U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3413
Pamphlet accompanies map

CORRELATION OF MAP UNITS

[See Description of Map Units (in pamphlet) for precise unit ages]

SURFICIAL DEPOSITS: Qa, Qls, Qg, Qt — Holocene, Pleistocene — QUATERNARY

CENOZOIC SEDIMENTARY UNITS: Tm, Tsu, Tsl

EOCENE CHALLIS VOLCANIC-PLUTONIC COMPLEX: CHALLIS VOLCANIC GROUP: Tc; INTRUSIVE ROCKS: Tr, Tg, Td — Miocene, Oligocene, Eocene — TERTIARY

MESOZOIC TO NEOPROTEROZOIC? SEDIMENTARY AND METASEDIMENTARY ROCKS: Ted — Lower — TRIASSIC; Pp — PERMIAN; PMs — PENNSYLVANIAN; Mb, Mr, Ms, Mm — Upper, Middle, Lower — MISSISSIPPIAN; Dj — Upper — DEVONIAN; SOs — Lower, Upper — SILURIAN; Ok — Middle, Lower — ORDOVICIAN; PALEOZOIC INTRUSIVE ROCKS: OCg, OCd; Ꞓf — Upper, Middle, Lower — CAMBRIAN; ꞒZc — Neoproterozoic

MESOPROTEROZOIC METASEDIMENTARY ROCKS: Ys, LEMHI GROUP: Yg, Yac — Mesoproterozoic — PROTEROZOIC

PALEOPROTEROZOIC INTRUSIVE ROCKS: Xg — Paleoproterozoic

LIST OF MAP UNITS

[See Description of Map Units (in pamphlet) for complete unit descriptions. Due to the addition of a shaded relief base, colors in the List of Map Units may not exactly match unit colors on the map]

SURFICIAL DEPOSITS

- Qa — **Alluvium (Holocene)**
- Qls — **Landslide deposits (Holocene and Pleistocene)**
- Qg — **Glacial deposits (Holocene and Pleistocene)**
- Qt — **Terrace deposits (Holocene and Pleistocene)**

CENOZOIC SEDIMENTARY ROCKS

- Tm — **Mudstone deposits (middle Miocene)**
- Tsu — **Basin-fill deposits, upper (lower Miocene to Oligocene)**
- Tsl — **Basin-fill deposits, lower (Oligocene to upper Eocene)**

EOCENE CHALLIS VOLCANIC-PLUTONIC COMPLEX

CHALLIS VOLCANIC GROUP

- Tc — **Challis Volcanic Group, undivided**

INTRUSIVE ROCKS

- Tr — **Rhyolite dike**
- Tg — **Granite**
- Td — **Mafic dike**

MESOZOIC TO NEOPROTEROZOIC? SEDIMENTARY AND METASEDIMENTARY ROCKS

- Ted — **Dinwoody Formation (Lower Triassic)**
- Pp — **Phosphoria Formation (Permian)**
- PMs — **Snaky Canyon Formation, undivided (Lower Permian to Upper Mississippian)**
- Mb — **Bluebird Mountain Formation (Upper Mississippian)**
- Mr — **Railroad Canyon Formation (Upper Mississippian)**
- Ms — **Scott Peak Formation (Middle Mississippian)**
- Mm — **Middle Canyon Formation (Middle and Lower Mississippian)**
- Dj — **Jefferson Formation (Upper Devonian)**
- SOs — **Saturday Mountain Formation (Lower Silurian to Middle Ordovician)**
- Ok — **Kinnikinic Quartzite (Middle Ordovician)**
- OCd — **Dolostone (Middle Ordovician? to Upper Cambrian?)**
- Ꞓf — **Flathead Quartzite (Middle Cambrian)**
- ꞒZc — **Conglomerate (Lower Cambrian? to Neoproterozoic?)**

