GEOLOGIC MAP OF THE EASTERN PART OF THE LEADORE 30' x 60' QUADRANGLE, MONTANA AND IDAHO

by

Edward T. Ruppel

Montana Bureau of Mines and Geology

Open File Report MBMG 372

1998 (revised 1999, 2014)

Partial support has been provided by the STATEMAP component of the National Cooperative Geologic Mapping Program of the U. S. Geological Survey under Contract Number 1434-HQ-97-AG-01794.

DESCRIPTION OF MAP UNITS

For more complete lithologic descriptions, see M'Gonigle (1993, 1994); M'Gonigle and others (1991); Ruppel and Lopez (1988).

Qal **Alluvium** (Holocene; may be partly of Pleistocene age). Silt, sand, and gravel in channels and flood plains of existing streams and rivers and in alluvial fans.

Qls **Landslide deposit** (Holocene and Pleistocene). Angular fragments of bedrock mixed with soil or heterogeneous boulders and finer-grained material; characterized by irregular, hummocky topography.

Qg **Glacial deposit** (Pleistocene). Unsorted mixture of boulders, cobbles, pebbles, and sand deposited by glaciers and by glacial meltwater. Unit includes undivided till and outwash of at least two major glacial episodes.

QTs **Quaternary and Tertiary sediments, undivided.**

Ts **Basin-fill sediment** (lower to middle Oligocene to upper Miocene). Light gray to yellowish-brown partly tuffaceous sandstone, siltstone, and shale, and subordinate interbeds of limestone and marl and lenses of pebble and cobble conglomerate composed of locally derived rock fragments. Locally, unit includes thin beds of lignite and lignitic shale in the Medicine Lodge Creek basin. Commonly veneered with gravel and a thin layer of eolian silt.

Ths **Hot spring deposit** (age uncertain, probably lower Oligocene). Includes limonitic, calcareous tufa near Shenon Creek and in the upper part of Medicine Lodge Creek, and calcareous, siliceous tufa and massive chalcedonic silica near the North Fork and South Fork of Everson Creek. Locally, unit contains repeatedly fractured and rehealed siliceous breccias. The Shenon Creek deposit probably is the source of placer gold mined in the Chinatown diggings in Jeff Davis Creek.

Tcv, Tmlv **Challis Volcanics (Tcv) and Medicine Lodge Volcanics (Tmlv)** (Eocene). Basaltic andesite, andesite, latite, rhyodacite, and rhyolite as flows, ashflow tuffs, and tuff and flow breccias. Locally, unit contains thin interbeds of light olive-gray, biotitic, tuffaceous, fine- to coarse-grained sandstone and conglomerate composed of volcanic detritus. Age ranges from about 48 Ma to 40 Ma (Staatz, 1979); Ruppel and Lopez, 1988; M'Gonigle and Dalrymple, 1996).

Tqdm **Quartz diorite and quartz monzonite of the Little Eightmile Stock** (Staatz, 1973). Pinkish-gray to dark gray, fine- to medium-grained; dioritic rocks contain about 20 to 25 percent biotite and hornblende; mafic minerals in the quartz monzonite constitute only about 8 percent of the rock. Age probably about the same as that of similar intrusive granitic rocks in the Lemhi Range farther west, about 48 Ma to 50 Ma (Ruppel and Lopez, 1988).

TRd **Dinwoody Formation** (Lower Triassic). Grayish-green to grayish-brown, calcareous, thinly bedded and laminated siltstone, sandstone and shale, and thinly bedded limestone; as much as 1,000 ft thick (Lucchitta, 1966).

Pp **Phosphoria Formation** (Permian). Mainly dolomite, dolomitic limestone, limestone, and interbedded chert; very light gray to medium-dark gray, very fine-grained to fine-grained, thin-bedded, platy. In the Hawley Creek area, unit includes the Tosi Chert, an upper unit of dark gray, thinly bedded chert, about 150 ft thick (Cressman and Swanson, 1964). Thickness ranges from about 250 ft to 850 ft.

