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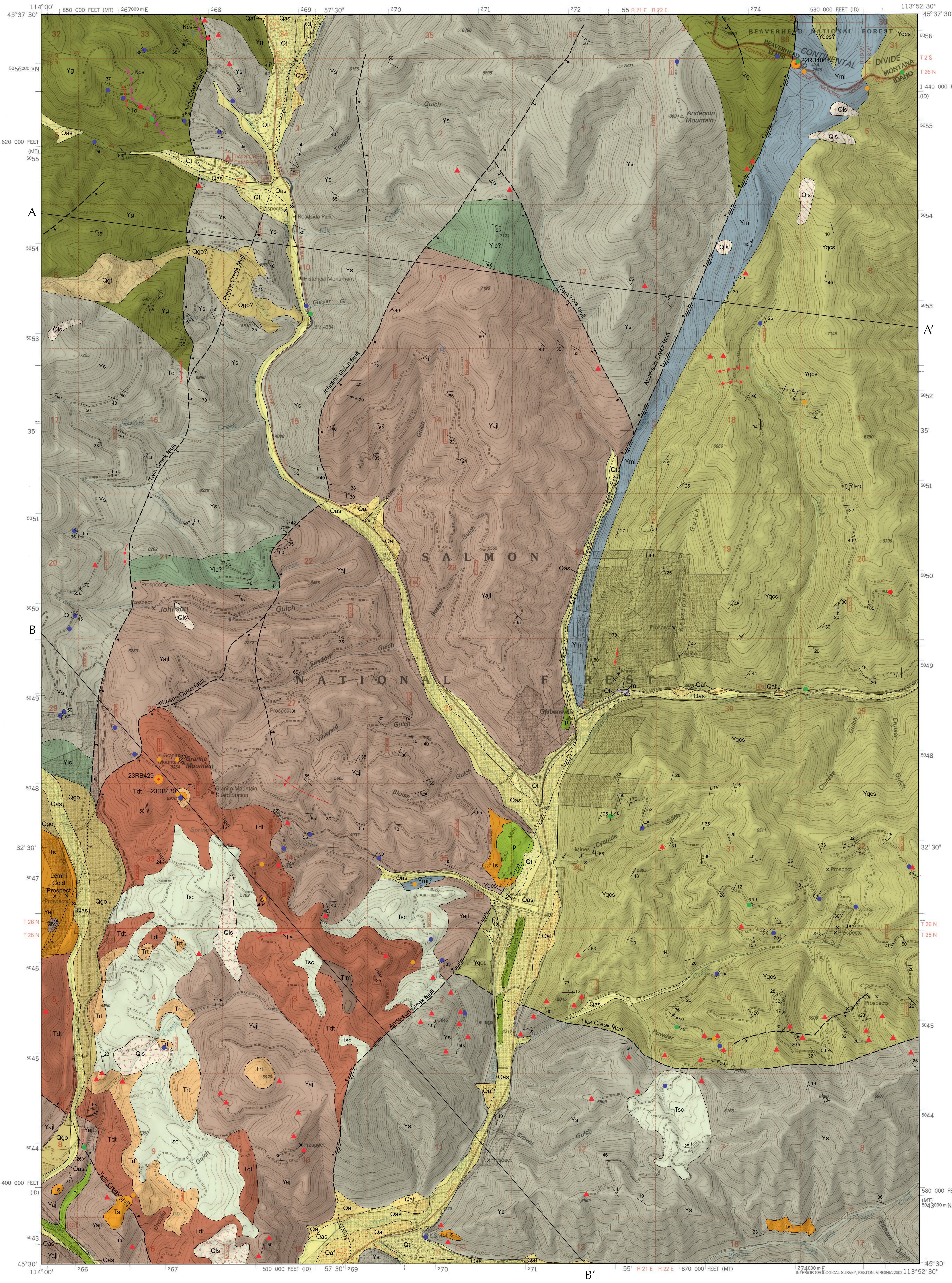
DIGITAL WEB MAP 241
MBMG OPEN FILE 779

Geologic Map of the Gibbonsville Quadrangle, Lemhi County, Idaho and Beaverhead County, Montana

David E. Stewart, Reed S. Lewis, Eric D. Stewart, Russell F. Burmester, and Jeffrey D. Lonn

2026



Base Map Credit

Topographic base modified from digitally scanned 1:24,000-scale USGS paper map, compiled in 1965. Planimetry derivd from imagery taken in 1995. Public Land Survey System and survey control current as of 1999.

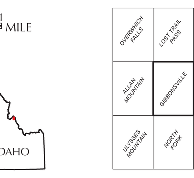
Transverse Mercator projection. 1927 North American Datum.

10,000-foot grid ticks: State Plane Coordinate System, Idaho Central Zone and Montana South Zone.

1000-meter grid ticks: Universal Transverse Mercator, zone 12.

Shaded relief from 10 m DEM.

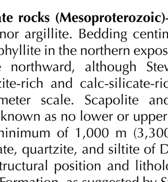
Declination from NOAA National Geophysical Data Center.