PALEOZOIC INTRUSIVE ROCKS

- OCg — **Syenogranite (Early Ordovician to Late Cambrian)**

MESOPROTEROZOIC METASEDIMENTARY ROCKS

- Ys — **Swauger Formation (Mesoproterozoic)**

LEMHI GROUP

- Yg — **Gunsight Formation (Mesoproterozoic)**
- Yac — **Coarse siltite unit of Apple Creek Formation (Mesoproterozoic)**

PALEOPROTEROZOIC INTRUSIVE ROCKS

- Xg — **Orthogneiss (Paleoproterozoic)**

EXPLANATION

- **Contact**—Long dashed where approximately located, dotted where concealed
- **Bedding (on cross section only)**
- **Cleavage (on cross section only)**
- **Angular unconformity**—Long dashed where approximately located, dotted where concealed. Major unconformities above Paleoproterozoic and Mesoproterozoic units. Lesser unconformities within Mesoproterozoic and Paleozoic sections. Mesoproterozoic-Paleozoic unconformity locally tectonized
- **Fault**—Complex movement, generally oblique reverse motion or oblique thrust-ramp geometry. Arrows show relative motion where strike-slip component is mapable. Long dashed where approximately located, dotted where concealed
- **Normal fault**—Ball and bar on downthrown block. Long dashed where approximately located, dotted where concealed
- **Low-angle normal fault**—Half-circles on downthrown block. Long dashed where approximately located, dotted where concealed
- **Reactivated fault**—Ball and bar and sawteeth on downthrown block. Dotted where concealed
- **Thrust fault**—Sawteeth on downthrown block. Long dashes where approximately located, dotted where concealed. Fault attitude tick shows dip
- **Strike-slip fault (on cross section only)**—minus, away from observer; plus, toward observer
- **Anticline**
- **Overturned anticline**—Beds on one limb are overturned; arrows show dip direction of limbs. Dotted where concealed
- **Syncline**—Dotted where concealed
- **Overturned syncline**—Beds on one limb are overturned; arrows show dip direction of limbs

PLANAR POINT FEATURES

- **Inclined bedding**—Showing strike and dip
- **Inclined bedding, upright**—Where top direction of beds is known from primary sedimentary features. Showing strike and dip
- **Overturned bedding**—Where top direction of beds is known from primary sedimentary features. Showing strike and dip
- **Inclined metamorphic foliation**—Showing strike and dip
- **Inclined axial planar foliation**—Showing strike and dip
- **Inclined cleavage**—Showing strike and dip
- **Vertical cleavage**—Showing strike
- **Inclined flow layering in volcanic rock**—Showing strike and dip
- **Inclined lineation at intersection of bedding and cleavage**—Showing bearing and plunge
- **Inclined aligned-mineral lineation**—Showing bearing and plunge
- **Inclined slickenside on fault surface**—Showing bearing and plunge
- **Inclined fold hinge of small, minor fold**—Showing bearing and plunge
- **Horizontal fold hinge of small, minor fold**—Showing bearing and plunge
- **Inclined asymmetric (S-shaped, counterclockwise sense of shear) minor fold hinge**—Showing bearing and plunge
- **Inclined asymmetric (Z-shaped, clockwise sense of shear) minor fold hinge**—Showing bearing and plunge
- **Horizontal asymmetric (Z-shaped, clockwise sense of shear) minor fold hinge**—Showing bearing and plunge

AREAL FEATURES

- **Breccia**—Associated with landslide blocks and major low-angle normal fault zone

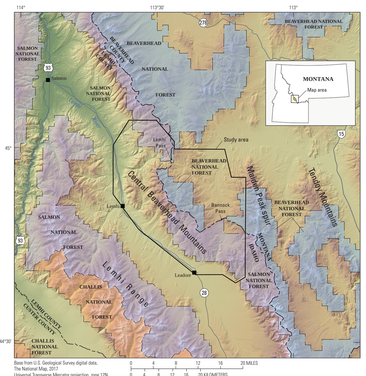


Figure 1. Index map showing the study area and nearby geographic features.

