

PROTEROZOIC METAMORPHIC ROCKS

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| Xn | <p>Hornblende gneiss and amphibolite (Paleoproterozoic (?)) – Well-foliated gray to dark gray equigranular fine- to medium-grained gneiss composed of hornblende (typically ~50%, but variable), K-feldspar (25%), plagioclase (~10%), quartz (~10%), and minor garnet, clinopyroxene, and biotite (~5% combined). This unit contains local amphibolite with up to 80% hornblende. Segregated layers of aligned grains of hornblende and of feldspar and quartz can be distinguished in thin section. Forms a gradational contact with both altered felsic gneiss units (Xag-1 and Xag-2). Previously described as the Swandylke Hornblende Gneiss of Lovering (1935).</p> |
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Xb **Biotite-gneiss and schist (Paleoproterozoic (?))** — Gray to dark gray rock containing plagioclase (50%), quartz (25%), biotite (15%), potassium feldspar (10%), and locally variable amounts of amphibole (likely hornblende) up to 10%. Unit is locally migmatitic and folded. Local pegmatites are parallel to foliation.

Ktd **Interlayered biotite-sillimanite-gneiss and schist, biotite-quartz gneiss and schist, and pegmatite (Paleoproterozoic (?)** — Generally heterogeneous light gray to black interbedded fine to medium-grained metasedimentary gneisses and schists with highly variable amounts of quartz, plagioclase, microcline, and local garnet. Sillimanite-rich areas (up to 10%) are characterized by abundant whitish elongate sillimanite fibrolite aggregates ranging from 0.5 mm to 5 cm in length and are accompanied with higher concentrations of biotite (up to 40% locally). Zircon (<1%) is observed in this section as inclusions within other mineral grains, particularly in quartz and biotite. Locally, the unit contains well-sorted coarse-grained quartz and biotite. The unit is generally small to map individually. This unit is locally folded and migmatitic. This unit was previously described as Idaho Springs Formation of Lovering (1935).

7 **Inclined foliation** — Showing strike and dip

46 **Horizontal foliation**

17 **Lineation** — Showing bearing and plunge

32 **Inclined symmetric minor fold hinge** — Showing bearing and plunge

70 **Inclined fold hinge of minor fold** — Showing bearing and plunge

Small, minor inclined joint — Showing strike and dip

Small, minor vertical joint — Showing strike

• **U-Pb LA-ICP-MS sample**

— **Contact** — Dashed where approximately located

— **Fault** — Dashed where approximately located, dotted where concealed

Antiform — Dashed where approximately located, plunging antiforms show large arrow in direction of plunge

Synform — Dashed where approximately located, plunging synforms show large arrow in direction of plunge

A A' **Alignment of cross section**

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ALLUVIAL AND COLLUVIAL DEPOSITS

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| Qa | Alluvium (Holocene to Pleistocene) — Interbedded clay, silt, sand, gravel, and cobbles along streams and washes. Locally contains organic-rich sediments from meadows, marshes, and beaver ponds. Estimated thickness is 1–5 m. |
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| Or | <p>Fan deposits (Holocene and uppermost Pleistocene) — Lobate, hummocky fan-shaped deposits at base of slope to the southwest of Montezuma town site. Unit consists of poorly to moderately sorted, weakly to moderately stratified, granule to boulder gravel with a clayey sandy silt matrix. Surface morphology is characterized by channels and levees produced by debris flows. Deposits laterally thin as individual flow events spread across adjacent surfaces. Deposits delineate general locations of debris flow hazards to structures, roads, and other infrastructure. Thickness approximately 0.5-5 m.</p> |
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| Qac | <p>Alluvium and colluvium (Holocene to upper Middle Pleistocene) — Undifferentiated, unconsolidated, non- to weakly stratified, poorly to moderately sorted, sandy, silty, clayey, angular to subrounded, granule- to boulder-gravel deposits that mantle abandoned erosional surfaces, fill local depressions, and form a thin slope veneer downslope from bedrock outcrops. Primarily transported and deposited by most recent slopewash and other local gravitational-driven processes, but includes older diamictic glacial erratics and periglacial solifluction/ice-wedging deposits on the west side of the quadrangle. Estimated thickness 2-15 m.</p> |
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MASS-WASTING DEPOSITS

Rock-glacier deposits (Holocene and uppermost Pleistocene) — Lobate and tongue-shaped deposits consisting primarily of cobbles to boulders with steep flanks and fronts. Deposits interpreted as active by creep and other down-slope, gravity-driven processes. Estimated thickness is 2–30 m.