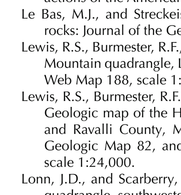
SCALE 1:24,000

MILE · FEET · KILOMETER

Contour interval 40 feet



QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Field work conducted in 2011-2012 and 2023-2024.

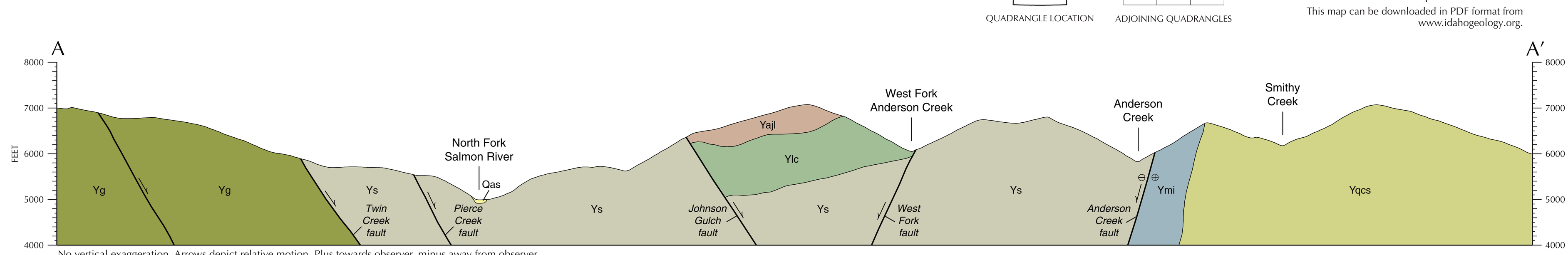
This geologic map was supported by the U.S. Geological Survey, National Cooperative Mapping Program, under assistance Award No. G24AC00268. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

GIS and digital cartography by Adam Trzinski at the Idaho Geological Survey's Digital Mapping Lab.

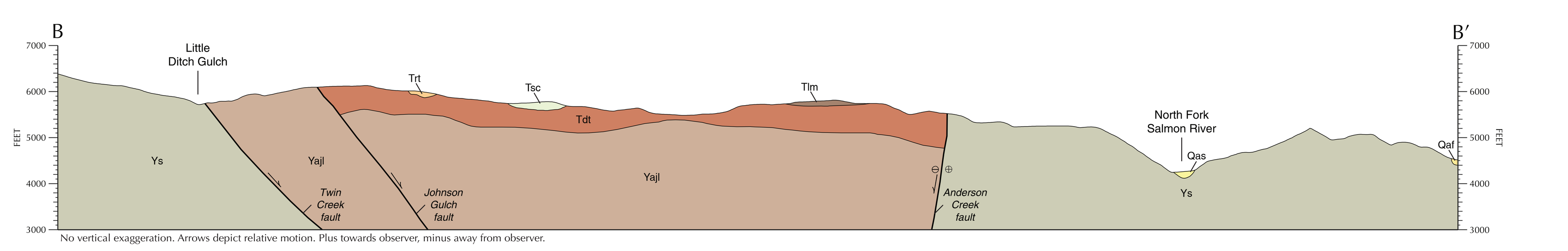
Technical review by Dennis M. Feeney and Claudio Berti.

Map version 05-05-2026.

This map can be downloaded in PDF format from www.idahogeology.org.

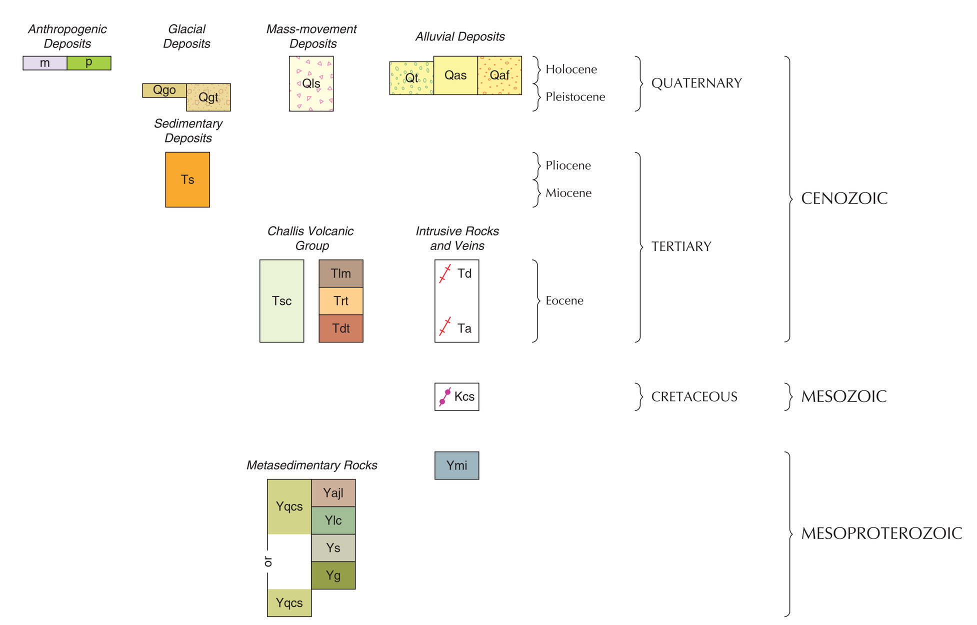


No vertical exaggeration. Arrows depict relative motion. Plus towards observer, minus away from observer.