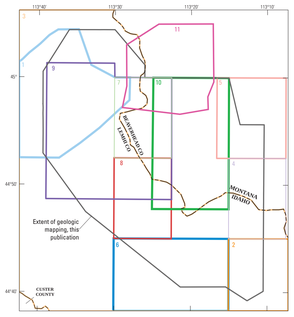


Figure 2. Index map showing areas of previous mapping in the study area. 1, Blankenau (1999); 2, Lucchitta (1966); 3, Lund and others (2003b); 4, M'Gonigle (1994); 5, M'Gonigle and Hait (1997); 6, Ruppel (1968); 7, Staatz (1972); 8, Staatz (1973); 9, Staatz (1979); 10, VanDenburg (1997); 11, Hansen (1983).

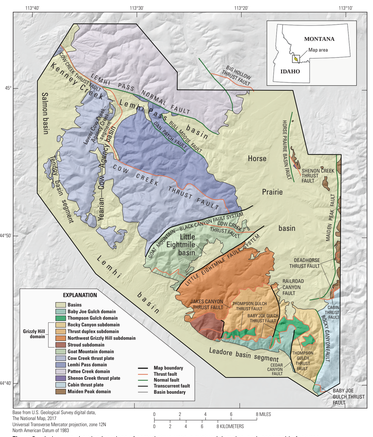


Figure 3. Index map showing locations of named structures, structural domains, and topographic features.

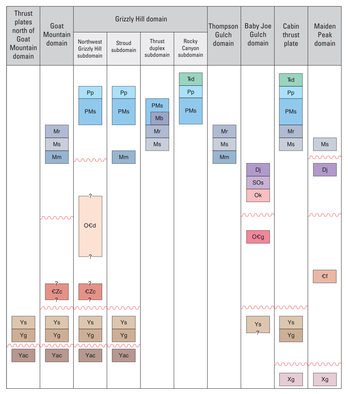
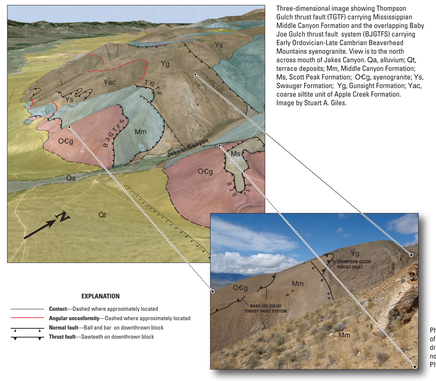


