idaho. The fault system is interpreted as a major zone of Eocene rifting and crustal extension. The western edge of the Panther Creek graben previously was shown (fig. 1 of Kiilsgaard and others, 1986) to mark the western edge of the Trans-Challis fault system east of the Blackbird Mountain quadrangle. Our mapping suggests the western limit should be extended to include the Quartzite Mountain fault. The apparent change in sense of displacement on opposite sides of the fault north and south of Quartzite Mountain is discussed in the last paragraph of this report.

WHITE LEDGE SHEAR ZONE

The White Ledge shear zone was the name applied by Shenon and others (1956) to a fault zone originaly mapped by Vhay (1948) northeast of the Blackbird Mountain quadrangle (see "Generalized geologic map"). The shear zone was reported to be as much as 245 m (800 ft) wide. Vhay's (1948) map shows the shear zone to extend southwest from the vicinity of the Sunshine mine to Musgrove Creek within the Blackbird Mountain quadrangle. Shenon and others (1956) and Bennett (1977, pl. 1) followed Vhay (1948) in showing the shear zone to extend southwest of the Sunshine mine. Few data points are shown between these two localities on the map of Vhay (1948), however. Evans and Connor (1993) could not trace the shear zone much farther south than the Sunshine mine, and do not show its trace extending beyond the mine. The Musgrove location is along the Quartzite Mountain fault, to which we attribute the shearing. Bennett (1977) speculated that the White Ledge shear zone may connect with the Iron Lake fault (his Porphyry Creek fault), but our mapping shows this is not the case.

PORPHYRY RIDGE FAULT

The Porphyry Ridge fault trends southward between the Quartzite Mountain fault and the Iron Lake fault. [The Porphyry Ridge fault is not to be confused with the "Porphyry Creek fault" of Bennett (1977), which on our map is named the Iron Lake fault, a segment of a longer fault shown on the "Generalized geologic map"]. The Porphyry Ridge fault is nearly vertical and downdrops the banded siltite unit of the Apple Creek Formation on the east against the older coarse siltite unit on the west. The southern end of the fault, within about 1 km of its junction with the Iron Lake fault, is flanked by a zone of brecciation as much as 100 m wide and an iron-stained alteration zone as much as 0.5 km wide. The fault may have developed as an adjustment to movement on the Quartzite Mountain and Iron Lake faults.

IRON LAKE FAULT

The Iron Lake fault was mapped originally in its southeastern extent within the quadrangle by Bennett (1977), who interpreted it as a thrust with displacement to the northeast. Its eastern limit, east of the area of the "Generalized geologic map", was interpreted as a reverse fault (Ekren, 1988) and a thrust fault (Rember and Bennett, 1979). Tysdal (2000) and Tysdal and Desborough (1997) reinterpreted the fault, most of which lies southeast of the quadrangle, as a thrust that later underwent normal displacement. Another possibility is that the Iron Lake fault is a normal fault that dropped a major thrust plate to the southwest against its original footwall of Apple Creek Formation. Within the map area, the fault displays characteristics of a normal fault. The actual fault itself is not exposed, but the rocks on opposite sides of the 100–200 m wide zone in which the fault must exist are of two formations—the Yellowjacket Formation on the southwest and the coarse siltite unit of the Apple Creek Formation on the northeast. The zone is covered, but pods of white bull quartz are present locally within it.

SHOVEL CREEK FAULT

The area of Hoodoo Quartzite east of the Quartzite Mountain fault, from Yellowjacket Creek on the southeast to the Iron Lake fault on the northeast, was depicted as a syncline on the map of Ekren (1988). Our mapping revealed that the Hoodoo actually is deformed into two synclines, on opposite sides of the Shovel Creek normal fault. The upper contact of downdropped Hoodoo southwest of the Shovel Creek fault is nearly juxtaposed against the lower contact of the formation northeast of the fault. The fault, which is actually a zone more than 200 m wide, has a vertical displacement of about 1,000 m. Relationships across the fault suggest increasing throw to the southeast.