No vertical exaggeration. Arrows depict relative motion. Plus towards observer, minus away from observer.

CORRELATION OF MAP UNITS



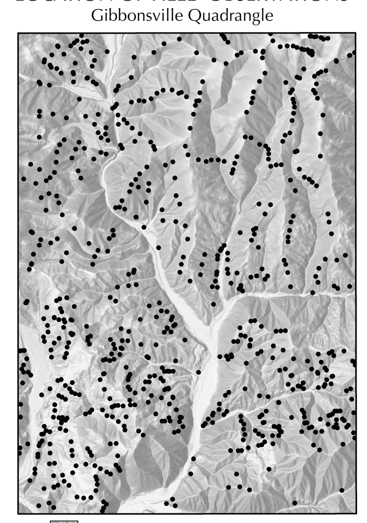
INTRODUCTION

The map is the result of field work primarily in 2011, 2012, 2023, and 2024 and previous research in the region. Field sheets from the 2011 and 2012 mapping by Eric and David Stewart that were the basis of a 1:40,000 scale regional map (Stewart and others, 2014) were particularly useful in producing the present map. Also helpful was previous regional mapping by Evans and Green (2003) at 1:100,000 scale. Many concepts for geologic units were developed while mapping in the Beaverhead Mountains to the southeast as part of a 1:24,000-scale collaborative mapping project by the Idaho Geological Survey and the Montana Bureau of Mines and Geology that started in 2007 and resulted in geologic maps of the western (Burmester and others, 2016a) and eastern (Lonn and others, 2019) parts of the Salmon 30′ x 60′ quadrangle (yellow outline, Figure 1) southeast of this 7.5′ quadrangle (blue outline, Figure 1). Mapping of landslides, alluvial deposits, placer deposits, and glacial deposits was aided by LiDAR-derived hillshade images. Magnetic susceptibility was measured with KT-9 and KT-10 Kappameters from Exploranium G.S. Ltd and Terra Plus (Table 1, Figure 2). These values assist with interpretation of regional aeromagnetic data sets.

The oldest rocks in the quadrangle are Mesoproterozoic metasedimentary rocks. They host Mesoproterozoic, Cretaceous(?), and Eocene intrusions and veins, all of which are overlain by volcanic rocks of the Challis Volcanic Group and coeval sedimentary deposits.

LOCATION OF FIELD OBSERVATIONS

Gibbonsville Quadrangle



Extent of LiDAR coverage as of 04/2025

SYMBOLS

Contact: solid where certain; dashed where approximately located; dotted where concealed.

Fault: dashed where approximately located; dotted where concealed.

Normal fault: dashed where approximately located; dotted where concealed; ball and bar on downthrown side.

Reactivated right-lateral strike-slip fault with later normal motion: dashed where approximately located; dotted where concealed.

Anticline: dashed where approximately located.

Strike and dip of bedding.

Approximate strike and dip of bedding.

Strike of vertical bedding.

Strike and dip of bedding known to be upright based on sedimentary structures.

Strike and dip of bedding interpreted to be overturned based on stratigraphic succession or position.

Strike and dip of cleavage.

Strike and dip of foliation.

Strike of vertical foliation.

Strike and dip of eutaxitic foliation.

Strike and dip of mylonitic foliation.

Trend and plunge of lineation.

Trend and plunge of minor fold axis.

Quartz vein.

23RB429 Geochronological sample location.

Tectonic breccia.

Spring.

Prospect.

Adit.

Gravel pit.

Location of magnetic susceptibility measurement (Table 1).

- 0.01 - 0.20
- 0.21 - 1.00
- 1.01 - 10.00
- > 10.00

DESCRIPTION OF MAP UNITS

The geologic map of the Gibbonsville quadrangle shows rock units exposed at the surface or underlying a thin surficial cover of soil and colluvium. Igneous rocks are classified using International Union of Geological Sciences nomenclature (Le Bas and Streckeisen, 1991). Grain size classification of unconsolidated and consolidated sediment employs the Wentworth scale (Lane, 1947). Bedding thicknesses and lamination type are after McKee and Weir (1953). Time scale is the 2022 Geological Society of America version 6.0 (Walker and Geissman, 2022). Grain sizes and bedding thicknesses are given in abbreviation of metric units (e.g., dm=decimeter). Unit thicknesses, distances, and elevations are in both metric and English units. Multiple lithologies within a rock unit description appear in order of decreasing abundance, and descriptions of stratigraphic units are from bottom to top where possible.

ANTHROPOGENIC DEPOSITS

p **Placered ground (late Holocene)**—Areas along Hughes Creek, Dahlonega Creek, and North Fork of Salmon River that were placer mined for gold (Lorain and Metzger, 1939).

m **Made ground (late Holocene)**—Mine dump northeast of Gibbonsville.