1Pq **Quadrant Formation** (Pennsylvanian). Pale yellowish brown, fine-grained, medium to thick bedded. Crops out mainly east of Medicine Lodge Creek.

lPMsb **Snaky Canyon and Bluebird Mountain Formations, undivided.** Unit includes rocks originally mapped as Quadrant Formation (Pennsylvanian) (Luchitta, 1966; Smith, 1961; Ruppel, 1968; and Ruppel and Lopez, 1988) that are now included in the Bloom and Gallagher Peak Sandstone Members of the Snaky Canyon Formation (latest Mississippian to Late Pennsylvanian) and in the Bluebird Mountain Formation (latest Mississippian)(Skipp, et al. 1979). Consists mainly of quartzitic sandstone, dolomite, and limestone, and includes three units: (1) an upper pale yellowish-brown, fine-grained, thickly bedded, prominently crossbedded, calcareous quartzitic sandstone with thin interbeds of similarly colored cherty, sandy dolomite; probably equivalent to the Gallagher Peak Sandstone Member of the Snaky Canyon Formation; (2) a middle unit of medium gray to medium-light gray, thin- to medium-bedded, partly cherty limestone and dolomite; probably equivalent to the Bloom Member of the Snaky Canyon Formation; and (3) a lower unit of interbedded medium-light gray to medium-dark gray quartzitic sandstone, dolomite, and limestone probably equivalent to the Bluebird Mountain Formation; the sandstone is fine-grained, thickly bedded to massive; dolomite and limestone are finely to coarsely crystalline, thinly bedded or thickly bedded to massive. The three units are roughly equal in thickness; total thickness of interval is 1,300 ft to 1,700 ft.

lPMs **Lower Pennsylvanian and Mississippian sedimentary rocks, undivided**. Unit includes the Upper Mississippian and Lower Pennsylvanian Snowcrest Range Group (Wardlaw and Pecora 1985) and the Lower to Upper Mississippian Tendoy Group (Sando et al., 1985), the Upper Mississippian Railroad Canyon Formation, and carbonate rocks originally mapped as the Mississippian Madison Group, Paine Limestone, and Milligen Formation that are now included in the Surrett Canyon, South Creek, Scott Peak, Middle Canyon, and McGowan Creek Formations (Huh, 1967; Sandberg, 1975). The Railroad Canyon Formation is the temporal and partly the lithologic equivalent of the Lombard Limestone in the Snowcrest Range Group, and includes rocks originally mapped as Big Snowy Formation in the Beaverhead Mountains. The upper two-thirds of the formation is medium-dark gray to pale red, thin- to thick-bedded, fine- to medium-grained limestone and interbedded brownish-gray to pale red siltstone and mudstone; the lower third of the formation is grayish-red to dark gray mudstone and papery shales. The formation is 850 ft thick (Ruppel and Lopez, 1988).

The Railroad Canyon Formation is underlain by thickly bedded to massive, medium-light gray to medium-dark gray limestones of the Middle Canyon and

Scott Peak Formations. The formations have a combined thickness of about 3,000 ft to 3,500 ft, but are greatly thinned by faulting in much of this region. The McGowan Creek Formation at the base of the Mississippian consists of medium gray to dark gray, fissile to chippy, carbonaceous siltstone, mudstone, and shale, and thin interbeds of dark gray fine-grained limestone. Thickness ranges from 100 ft to 200 ft.

MDtj **Three Forks Formation and Jefferson Formation,undivided** (Mississippian and Upper Devonian). Dolomite, medium-dark gray to dark gray, finely to medium crystalline, fetid, locally sandy near base of formation, and locally conglomeratic. The Three Forks Formation is known to be present only in the Hawley Creek area where it consists of dark gray siliceous mudstone and is less than 100 ft thick (Lucchitta, 1966). The Jefferson Formation is about 800 ft thick.

DOs **Devonian and Ordovician sedimentary rocks, undivided**. Unit includes rocks of the Jefferson, Three Forks, and Summerhouse Formations.

SOm **Saturday Mountain Formation** (Lower Silurian and Upper Ordovician). Dolomite, medium gray to light gray, finely crystalline, thickly bedded to massive, partly fossiliferous. Present only in thin, thrust-faulted slices in Railroad Canyon.

SOg **Granite** (Lower Silurian to Upper Ordovician). Light pink to pale red, fine- to medium-grained porphyritic granite and alkali granite; typically strongly fractured, partly granulated. Age about 430 Ma to 440 Ma (Ruppel and Lopez, 1988).