TOURMALINE, SILICA, HYDROCLASTIC BRECCIA, AND HYDROTHERMAL ALTERATION

Microcrystalline tourmaline forms local masses within the Hoodoo Quartzite throughout the quadrangle. It forms veinlets that include quartz within the Yellowjacket Formation north and east of the South Fork of Porphyry Creek, west of its junction with Porphyry Creek. In this area, tourmaline and quartz veinlets also occur within silicified rock, as do hydroclastic breccia and iron-oxide alteration. The alteration is considerably more extensive than the area of silicification shown on the map; hornfelsed and hydrothermally altered siltite occur as far as 1 km northwest of the area of silicification. Silicification, hydroclastic brecciation, and hydrothermal alteration occur in both the Yellowjacket and Apple Creek Formations. The pattern of silicification is elongate northwest-southeast. This suggests that the Iron Lake fault may have served as the conduit for granitic intrusion and related silicification and hydrothermal alteration. Precise placement of the Iron Lake fault is difficult in this area. Kiilsgaard and Fisher (1995) reported that hydrothermally altered rocks, including silicification, are common along faults of the Trans-Challis fault system and are genetically related to Eocene granitic and volcanic rocks that intrude the faults.

TIMING OF EVENTS AND RELATIONSHIPS OF FAULTS

Normal displacement on the Iron Lake fault is younger than thrusting. Normal faulting predates intrusion of the Eocene Bighorn Crags pluton and related small intrusions. Normal faulting also predates intrusion and related silicification, hydroclastic brecciation, and hydrothermal alteration, shown within the area near the junction of Porphyry Creek and the South Fork of Porphyry Creek. Extensional faulting and the igneous events could be close in time, but we have no data to demonstrate this. Minor adjustment along normal faults within the quadrangle may have taken place subsequent to igneous events, as indicated by shearing and brecciation within the rhyolite plug that intruded the Quartzite Mountain fault north of Musgrove Creek.

In the east-central part of the quadrangle, a triangular-shaped block of Apple Creek Formation is delimited on the southwest by the Iron Lake fault, and on the west by the northern segment of the Quartzite Mountain fault (that is, northward from Quartzite Mountain). Rocks west and southwest of the triangular-shaped block are chiefly Yellowjacket Formation (and the locally associated conformable strata, Yaq). Our map indicates that the area of Yellowjacket Formation is downthrown relative to the triangular-shaped, fault-bounded block of Apple Creek Formation. Similarly, relationships along the Iron Lake fault in the vicinity of the Panther Creek graben (see "Generalized geologic map") clearly are down on the southwest. From these observations it is reasonable to interpret displacement of the entire area of Yellowjacket in the quadrangle as downthrown relative to the Apple Creek. But such displacement does not necessarily yield the final relative age of the two formations. The entire volume of the Yellowjacket, in and out of the quadrangle, may have been thrust over the Apple Creek Formation and later downdropped along the Iron Lake and Quartzite Mountain faults (Tysdal, 2000). The Apple Creek may be the original footwall rocks of a thrust plate that contained the conformable sequence of Yellowjacket–Hoodoo–argillaceous quartzite. This interpretation indicates that the Yellowjacket is older than the Apple Creek. The structural interpretation is consistent with the reverse fault relationship applied by Ekren (1988, pl. 2), and the thrust relationship applied by Rember and Bennett (1979), Tysdal (2000), and Tysdal and Desborough (1997), to the Iron Lake fault in the vicinity of Iron Lake ("Index map"; 5 km east of border of "Generalized geologic map").

The relative downthrown side of the Quartzite Mountain fault changes from east-side-down along the southern segment of the fault (that is, southward from Quartzite Mountain), to west-side-down along the northern segment. The ball-and-bar symbol remains on the east side for the entire length of the fault, however, to reflect the last movement as continuous along the entire fault. If the rocks east of the southern fault segment were uplifted, such that no displacement existed, the Yellowjacket southwest of the Iron Lake fault, and west of the northern segment of the Quartzite Mountain fault, would be contiguous—a single block. The amount of down-on-the-east displacement restored along the southern segment of the Quartzite Mountain fault, such that no movement took place, probably reflects late movement on the Quartzite Mountain fault and is small in magnitude. Restoration of the same amount of down-on-the-east displacement along the northern segment of the fault does not change the stratigraphic relationships across this segment of the fault, relationships that appear to be consistent with earlier thrusting.

