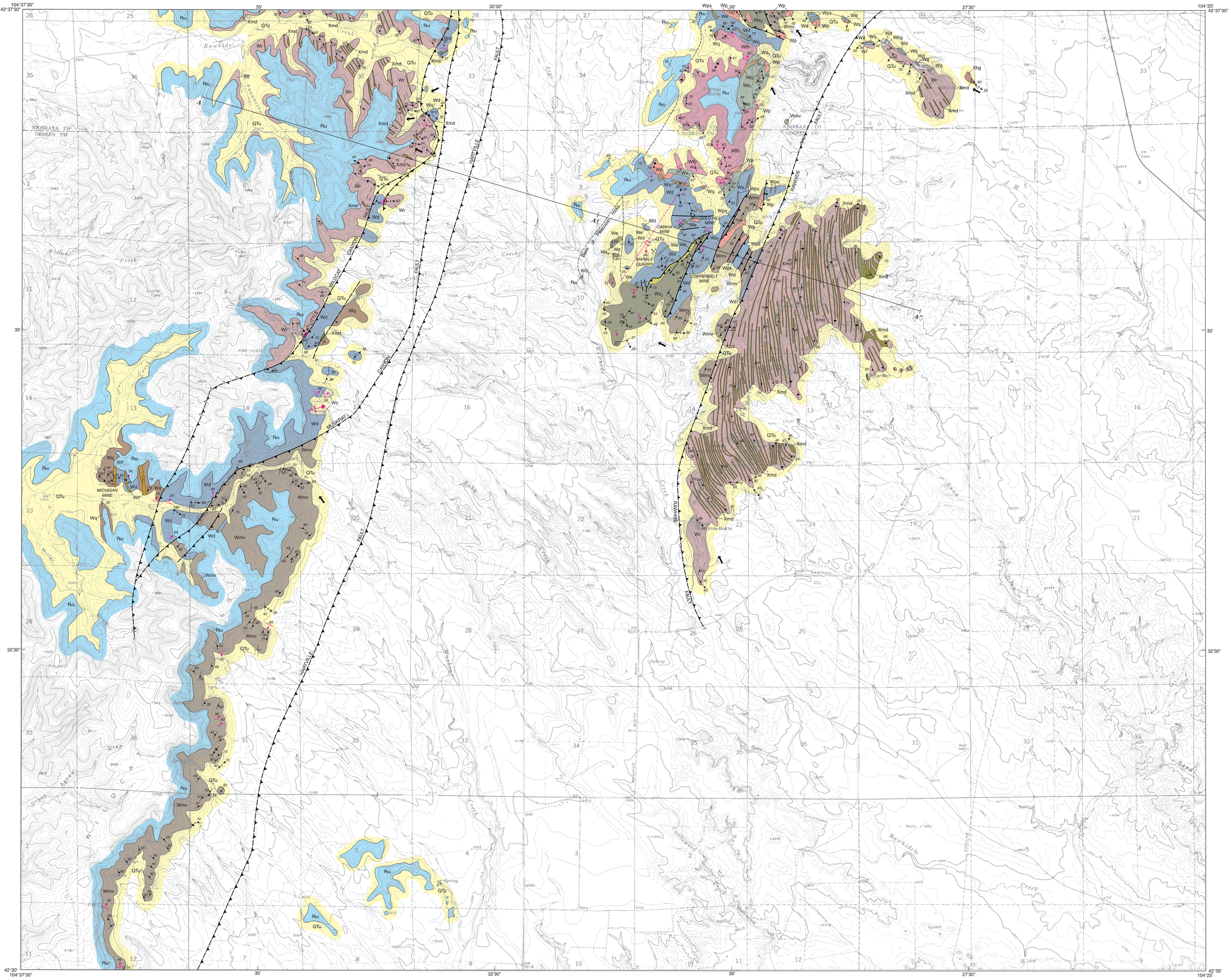
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOLOGIC INVESTIGATIONS SERIES
I—2635

Pamphlet accompanies map



Base from U.S. Geological Survey
Rawhide Buttes East, 1974; Rawhide Buttes West, 1978
Projection and 10,000-foot grid ticks: Wyoming coordinate system, east zone (transverse Mercator)
1927 North American datum