Os **Ordovician sedimentary rocks, undivided.** Unit includes rocks of the Summerhouse Formation and Kinnikinic Quartzite and may locally include rocks of Devonian age. Units typically are too thin to be mapped separately or are so poorly exposed as to be inseparable. Regionally, the Summerhouse Formation (Lower Ordovician) is composed of sandstone that is quartzitic or feldspathic to arkosic, light gray to white, medium- to coarse-grained, locally feldspathic and micaceous, and locally conglomeratic; *Scolithus* burrows locally abundant; thickness ranges from 0 ft to about 230 ft (Ruppel et al., 1975).

Ok **Kinnikinic Quartzite** (Middle Ordovician). Quartzite, white or light gray, vitreous, fine- to medium-grained; partly mottled, with irregular lenses and blebs a few cm long of reddish-brown sandstone cemented by ferrodolomite. Present only in thin, thrust-faulted slices and thins depositionally to 0 ft in the Beaverhead Mountains.

Ysw **Swauger Formation** (Middle Proterozoic). Quartzite, pale purple to grayish- pink, medium- to coarse-grained and grains well sorted and well rounded, beds 3 ft to 6 ft thick, partly prominently cross-laminated; contains abundant hematite grains. Thickness ranges from 0 ft to about 10,000 ft as a result of later Proterozoic and early Paleozoic erosion.

Yms **Mount Shields Formation** (Middle Proterozoic Belt Supergroup). Quartzitic sandstone, pale red, medium- to coarse-grained, feldspathic to arkosic, locally

conglomeratic. Present only near the north border of the map area east of Horse Prairie.

Yl **Lemhi Group** (Middle Proterozoic). In this area the group includes (Ruppel 1975; Ruppel and Lopez, 1988):

Ygs **Gunsight Formation**. Light brownish-gray to grayish-reddish-purple, thin- to medium-bedded, fine- to medium-grained, feldspathic quartzite; many beds laminated or cross-laminated. Minimum thickness about 6,000 ft.

Ybc **Big Creek Formation**. Pale greenish-gray to light gray, thickly bedded or massive, fine-grained feldspathic quartzite. Thickness about 10,000 ft.

Yy **Yellowjacket Formation** (Middle Proterozoic). Medium gray to medium-dark gray, mostly thin- to medium-bedded, very fine-grained to fine-grained, feldspathic, finely biotitic quartzite and subordinate, interbedded, similarly colored siltite and argillite. Probable thickness more than 20,000 ft.

Aqfg **Quartzofeldspathic gneiss and schist** and related granitic crystalline metamorphic rocks of Late Archean age (M'Gonigle, 1993); originally included in the Dillon granite gneiss of Heinrich (1960).

MAP SYMBOLS

Contact: dotted where concealed

Fault: ball and bar on downthrown side; dotted where concealed

Strike-slip fault: arrows indicate direction of relative lateral movement; dotted where concealed