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Contact—Dashed where approximately located; queried where location uncertain. S indicates demonstrated sheared contact of Hoodoo Quartzite with Yellowjacket Formation, probably due to high ductility contrast of the two formations

Normal fault—Dashed where approximately located; dotted where concealed; queried where location uncertain. Bar and ball on downthrown side

Syncline—Showing trace of axial plane and direction of plunge of axis where known

Anticline—Showing trace of axial plane

Strike and dip of beds—Ball at one end of strike line indicates top determined from sedimentary structures

- 32 **Inclined**
- **Vertical**
- 67 **Overturned**
- ⊕ **Horizontal**

Strike and dip of cleavage—Where cleavage and bedding occur together, site location is intersection of strike-and-dip lines of bedding, and cleavage symbol is placed on or adjacent to bedding symbol for clarity. At one locality, ball shows site of measurement

- 70 **Inclined**
- **Vertical**

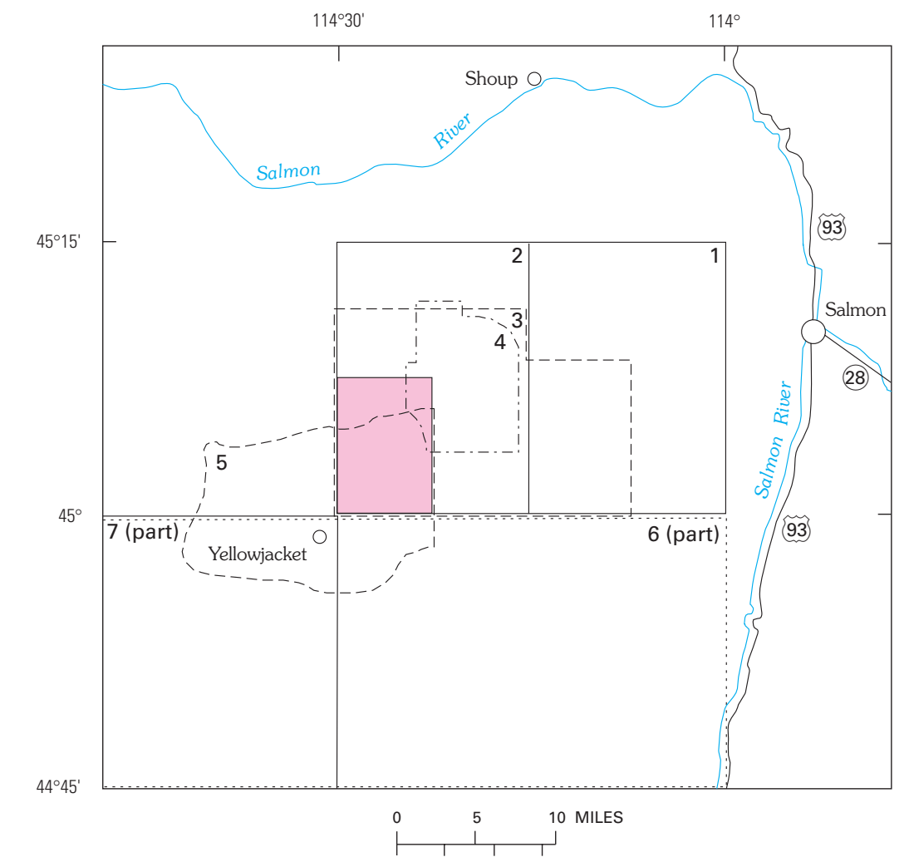
57 **Strike and dip of foliation**—Inclined

53 **Small fold**—Showing direction and plunge of axis. For clarity, symbol locally placed adjacent to coincident foliation symbol

Dike—Granite (Tr)