ALLUVIAL DEPOSITS

Qas **Side-stream alluvium (Holocene to Late Pleistocene)**—Subangular to rounded, moderately sorted and stratified pebble to boulder sandy gravel. Designated as '*Qas*' as these are tributaries to the Salmon River.

Qaf **Alluvial-fan deposits (Holocene to Late Pleistocene)**—Angular to subrounded, poorly sorted, matrix-supported pebble to boulder gravel in a sand, silt, and clay matrix. Profiles are relatively steep.

Qt **Terrace deposits (Holocene to Late Pleistocene)**—Subangular to rounded, moderately sorted and stratified pebble to boulder sandy gravel above current stream level along the North Fork of the Salmon River, Dahlonega Creek, Anderson Creek, and Sheep Creek. Profiles are relatively flat.

GLACIAL DEPOSITS

Qgo **Outwash (Late Pleistocene)**—Areas of poorly sorted sand, gravel, cobbles, and boulders deposited downstream of till deposits near the west edge of the map. Longitudinal profiles are steeper than those of *Qt*.

Qgt **Till (Pleistocene)**—Unsorted sand, gravel, cobbles, and boulders. Partially preserved end moraine as well as ground till is present along Deep Creek, near the western edge of the map.

MASS-MOVEMENT DEPOSITS

Qls **Landslide deposits (Holocene to Pleistocene)**—Unstratified, poorly sorted silty clay, gravelly silty clay, and boulders.

SEDIMENTARY DEPOSITS

Ts **Sediments (Pliocene or Miocene)**—Unconsolidated subangular to rounded, moderately to poorly sorted and stratified sand, silt, cobbles, and boulders (Figure 3). Contains quartzite and lesser volcanic clasts, commonly supported by an orange-stained matrix.

CHALLIS VOLCANIC GROUP

Rocks of the Eocene Challis Volcanic Group formed from eruptions and to a lesser extent sedimentation. They are widespread to the south where they were mapped by D.H. McIntyre, E.B. Ekren, and R.F. Hardyman in the Challis 1° x 2° quadrangle (Fisher and others, 1992). Here only remnants of originally more extensive volcanic units are present.

Tsc **Sediment and sedimentary rock (Eocene)**—Poorly consolidated to consolidated, generally poorly sorted and stratified, conglomeratic sands and silts supporting clasts up to boulder size. Clasts are subrounded to subangular pebbles, cobbles, and boulders of quartzite and lesser volcanics interlayered with finer grained material (Figure 4). Deposits west of the North Fork of the Salmon rest on *Yajl* and contain abundant quartzite clasts. One exposure along southern Ditch Creek contains poorly lithified, well-bedded, poorly sorted juvenile epiclastic quartz-feldspar sands with abundant biotite that resembles weathered granite.

Tlm **Mafic lavas (Eocene)**—Dark- to medium-gray mostly aphyric red-weathering andesite lava flows. Sparse phenocrysts of plagioclase laths or hornblende visible in some samples. Locally vesicular.

Trt **Rhyolite tuff (Eocene)**—Tan to white, poorly to moderately welded rhyolite tuff. Phenocrysts of sanidine and quartz are less than 3 mm across and constitute about 5 percent of the rock (Figure 5). Also contains sparse tan flattened pumice as much as 1 cm across and tan volcanic lithics. Gas cavities comprise as much as 20 percent, are as much as 2 cm across, and most are filled with lithophysae. U-Pb zircon age of 49.0 ± 0.2 Ma (Figure 6, sample 23RB430) determined for a sample collected south of Granite Mountain (see Symbols).

Tdt **Flow-banded dacite tuff (Eocene)**—Variably phyric flow-banded dacite. Phenocrysts of plagioclase, hornblende, quartz, and biotite comprise about 25 percent of the rock (Figure 7). All but the hornblende are less than 2 mm across. Biotite lacks the pseudohexagonal form common to many of the Challis dacitic rocks. Flow banding is on the cm to mm scale. U-Pb zircon age of 49.4 ± 0.4 Ma (Richard Gaschnig, written comm., 2025, sample 23RB429) determined for a sample collected southwest of Granite Mountain (see Symbols). This age is the average of the youngest grains; the age range over several million years likely reflects recycling of zircon antecrysts.

INTRUSIVE ROCKS AND VEINS

Ta **Andesite dike (Eocene)**—Single andesitic to basaltic dike southeast of Granite Mountain.

Td **Dacite dike (Eocene)**—Single dacite dike in the northwest corner of the map. Contains sparse plagioclase, quartz, hornblende, and biotite phenocrysts.

Kcs **Calc-silicate veins (Cretaceous?)**—Red-brown-weathering, coarse-grained, actinolite-diopside-calcite veins or dikes (Figure 8). Contacts sharp and linear. Known only in *Yg* in northwest corner of map and north-adjacent Lost Trail Pass quadrangle (Stewart and others, 2025).