Q1s **Landslide deposits (Holocene to Upper Pleistocene)** — Unsorted and unstratified rock debris and sediments, with hummocky topography, headwall scarps, and lobate toes. Locally includes rockfall deposits. Thickness is estimated at 5–50 m.

Till of Pinedale age reworked into landslide deposits (Holocene and Upper Pleistocene) — Unsorted, subangular to subrounded, granule to boulder debris with little to no stratification, in a clayey, sandy, silt matrix. Deposits are located in the south-central margin of the quadrangle within a southeast-facing drainage covered by ice during the Pinedale glacial maximum. Postglacial gravitationally driven processes have remobilized till into younger landslide deposits. An apparent lobate remnant of a latest Pleistocene recessional moraine is within the drainage. Thickness approximately 1-5 m.

GLACIAL DEPOSITS

Qtz **Till of Pinedale glaciation (Upper Pleistocene)** — Rounded to subrounded, unsorted boulder- to gravel-sized clasts in a sandy-silty matrix. Original glacial landforms, including lateral and terminal moraines, are well preserved, and commonly contain undrained kettles and depressions. Thickness is about 2–30 m.

BEDROCK GEOLOGY

CENOZOIC INTRUSIVE ROCKS

Fig. 2 **Quartz monzonite porphyry (Eocene)** — White to light gray, medium-to coarse-grained, porphyritic quartz monzonite with up to 3-cm long blocky to tabular phenocrysts of orthoclase, quartz, and plagioclase. Lenses of biotite, muscovite, hornblende, magnetite, and titanite. Unit makes up the majority of the Montezuma stock, located in the northern half of the Montezuma quadrangle. Dikes exposed throughout the quadrangle. In the southern half of the quadrangle, outcrops of the map unit are rare, and locations are determined primarily by float mapping. The main stock is massive, with two orthogonal joint sets, dipping steeply NWN and shallowly SSE, and a less well-defined set dipping steeply NWN and SE. Dikes and sills, weathered rust-colored and extending from a mafic porphyry stock, commonly have a highly textural texture with a very fine-grained light-gray matrix and phenocrysts of quartz and feldspar. U-Pb zircon ages range from 38.8 ± 0.5 Ma (Rosenzweig et al., 2021).

PROTEROZOIC INTRUSIVE ROCKS

Ygo **Biotite granite (Mesoproterozoic)** — Medium- to dark-gray, medium-grained, weakly to moderately foliated granite composed of feldspar (58%), quartz (30%), biotite (10%) and muscovite (2%). White feldspar phenocrysts are up to 2 cm in length. Feldspar in this unit was interpreted in the field to be predominantly plagioclase based on color and habit. The unit is rarely observed in the mapping area and is potentially correlative with a phase of the Granite (Yg). It is separated based on differences in grain size, color, and mineralogy, particularly the interpreted higher proportion of plagioclase feldspar compared to microcline.

Ygsm Mixed biotite-quartz gneiss and schist with Silver Plume granite (Mesoproterozoic) — Light gray to pink K-feldspar porphyritic granite (Yg) with abundant xenoliths of gray to dark gray biotite-quartz gneiss containing plagioclase (50%), quartz (25%), biotite (15%), and potassium feldspar (10%). Variable amounts of amphibolite (up to 10%) are locally present in the xenoliths. Lithology changes at the meter or smaller scale. May represent an intrusive contact or a margin where metamorphic xenoliths are incorporated into the granite. The granite observed in this unit is interpreted to possibly represent a phase of the Silver Plume Granite.