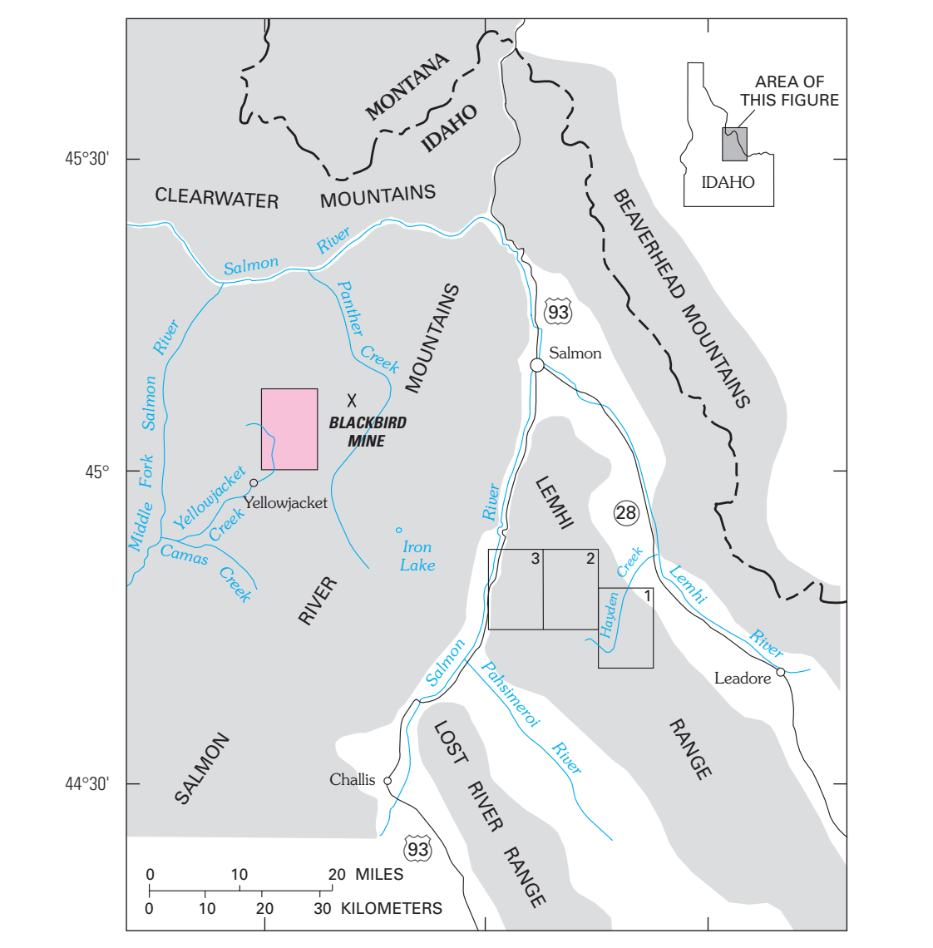
▲ **Tourmaline**—Masses of microcrystalline tourmaline in Hoodoo Quartzite; veinlets in Yellowjacket Formation

Area of silicification



1 Connor and Evans (1986)
2 Evans and Connor (1993)
3 Bennett (1977)
4 Vhay (1948)
5 Ekren (1988, pl. 1)
6 Ekren (1988, pl. 2)
7 Ross (1934)
▨ Blackbird Mountain quadrangle

INDEX TO GEOLOGIC MAPPING



1 Parts of Hayden Creek and Mogg Mountain quadrangles (Tysdal, 1996a)
2 Lem Peak quadrangle (Tysdal, 1996b)
3 Allison Creek quadrangle (Tysdal and Moye, 1996)

INDEX MAP SHOWING MAJOR GEOGRAPHIC FEATURES, AND LOCATIONS OF BLACKBIRD MOUNTAIN QUADRANGLE (PINK) AND OTHER 7.5-MINUTE QUADRANGLES CITED IN TEXT

- ▨ Mainly Challis Volcanic Group
- ▨ Mainly Proterozoic rocks
- Contact
- Fault—Dotted where concealed. Bar and ball on downthrown side

GENERALIZED GEOLOGIC MAP IN VICINITY OF STUDY AREA

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