Ymi **Mafic intrusive rocks (Mesoproterozoic)**—Fine- to medium-grained mafic dike in northeast part of quadrangle (Figure 9). White plagioclase as much as 30 percent. Original hornblende and pyroxene(?) partly altered to amphibole, chlorite, and epidote, likely during metamorphism. Appears to have intruded along and subsequently been cut by the Anderson Creek fault. Sample 22RB406 collected near the state line 530 m (1,700 ft) south of the north map boundary contained 52.7 percent SiO_2 and was dated by U-Pb LA-MC-ICP-MS methods on zircon (Stewart and others, 2025). Zircon yield from this sample was poor. Of nine grains analyzed, seven yielded similar ages with a $^{207}Pb/^{206}Pb$ weighted mean of 1,264 ± 15 Ma. One concordant (likely inherited) grain yielded a ~1,747 Ma age and one discordant grain showed Cretaceous or younger Pb-loss. A smaller mafic dike 2.4 km (1.5 mi) southwest of Gibbonsville is possibly the same age. Alternatively, that pyroxene-rich and relatively fresh dike is Eocene in age and related to the mafic Eocene dikes in the Beaverhead Range, 35 km (22 mi) to the south-southeast (Tdi; Burmester and others, 2016a).

METASEDIMENTARY ROCKS

Mesoproterozoic metasedimentary rocks comprise most of the bedrock in the quadrangle. Unit names follow the stratigraphic nomenclature (Burmester and others, 2016b) that uses the coarsest unit, the Swauger Formation, to distinguish otherwise similar rocks that are above and below it.

Yajl **Jahnke Lake member of the Apple Creek Formation (Mesoproterozoic)**—Pale-gray to green, fine- to very fine grained, plagioclase-rich quartzite. Locally has pinkish cast where iron oxide is hematite. Beds typically decimeter-scale (Figure 10), with ripples, climbing ripples, load casts, and trough and planar cross bedding (Stewart and others, 2014). Locally quartzite contains argillite as irregular chunks and flakes. Thickness unknown due to lack of upper contact but as much as 3,000 m (10,000 ft) in the Henderson Ridge quadrangle to the west (Lewis and others, 2021). Unit assignment based on stratigraphic position above the Lawson Creek Formation.

Ylc **Lawson Creek Formation (Mesoproterozoic)**—Gray, fine-grained feldspathic quartzite to dark-gray to black siltite and argillite. According to Stewart and others (2014) quartzite fines upward on the decimeter scale into siltite-argillite. They reported that heavy mineral laminations, ripple cross laminations and climbing ripples are common and that the units contains significantly more siltite and argillite than the Gunsight Formation (*Yg*) and the Jahnke Lake member of the Apple Creek Formation (*Yajl*). Upper contact appears gradational into *Yajl*. Thickness varied, perhaps 100 to 400 m (330 to 1,310 ft) based on map pattern in Stewart and others (2014). Assigned to the Lawson Creek Formation because it is fine grained and above *Ys*.

Ys **Swauger Formation (Mesoproterozoic)**—Light-gray to white, fine- to medium-grained, poorly sorted quartzite with well-rounded quartz grains and little to as much as 50 percent feldspar; potassium feldspar typically greater than plagioclase in medium to thick beds (Figure 11). In the west (Ys of Stewart and others, 2014) quartzite beds generally fine upward within laterally continuous beds between 75 and 150 cm thick. Some crossbeds are defined by heavy mineral laminae with hematite. Greenish 1-3 cm mud chunks concentrated near Johnson Gulch west of the Twin Creek fault (west central part of the map area). Thin, laminated siltite and argillite caps are present on the tops of many cycles. Locally foliated with micaceous partings. Where mapped in the southeast corner as upper Swauger (Stewart and others, 2014) fine-grained quartzite and siltite caps are generally laminated and locally include small amounts of scapolite. Appears gradational into *Ylc* with interbeds of thin-bedded gray quartzite and siltite. Approximately 3,400 m (11,000 ft) thick in the Allan Mountain quadrangle to the west. Assigned to the Swauger Formation based on continuity with Swauger Formation mapped along the east flank of the Beaverhead Mountains to the south-southeast.

Yg **Gunsight Formation (Mesoproterozoic)**—Quartzite, siltite, and minor argillite. The quartzite is feldspathic, well sorted. Beds are thin (1 cm) to thick (1 m) with rare grading in thinner beds, rare ripples, climbing ripples, load casts, and trough and planar crossbedding with hematite-bearing heavy mineral laminations in thicker ones. Upper contact gradational into *Ys*. Thickness on the map uncertain, but estimated to be approximately 4,500 m (15,000 ft) (Stewart and others, 2014). Stratigraphic position under the Swauger Formation supports assigning this unit to the highest formation of the Lemhi Group.