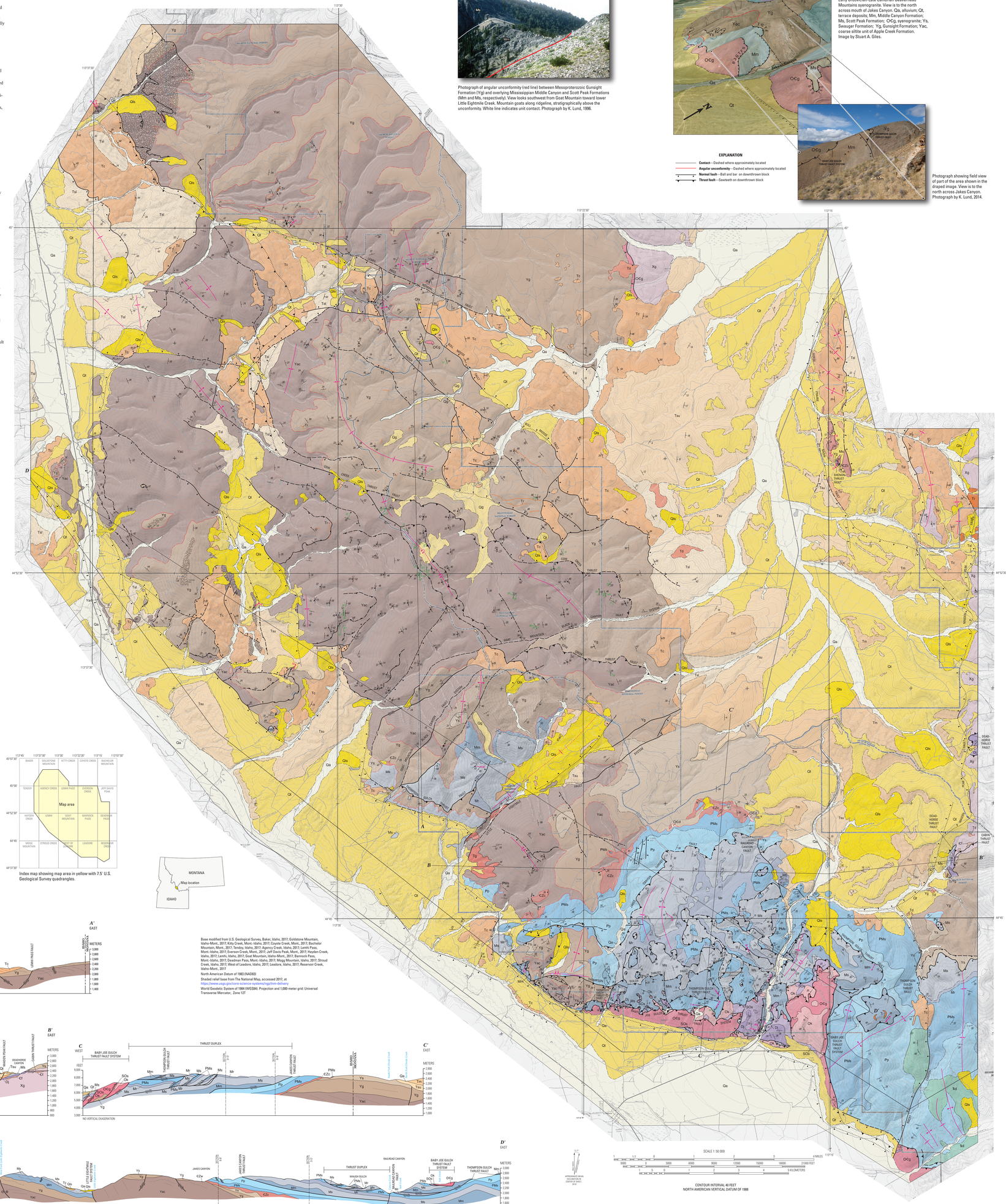
Figure 4. Stratigraphic correlation chart for units in individual structural domains and subdomains. Location of domains, subdomains, and thrust plates are shown in figure 3. Column labeled "Thrust plates north of Goat Mountain domain" includes Cow Creek, Lemhi Pass, and Pattee Creek domains plus Shenon Creek thrust plate. Wavy red lines indicate angular unconformities.

Photograph of angular unconformity (red line) between Mesoproterozoic Gunsight Formation (Yg) and overlying Mississippian Middle Canyon and Scott Peak Formations (Mm and Ms, respectively). View looks southwest from Goat Mountain toward lower Little Eightmile Creek. Mountain goats along ridgeline, stratigraphically above the unconformity. White line indicates unit contact. Photograph by K. Lund, 1996.



Three-dimensional image showing Thompson Gulch thrust fault (TGTF) carrying Mississippian Middle Canyon Formation and the overlapping Baby Joe Gulch thrust fault system (BJGTFS) carrying Early Ordovician–Late Cambrian Beaverhead Mountains syenogranite. View is to the north across mouth of Jakes Canyon. Qa, alluvium; Qt, terrace deposits; Mm, Middle Canyon Formation; Ms, Scott Peak Formation; OCg, syenogranite; Ys, Swauger Formation; Yg, Gunsight Formation; Yac, coarse siltite unit of Apple Creek Formation. Image by Stuart A. Giles.