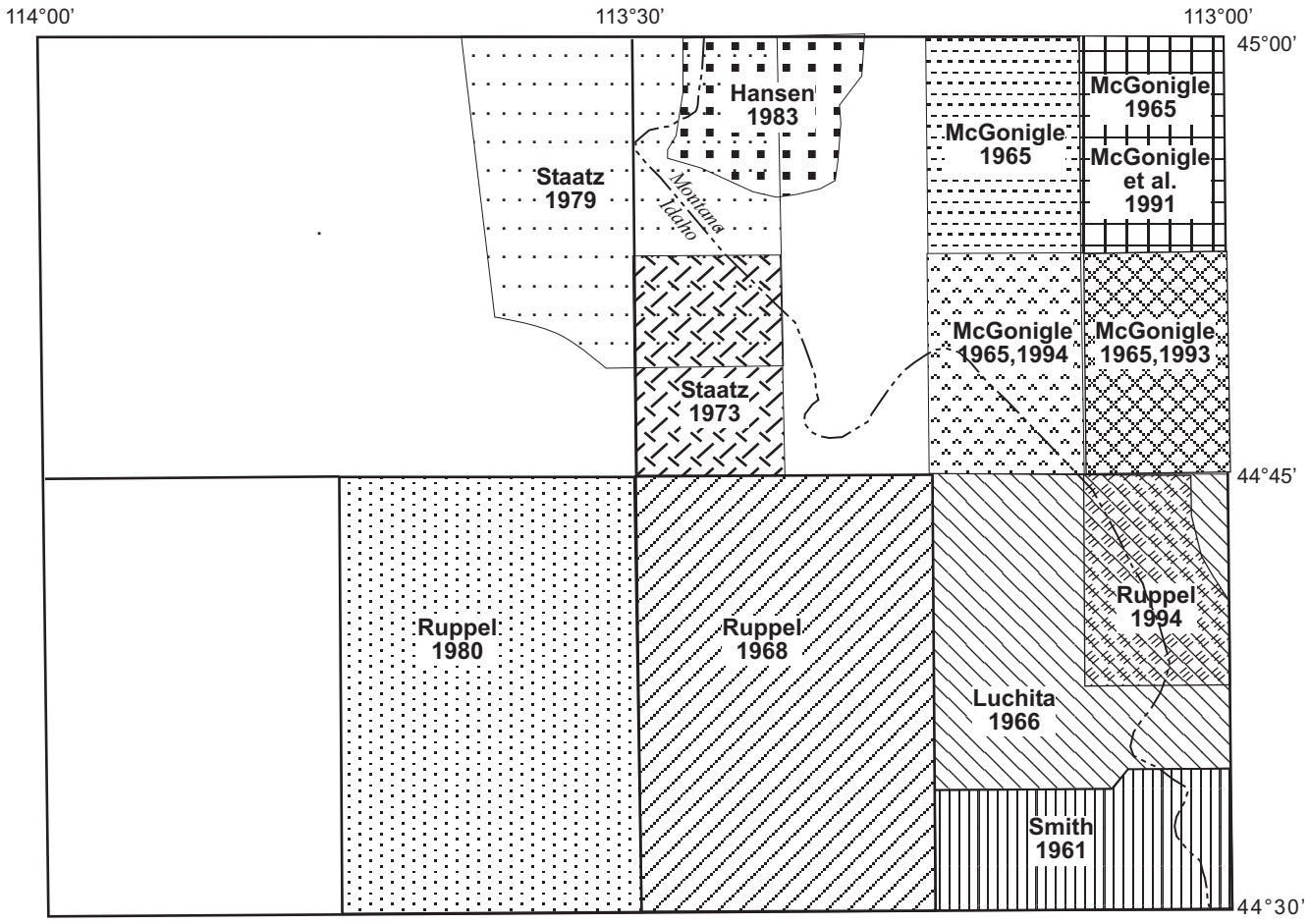
Thrust fault: sawteeth on upper plate; dotted where concealed

Anticlinal fold showing trace of axial plane; dotted where concealed

Synclinal fold showing trace of axial plane; dotted where concealed

Overturned synclinal fold showing trace of axial plane

NOTE:The western map border is in Idaho along the Lemhi River north of the town of Leadore, and along Eighteenmile Creek south of the town of Leadore. The Montana-Idaho border is indicated



Index of sources of geologic mapping, Leadore 30'x60' quadrangle

REFERENCES CITED

Cressman, E. R., and Swanson, R. W. 1964. Stratigraphy and petrology of the Permian rocks of southwestern Montana. U.S. Geological Survey Professional Paper 313-C. 569 pp.

Hansen, P. M. 1983. Structure and stratigraphy of the Lemhi Pass area, Beaverhead Range, southwest Montana and east-central Idaho. M.S. thesis. University Park: The Pennsylvania State University. 112 pp.

Heinrich, E.W. 1960. Pre-Beltian geology of the Cherry Creek and Ruby Mountains areas, southwestern Montana--Part 2, Geology of the Ruby Mountains. Montana Bureau of Mines and Geology Memoir 38. Pp. 15-40.

Huh, D.K. 1967. The Mississippian System across the Wasatch line, east-central Idaho, extreme southwestern Montana. Pp. 31-62 in 18th Annual Field Conference Guidebook: Billings Geological Society.

Lucchitta, B. K. 1966. Structure of the Hawley Creek area, Idaho-Montana. Ph.D. thesis. University Park: The Pennsylvania State University. 205 pp.