Yqcs **Quartzite and calc-silicate rocks (Mesoproterozoic)**—Quartzite, calc-silicate rocks, siltite, and minor argillite. Bedding centimeter- to decimeter-scale (Figure 12). Includes phyllite in the northern exposures. Amount of calc-silicate rocks decrease northward, although Stewart and others (2014) observed that quartzite-rich and calc-silicate-rich intervals alternate on approximately 100-meter scale. Scapolite and actinolite are locally present. Thickness unknown as no lower or upper stratigraphic contact has been found, but a minimum of 1,000 m (3,300 ft) is likely. Previously mapped as calc-silicate, quartzite, and siltite of Dahlonega Creek (Stewart and others, 2014). Structural position and lithologies suggest correlation with the Yellow Lake Formation, as suggested by Stewart and others (2014), but lower parts that are dominated by quartzite may include strata of the Big Creek Formation. It even could be below those units if normal displacement on the Lick Creek fault was large. Alternatively, it could be equivalent to the Lawson Creek and Apple Creek formations. Strata similar to *Yqcs* have been observed above the Swauger Formation to the east in the West Pioneer Mountains (Lonn and Scarberry, 2022). However, the Lawson Creek Formation (Hobbs, 1980) and some Apple Creek Formation members have medium quartz grains that are absent from *Yqcs*.

STRUCTURE

This map and the Lost Trail Pass quadrangle to the north (Stewart and others, 2025) share *Ys*, *Yg*, *Yqcs*, *Ymi*, *Kcs*, and the Anderson Creek fault. The Cool Gulch fault on the Lost Trail Pass map (Stewart and others, 2025) and the Lick Creek fault on the Gibbonsville map are the southern contacts of *Yqcs* with *Yg* or *Ys*. Understanding *Yqcs* therefore depends on both maps.

LICK CREEK FAULT

The Lick Creek fault strikes east and dips steeply. Breccia occurs widely around the fault, but at its west end near the Anderson Creek fault, the breccia zone is more than 2,000 m (1.2 mi) wide (Stewart and others, 2014). Because the stratigraphic assignment of the strata north of the fault is uncertain, the style of faulting is also in question. Most of the authors on this map consider that *Yqcs* mapped on the north side is older than the Swauger Formation and that the fault dips to the south. This is based in part on the observation that the strata west of the Anderson Creek fault young to the south, and if also true in a regional sense for the more highly folded strata east of the Anderson Creek fault, would indicate down-to-the-south normal motion. In contrast, if *Yqcs* is above the Swauger Formation the Lick Creek fault would be down on the north.

ANDERSON CREEK FAULT

The Anderson Creek fault strikes south-southwest and is interpreted to dip steeply to the west-northwest. It passes from the Lost Trail Pass quadrangle (Stewart and others, 2025) into the Gibbonsville quadrangle near its northeast corner and extends to near the southwest corner. South of the Lick Creek fault and into the North Fork quadrangle (Lonn and others, 2013) west-side-down motion accounts for *Yajl* and Tertiary units to the west of *Ys* (Figure 1). Similar (net) displacement north of the Lick Creek fault requires that *Yqcs* is stratigraphically or structurally below *Yajl*. However, at least there, the Anderson Creek fault likely has a more complicated history. The narrow width of *Ymi* along most of its trace is consistent with *Ymi* being a dike intruded into the fault. If so, the fault's original continuity around 1,260 Ma (Lewis and others, 2025) likely was disrupted by deformation in the Neoproterozoic, Cretaceous, and Eocene. Segments of it would have been distributed, possibly folded, on different thrust plates. Early motion may have included dextral slip. Stewart and others (2014) cited Bacorn (1905) and Mayerle and Close (1993) for evidence from underground mines in the Gibbonsville area that indicated right-lateral strike-slip motion. However, the estimate of 11 km (7 mi) displacement was based on offset of the *Ys* - *Yqcs* contact across the Lick Creek fault and the *Yg* - *Yqcs* contact across the Cool Gulch fault about 1.5 km (0.9 mi) north of the map (Stewart and others, 2025). Those contacts are dissimilar so do not constitute a good piercing point. Similarly large strike slip is not found on the Monument Gulch fault in the Ulysses Mountain quadrangle to the southwest (Lewis and others, 2019). Although traces of the Trail Gulch and North Fork thrusts are offset in a dextral sense, most or all of that could result from west-side-down displacement of their southward dipping contacts. Furthermore, that strike slip would postdate those thrusts. Continuation through the North Fork quadrangle does not cross thrust faults, so it is possible that the Anderson Creek fault accommodated early strike slip motion if its present curvilinear trace can be explained by later deformation. Alternatively, perhaps dextral slip was restricted to north of the Lick Creek fault. Such would be possible if the Lick Creek fault had earlier large thrust motion and the Anderson Creek fault to the north acted as a lateral ramp or transfer fault. A complication is that down on the southwest motion on the West Fork fault adds to the normal motion on the Anderson Creek fault only south of their intersection.

PIERCE CREEK FAULT

The Pierce Creek fault is mapped as a northeast-striking structure in the southern part of the Lost Trail Pass quadrangle that drops *Ys* on the east against *Yg* on the west (Stewart and others, 2025). It is presumed to continue southward into this quadrangle under Quaternary deposits along the North Fork Salmon River east of the Twin Creek fault, eventually merging with that fault north of Quartz Creek.

TWIN CREEK FAULT

The Twin Creek fault in the west part of the map dips east. In this quadrangle its normal motion dropped Challis Volcanic Group strata in the east against Mesoproterozoic metasedimentary rocks in the west, and relatively younger Mesoproterozoic units in the east against relatively older units in the west.