APPROXIMATE MEAN DECLINATION, 1999

SCALE 1:24 000
1 ½ 0 1 MILE
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

WYOMING
MAP LOCATION

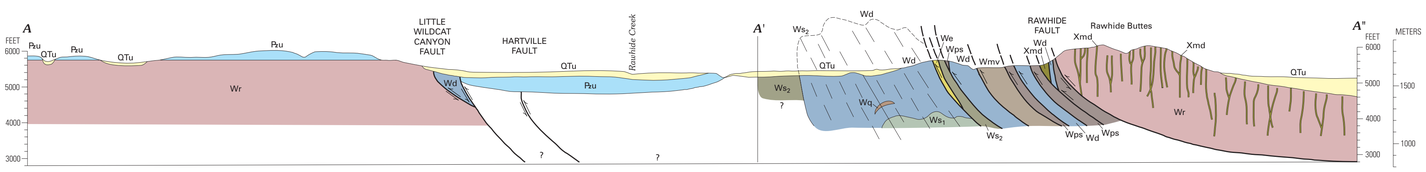
Geology mapped in 1977–79 by G.L. Snyder and in 1993–95 by W.C. Day, P.K. Sims, A.B. Wilson, and T.L. Klein.
Geology of Cenozoic and Paleozoic rocks by G.L. Snyder.

Edited by Diane E. Lane
Color design by Diane E. Lane
Graphics design and layout by Denny Welp

Manuscript approved for publication February 26, 1998

CONVERSION FACTORS

Multiply	By	To obtain
centimeters (cm)	0.3937	inches (in.)
meters (m)	3.281	feet (ft)
kilometers (km)	0.6214	miles (mi)



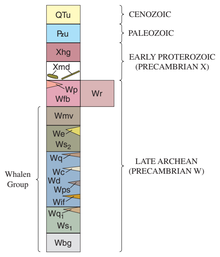
GEOLOGIC MAP OF PRECAMBRIAN ROCKS, RAWHIDE BUTTES WEST QUADRANGLE AND PART OF RAWHIDE BUTTES EAST QUADRANGLE, HARTVILLE UPLIFT, GOSHEN AND NIOBRARA COUNTIES, WYOMING

By

W.C. Day, P.K. Sims, G.L. Snyder, A.B. Wilson, and T.L. Klein, *with a section on* Geochronology *by* Zell E. Peterman, Kiyoto Futa, and R.E. Zartman

1999

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

CENOZOIC ROCKS

QTu — **Quaternary sediments and Tertiary sedimentary rocks** Predominantly Tertiary Arikaree Formation but includes Quaternary sur cial deposits

PALEOZOIC ROCKS

Pzu — **Paleozoic rocks** Includes Fremont Canyon (Upper Devonian), Guernsey (Mississippian), and Hartville (Pennsylvanian) Formations

EARLY PROTEROZOIC (2,500—1,600 Ma) ROCKS

Xhg — **Grantic gneiss** Coarse-grained, strongly foliated biotite-granite containing interlayers of gray granodiorite to tonalite. Unit interpreted as metamorphosed and deformed equivalent to the ~1.72-Ga Haystack Range granite. Penetrative fabric caused by deformation D_4

Xmd — **Metadiabase** Dark-greenish-black, medium-grained hornblende-plagioclase-quartz metadiabase dike; granular amphibolite east of Hartville fault. Estimated age ~2.0 Ga

LATE ARCHEAN ROCKS

Wp — **Granitic pegmatite** Forms small to large lenses in metasedimentary rocks in northeastern part of map area. Unit contains characteristic schorl, as well as garnet, biotite, and muscovite. Strike of lenses commonly cross cuts the strong schistosity (S_3), implying intrusion of pegmatites was syn- to post-D_3 deformation. May be related to partial melting at upper amphibolite-grade metamorphism during deformation D_3