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| Yg | <p>Granite (Mesoproterozoic) – Light gray to salmon pink equigranular to porphyritic two-mica granite composed of microcline (50%), quartz (25%), plagioclase feldspar (15%), biotite (5%), muscovite (3%), and minor accessories (2%). The unit is foliated and lineated, with some evidence for foliation along its contacts, as well as a W-nipping tectonic foliation within the granite, formed by tightly packed 4–1 cm long feldspar phenocrysts. Joints are generally randomly oriented at the meter-scale, but without the interference of the foliation. This granite contains a satellite plume of the nearby Silver Plume Granite, an extensive, porphyritic Mesoproterozoic two-mica granite with a reported U-Pb zircon age of 1424 ± 5 Ma (du Bray and others, 2018). This unit forms extensive cohesives exposures throughout the northern half of the quadrangle, with smaller ponds and dikes throughout the northern half of the quadrangle.</p> |
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Ygmp **Megacrystic K-feldspar granite (Mesoproterozoic)** – Pink to light gray, medium- to coarse-grained porphyritic granite with up to 60% K-spars, up to 35% plagioclase (white) feldspar, 20-30% quartz, biotite (5-20%) and locally minor hornblende. Mineral compositions vary locally. Contains phenocrysts up to 3 cm in length composed of up to 95% potassium (pink) feldspar. May represent a phase of the 1442 ± 2 Ma (Alcinikoff and others, 1993) Mount Blue Sky batholith.

Older pegmatite (Mesoproterozoic to Paleoproterozoic ?) — Undifferentiated pegmatite pods and dikes in Paleoproterozoic host rock. Pegmatite is coarse- to very coarse-grained, white to pink, and contains feldspar (65%), quartz (25%), muscovite up to 5% and (or) biotite up to 5%, and minor opaques such as magnetite and pyrite (1%). Thin veinlets of biotite within larger quartz and feldspar grains and along fractures are common in this section. This unit is generally weakly to moderately foliated and dikes and pods commonly parallel local folds in the metamorphic host rocks.

Xag-2 **Altered felsic gneiss 2 (Paleoproterozoic (?))** — Brown, weather resistant, moderately to strongly foliated, altered felsic gneiss layer containing quartzite (40%), feldspar (50%), muscovite (5%), biotite (3%), and minor chlorite. This unit contains local quartzite in discontinuous lenses and thin layers. Does not effervesce in acid. In outcrop, the unit resembles calc-silicate gneiss. Gradational contacts are observed with units X8b and Xh.

Xag-1 **Altered felsic gneiss 1 (Paleoproterozoic ?)** — Greenish, weather-resistant, weakly to moderately foliated, altered felsic gneiss layer containing quartz (24%), feldspar (67%), muscovite (6%) calcite (1%), and chlorite (1%). This unit contains local biotite and rutile. Calcite occurs partly in micrometer-scale veins. Contains local quartzite, commonly as lenses or pods. Effervesces in acid. In outcrop, the unit resembles calcisilicate gneiss. Contacts with units Xsb and Xh are gradational.

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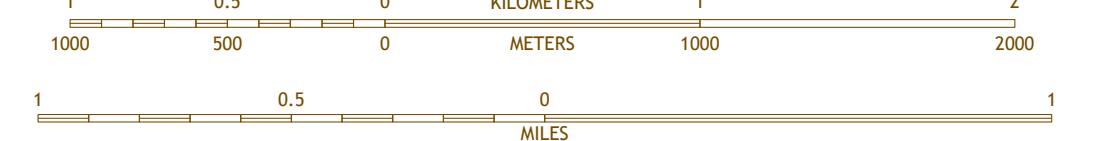
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Roads.....U.S. Census Bureau
Roads within US Forest Service Lands.....FS Top
Names.....GNIS, 15
Hydrography.....National Hydrography Dataset, 20
Contours.....National Elevation Dataset
Boundaries.....Multiple sources, see metadata file, 20
Public Land Survey System.....BLM, 20

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| Roads..... | U.S. Census Bureau, 2016 |
| Roads within US Forest Service Lands..... | FS Topo, 2013 |
| Names..... | GNIS, 1978-2021 |
| Hydrography..... | National Hydrography Dataset, 2003-2020 |
| Contours..... | National Elevation Dataset, 2022 |
| Boundaries..... | Multiple sources, see metadata file, 2017-2021 |
| Public Land Survey System..... | BLM, 2021 |

SCALE 1:24,000

1 0.5 0 KILOMETERS



CONTOUR INTERVAL 40 FEET

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By Erick T. Bora, Ariel J. Borsook, Dustin Shockley, Yvette D. Kuiper, and Chester A. Ruleman

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