JOHNSON GULCH FAULT

The Johnson Gulch fault in the west-central part of the map is only well located along its central portion, from Johnson Gulch north to a short distance beyond the North Fork Salmon River. The fault strikes northeast and dips southeast. It may be a splay off the Twin Creek fault, but it offsets the southward dipping *Ylc?* contacts more than does the Twin Creek fault so likely has a larger displacement at least there. Its northern extent is unknown as it is not mapped in the Lost Trail Pass quadrangle to the north. A possible reason for its disappearance is that much of its displacement was transferred to the West Fork fault, and together, it and Anderson Creek fault form a wedge-shaped graben with decreasing displacement to the south.

WEST FORK FAULT

The southeast-striking West Fork fault connects the Johnson Gulch and Anderson Creek faults. Stratigraphic offset documents displacement down on the southwest comparable to that of the Johnson Gulch fault at the same latitude.

MINERALIZATION

Numerous small mines and prospects are present in the quadrangle. Unpublished maps and documents for mining properties are available by examining "Property Details" through the interactive map ("Mines" web app) on the Idaho Geological Survey website (https://www.idahogeology.org/webmap). Property code (e.g., DI0028) is given below to assist with website searches.

GIBBONSVILLE DISTRICT

Several mines and prospects are present near Gibbonsville. According to Johnson and others (1998) the first lode claims were staked on gold-bearing quartz veins in 1877 near the confluence of Anderson Creek with Dahlonega Creek. The deposit, later known as the AD&M mine (American Development and Reduction Mining Company, DI0028) eventually became the largest producer in the district. Other gold-bearing quartz veins were soon discovered; the most notable were at the Twin Brothers mine (DI0031) and the Clara Morris mine (DI0021, Mayerle and Close, 1993, p. 19). The AD&M mine is credited with 48,000 ounces of gold, the Twin Brothers with 14,500 ounces, and the Clara Morris with 12,000 ounces. Mineralization generally consists of gold-, silver-, and copper-bearing quartz veins trending east-west in phyllite and micaceous quartzite. The deposits appear to be zoned around the AD&M where gold and silver are the major constituents. Copper concentrations and eventually lead concentrations increase away from the AD&M (Johnson and others, 1998).

LEMHI GOLD (HUMBUG, DITCH CREEK) DEPOSIT (DI0017)

According to Johnson and others (1998) significant resources have been identified at the Lemhi Gold deposit located west of Ditch Creek, at and beyond the west edge of this quadrangle. Drilling programs conducted by FMC Corporation and American Gold Resources in the 1980s and 1990s delineated significant concentrations of gold in quartz veins and silica-rich zones in fine-grained metasedimentary strata of the Apple Creek Formation. Exploration has continued, with additional drilling by Lemhi Gold Trust in 2012 and Freeman Gold Corporation in 2020. Our reconnaissance indicated that the metasedimentary rocks were strongly mylonitized along low-angle shear zones. According to Dufresne and others (2021), sill-like bodies of quartz-feldspar porphyry have intruded a subhorizontal zone of shattering and brecciation. The intrusive rocks are not exposed at the surface but have apparently been encountered in numerous drill holes. The deposit appears to be in the footwall of the Twin Creek fault but a direct connection between that fault and the shearing and mineralization is uncertain.

PLACER DEPOSITS

Several placer gold deposits along the North Fork Salmon River and its larger tributaries are described by Lorain and Metzger (1939). These include the Dahlonega Creek placer (DI0039) and others along the North Fork Salmon River. These and other placer deposits visible on lidar imagery are shown as "p" on the map (see Description of Map Units). Lorain and Metzger noted that although the area around Gibbonsville is widely mineralized with gold-bearing quartz veins, high-grade gold deposits such as those found at Leesburg are lacking. They attributed this to the steepness of the smaller streams and the fact the larger streams flow through straight narrow valleys.

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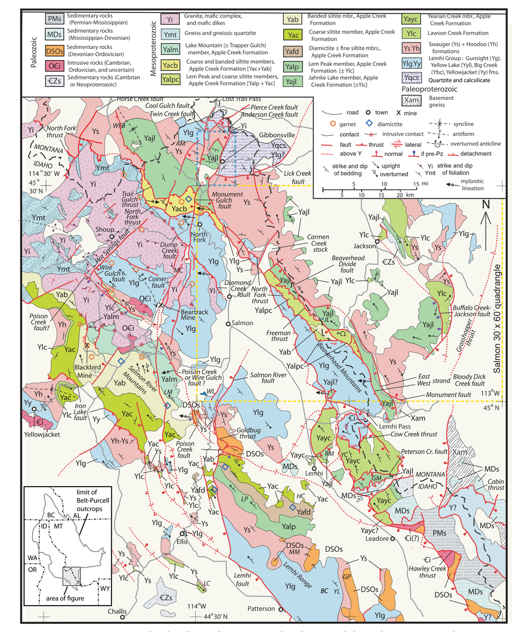