Wfb — **Flattop Butte Granite** Pink to red biotite-muscovite granite; moderately to strongly foliated with gneissic fabric. Cut by ne-grained aplite dikes, especially in northernmost part of pluton. Pluton was deformed during deformations D_2 and D_3; it appears to occupy the core of an overturned F_3 anticline. U-Pb zircon age 2.65 Ga (Kevin Chamberlain, oral commun., 1997); uniform Sm/Nd ratios yield model ages ranging from 2.8 to 3.1 Ga; Rb-Sr whole-rock age 1.98 Ga. Primary age of unit is Late Archean (2.65 Ga); unit was derived from older (2.8—3.1 Ga) Archean crustal source. Early Proterozoic Rb-Sr age of 1.98 Ga represents resetting during D_5 deformation

Wr — **Rawhide Buttes Granite** Pink, red, or gray, medium- to coarse-grained, inequigranular granite; locally contains accessory sillimanite and muscovite. Predominately foliated granite but includes granite gneiss and gray tonalite. Rb-Sr whole-rock isochron age 2.66 Ga. At Little Rawhide Butte and Bald Butte, contains inclusions of metasedimentary rocks presumed to belong to the Whalen Group

Whalen Group

Wmv — **Ma c metavolcanic rocks** Dark-green, ne-grained actinolite-biotite-chlorite schist west of Hartville fault and medium-grained amphibolite east of Hartville fault. Protolith for unit was tholeiitic basalt that erupted in a subaqueous environment. Pillows are well developed in sec. 19, T. 30 N., R. 64 W., Muskrat Canyon. Amygdaloidal basalt and agglomerate preserved locally from Muskrat Canyon to Wildcat Hills. Unit equivalent to metabasalt of Mother Featherlegs of Snyder (1980)

Ws_2 — **Biotite-muscovite schist** Gray, medium-grained biotite-muscovite schist containing garnet and, locally, sillimanite, in area immediately west of Rawhide Buttes. Protolith was graywacke in predominantly massive beds. Map unit varies from older schist unit Ws_1 in that it lacks interlayers of metaquartzite and metacarbonate. Structurally and stratigraphically overlies metadolomite in the area

We — **Exhalite** Thin bed of interlayered hydrothermal chert, disseminated and massive sul de, and dolomite

Wd — **Metadolomite** Primarily white to gray dolomitic marble, with lesser amounts of tremolitic dolomitic, calcitic, and chondritic marble. East of Hartville fault the unit lacks algal stromatolitic mounds and is a clean, white to light-gray marble. Archean granite intrudes unit in Bald Butte area. West of Hartville fault the unit contains planar stromatolites and algal stromatolitic mounds, is commonly light brown, and contains more interlayers of metamorphosed clay and sand. In the regional perspective, western part of unit interpreted to be near-shore facies, whereas eastern part represents deeper water facies of carbonate unit deposited in continental shelf environment on the eastern margin of Wyoming craton.

Wq — **Metaquartzite** Gray to pinkish-red, crossbedded metaquartzite. Unit commonly contains thin (1—5 m thick) interlayers of metadolomite and pelite

Wc — **Metaconglomerate** Quartz-pebble conglomerate interbedded with minor cherty iron-formation, slate, and ferruginous quartzite. Outcrops west of Hartville fault and occurs as horizon in predominantly metacarbonate sequence (unit Wd) north of eastern mouth of Muskrat Canyon

Wps — **Pelitic schist** Muscovite schist containing biotite, garnet, and, locally, sillimanite. Protolith was pelitic sediments deposited coevally with adjacent carbonate and epiclastic metasedimentary units of Whalen Group

Wif — **Iron-formation** Banded cherty oxide-facies iron-formation in western part of Muskrat Canyon

Wq_1 — **Metaquartzite** Light-gray to brown, medium-grained, well-sorted metaquartzite interbedded in garnet-biotite schist unit Ws_1 in Flattop Buttes area east of Hartville fault

Ws_1 — **Garnet-biotite schist** Gray, medium-grained garnet-biotite-quartz-plagioclase schist in area near Flattop Butte; contains sillimanite and, locally, kyanite

Wbg — **Biotite gneiss** Coarse-grained biotite granite gneiss; located on northern part of Bald Butte