M'Gonigle, J. W. 1965. Structure of the Maiden Peak area, Montana-Idaho. Ph.D. thesis. University Park: The Pennsylvania State University. 146 pp.

_____. 1993. Geologic map of the Medicine Lodge Peak Quadrangle, Beaverhead County, southwest Montana. U.S. Geological Survey Geologic Quadrangle Map GQ-1724. Scale 1:24,000.

_____. 1994. Geologic map of the Deadman Pass Quadrangle, Beaverhead County, Montana, and Lemhi County, Idaho. U.S. Geological Survey Geologic Quadrangle Map GQ-1753. Scale 1:24,000.

M'Gonigle, J.W., Kirschbaum, M.A., and Weaver, J.N. 1991. Geologic map of the Hansen Ranch Quadrangle, Beaverhead County, southwest Montana. U.S. Geological Survey Geologic Quadrangle Map GQ-1704. Scale 1:24,000.

M'Gonigle, J. W., and Dalrymple, G. B. 1996. $^{40}Ar/^{39}Ar$ ages of some Challis Volcanic Group rocks and the initiation of Tertiary sedimentary basins in southwestern Montana. U.S. Geological Survey Bulletin 2132. 17 pp.

Ruppel, E. T. 1968. Geologic map of the Leadore Quadrangle, Lemhi County, Idaho. U.S. Geological Survey Geologic Quadrangle Map GQ-733. Scale 1:24,000.

_____. 1975. Precambrian Y sedimentary rocks in east-central Idaho. U.S. Geological Survey Professional Paper 889-A. 23 pp.

_____. 1980. Geologic map of the Patterson Quadrangle, Lemhi County, Idaho. U.S. Geological Survey Geologic Quadrangle Map GQ-1529. Scale 1:62,500.

_____. 1994. Geologic map of Proterozoic rocks, Tepee Mountain Quadrangle, Montana-Idaho. Montana Bureau of Mines and Geology Open File Map MBMG-317. Scale

1:24,000.

Ruppel, E. T., and Lopez, D. A. 1988. Regional geology and mineral deposits in and near the central part of the Lemhi Range, Lemhi County, Idaho. U.S. Geological Survey Professional Paper 1480. 122 pp.

_____. Ross, R.J., Jr., and Schleicher, D. 1975. Precambrian Z and Lower Ordovician rocks in east central Idaho. U.S. Geological Survey Professional Paper 889-B. 9 pp.

Sandberg, C.A. 1975. McGowan Creek Formation, a new name for Lower Mississippian flysch sequence in east-central Idaho. U.S. Geological Survey Bulletin 1405-E. 11 pp.

Sando, W.J., Sandberg, C.A., and Perry, W. J., Jr. 1985. Revision of Mississippian stratigraphy, northern Tendoy Mountains, southwest Montana. Pp. A1-A10 in W. J. Sando, ed. Mississippian and Pennsylvanian stratigraphy in southwest Montana and adjacent Idaho. U.S. Geological Survey Bulletin 1656.

Skipp, B., Haggar, R.D., Schleicher, D.L., and Douglas, R.C. 1979. Upper Paleozoic carbonate bank in east-central Idaho - Snaky Canyon, Bluebird Mountain and Arco Hills Formations, and their paleotectonic significance. U. S. Geological Survey Bulletin 1486. 78 p.

Smith, J.G. 1961. The geology of the Clear Creek area, Montana-Idaho. M.S. thesis. University Park: The Pennsylvania State University. 75 pp.

Staatz, M. H. 1973. Geologic map of the Goat Mountain Quadrangle, Lemhi County, Idaho, and Beaverhead County, Idaho. U.S. Geological Survey Geologic Quadrangle Map GQ-1097. Scale 1:24,000.

_____. 1979. Geology and mineral resources of the Lemhi Pass Thorium District, Idaho and Montana. U.S. Geological Survey Professional Paper 1049-A, 90 pp.

Wardlaw, B. R., and Pecora, W. C. 1985. New Mississippian-Pennsylvanian stratigraphic units in southwest Montana and adjacent Idaho. Pp. B1-B9 in W. J. Sando, ed. Mississippian and Pennsylvanian stratigraphy in southwest Montana and adjacent Idaho. U.S. Geological Survey Bulletin 1656.