Photograph showing field view of part of the area shown in the draped image. View is to the north across Jakes Canyon. Photograph by K. Lund, 2014.



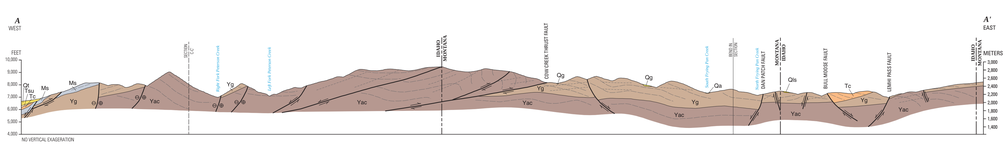
Index map showing map area in yellow with 7.5' U.S. Geological Survey quadrangles.

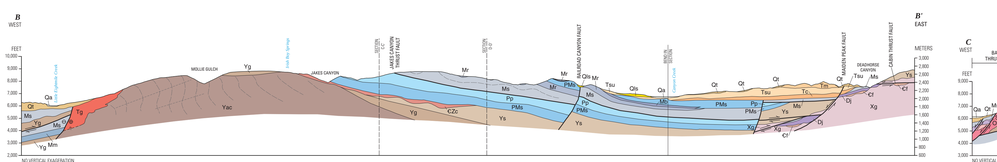
Base modified from U.S. Geological Survey, Baker, Idaho, 2017; Goldstone Mountain, Idaho-Mont., 2017; Kitty Creek, Mont.-Idaho, 2017; Coyote Creek, Mont., 2017; Bachelor Mountain, Mont., 2017; Tendoy, Idaho, 2017; Agency Creek, Idaho, 2017; Lemhi Pass, Mont.-Idaho, 2017; Everson Creek, Mont., 2017; Jeff Davis Peak, Mont., 2017; Hayden Creek, Idaho, 2017; Lemhi, Idaho, 2017; Goat Mountain, Idaho-Mont., 2017; Bannock Pass, Mont.-Idaho, 2017; Deadman Pass, Mont.-Idaho, 2017; Mogg Mountain, Idaho, 2017; Stroud Creek, Idaho, 2017; West of Leadore, Idaho, 2017; Leadore, Idaho, 2017; Reservoir Creek, Idaho-Mont., 2017

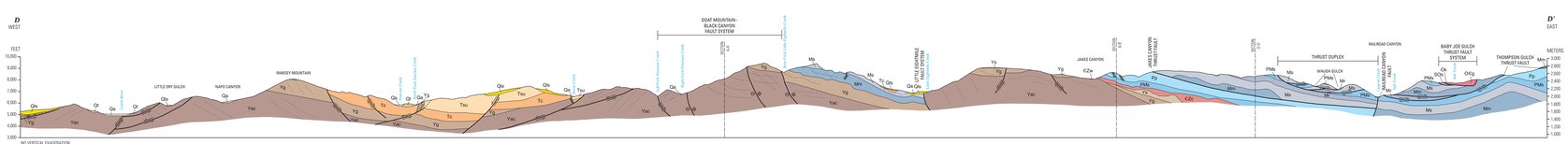
North American Datum of 1983 (NAD83)

Shaded relief base from The National Map, accessed 2017, at https://www.usgs.gov/core-science-systems/ngp/tnm-delivery

World Geodetic System of 1984 (WGS84). Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 12T







Geologic mapping by K. Lund 1996–2002, 2014–2017. Bedrock geology along eastern margin of map is a combination of new geologic mapping and compilation from Lucchitta (1966), M'Gonigle (1994), and M'Gonigle and Hait (1997). Basin geology generalized from VanDenburg (1999) and Blankenau (1997)

GIS database and digital cartography by
Stuart A. Giles and K. Lund

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Geologic Map of the Central Beaverhead Mountains, Lemhi County, Idaho, and Beaverhead County, Montana

By
Karen Lund

2018

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