Samples of granitic rocks from Hartville Uplift and vicinity

Sample No.	Locality	Description
709A	SE¼NW¼ sec. 13, T. 30 N., R. 64 W.	Grayish-red, medium-grained, inequigranular, foliated granite.
13A	NW¼NE¼ sec. 26, T. 30 N., R. 64 W.	Pinkish-gray, fine- to medium-grained gneissic granite. Strong ductile deformation.
13B	NW¼NE¼ sec. 26, T. 30 N., R. 64 W.	Pinkish-gray, fine- to medium-grained gneissic granite. Strong ductile deformation.
715A	NE¼SE¼ sec. 1, T. 30 N., R. 64 W.	Pinkish-gray, medium-grained, inequigranular, foliated granite.
715B	NE¼SE¼ sec. 1, T. 30 N., R. 64 W.	Grayish-red, medium-grained, foliated granodiorite containing feldspar phenocrysts as much as 2 cm in diameter. Numerous ductile shears.
716	NE¼SE¼ sec. 1, T. 30 N., R. 64 W.	Grayish-red, medium-grained, inequigranular granite.
745	NE¼SE¼ sec. 31, T. 31 N., R. 63 W.	Pinkish-gray, medium-grained gneissic ganite. Strong rodding (ductile deformation). Protomylonite.
758	SW¼NW¼ sec. 31, T. 31 N., R. 63 W., (small, isolated knob).	Pinkish gray, medium-grained, inequigranular gneissic granite. Strong rodding. Protomylonite.
801	SW¼SE¼ sec. 31, T. 31 N., R. 63 W., (quarry).	Grayish-red, medium-grained, inequigranular gneiss granite. Ductile shears. Protomylonite.
344	NE¼NW¼ sec. 32, T. 31 N., R. 64 W.	Grayish-red, medium-grained, inequigranular, foliated granodiorite. Protomylonite.
345A	SW¼SW¼ sec. 29, T. 31 N., R. 64 W.	Pinkish-gray, medium-grained, inequigranular, foliated granite. Protomylonite.
346	SE¼SE¼ sec. 30, T. 31 N., R. 64 W.	Pinkish-gray, medium-grained, foliated granite. Protomylonite. Muscovite in shears.
809	SE¼NE¼ sec. 2, T. 30 N., R. 64 W.	Light-brownish-gray, fine- to medium- grained, foliated biotite-muscovite granite.
810	NW¼NE¼ sec. 2, T. 30 N., R. 64 W.	Light-brownish-gray, fine- to medium- grained, foliated biotite-muscovite granite.
811A	NW¼NE¼ sec. 2, T. 30 N., R. 64 W.	Light-brown, fine- to medium-grained, foliated biotite-muscovite granite. Few ductile shears.
811B	NW¼NE¼ sec. 2, T. 30 N., R. 64 W.	Same as above.

- **Contact** Approximately located; dashed where covered or inferred
- **Fault** Bar and ball on downthrown side
- **High-angle fault**
- **Thrust fault of Early Proterozoic age (deformation D_3)** Sawteeth on hanging wall; dashed where covered or inferred; queried where uncertain; arrows indicate relative horizontal movement on fault
- **Asymmetrical overturned anticline** Showing bearing and plunge of axis; dashed where covered
- **Syncline** Showing direction of plunge
- **Strike and dip of bedding**
  - **Inclined** Top not known
  - **Inclined** Bar and ball indicate top of bed
  - **Overturned**
  - **Vertical** Bar and ball indicate top of bed
- **Strike and dip of foliation**
  - **Inclined**
  - **Vertical**
- **Bearing and plunge of lineation** May be combined with foliation or bedding symbol
- **Bearing and plunge of stretching lineation** May be combined with foliation or bedding symbol
- **Bearing and plunge of symmetrical fold**
- **Bearing and plunge of asymmetrical fold**
- **Mylonite**
- **Direction of tectonic transport as indicated by bearing of stretching lineation**
- **Mine or prospect**
- **Quartz vein in fault zone**

ISBN 0-607-89411-3

For sale by U.S. Geological Survey Information Services
Box 25286, Federal Center, Denver, CO 80225

This map is also available as a PDF at
http://greenwood.cr.usgs.gov