Figure 1. Pre-Mesozoic bedrock geology around Salmon, Idaho. The coarsest clastic unit (Ys = Yh) separates lower formations of the Lemhi Group (in blue) from higher Lawson Creek and Apple Creek formations (greens and yellows). Units are combined where scale or previous mapping makes separating them impractical. Geographic locations are in italics: *AM*—Allan Mountain; *BC*—Big Creek; *CL*—Cowbone Lake; *GM*—Goat Mountain; *GP*—Gunsight Peak; *HC*—Hayden Creek; *JL*—Jahnke Lake; *LC*—Lawson Creek; *LM*—Lake Mountain; *LP*—Lem Peak; *MC*—Moose Creek; *MM*—Mogg Mountain); *RM*—Ramsey Mountain; *WFB*—West Fork Bitterroot River; *YC*—Yearian Creek; *YL*—Yellow Lake. Dashed rectangles outline the Salmon 1° x 2° (yellow) and Gibbonsville (blue) maps. Modified after Burmester and others (2023) to include insights from field work in 2023.

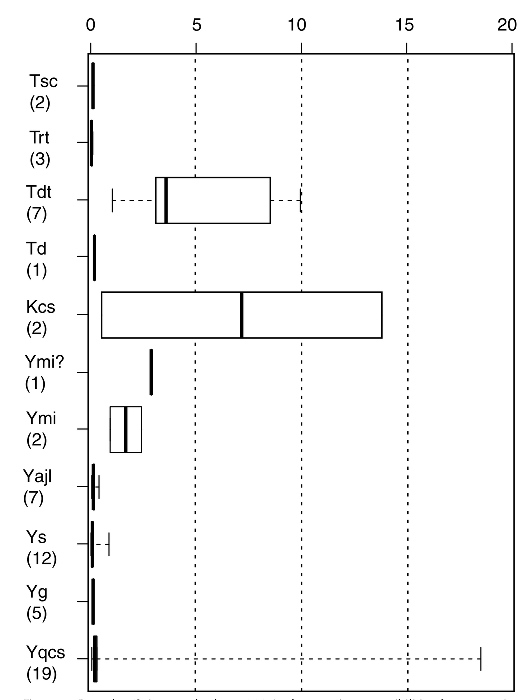

Figure 2. Box plot (Spitzer and others, 2014) of magnetic susceptibilities for map units measured. Susceptibility (κ) axis is linear. Bold black lines show the medians; box limits are the 25th and 75th percentiles; whiskers extend to minimum and maximum values. See Table 1 for data for each unit. Base plot generated using http://shiny.chemgrid.org/boxplotr/.

Figure 3. Unconsolidated *Ts* in roadcut west of Ditch Creek at western margin of the quadrangle.

Figure 4. Outcrop exposure east of Ditch Creek of *Tsc* conglomerate with mixed pebble clasts (lower part of photo) and coarse sandstone with granite-derived clasts (upper part of photo).

Figure 5. Rhyolite tuff (*Trt*) dated by U-Pb methods (sample 23RB430).

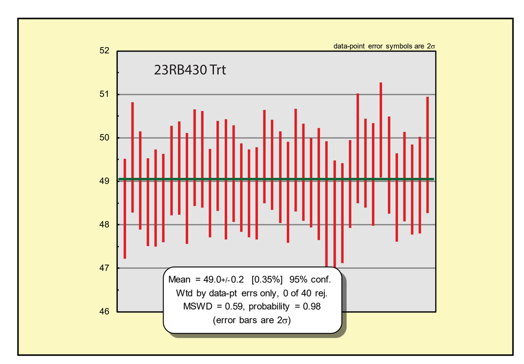

Figure 6. Plot of U-Pb zircon age of 49.0 ± 0.2 Ma for *Trt*. Analytical work by Daniel Brennan of the Montana Bureau of Mines and Geology using facilities at University of California, Santa Barbara.

Figure 7. Flow-banded dacite tuff (*Tdt*) dated by U-Pb methods (sample 23RB429).

Figure 8. Calc-silicate vein or dike (*Kcs*) in northwest part of map.

Figure 9. Mafic dike (*Ymi*) along the state line that was dated by U-Pb methods (sample 22RB406).

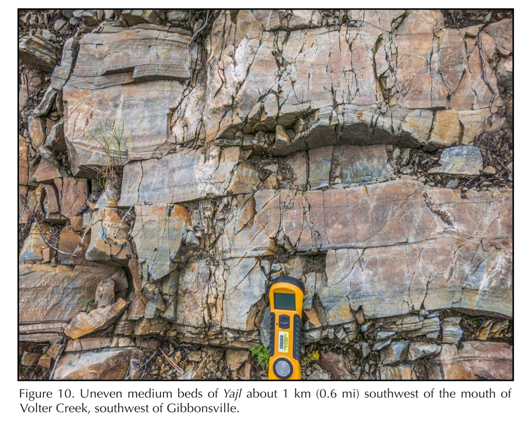

Figure 10. Uneven medium beds of *Yajl* about 1 km (0.6 mi) southwest of the mouth of Volter Creek, southwest of Gibbonsville.

Figure 11. Thick-bedded almost massive sparsely feldspathic quartzite in the upper part of *Ys* in the footwall of the Twin Creek fault along Johnson Gulch near the west edge of the map.

Figure 12. Thinly layered calc-silicate and feldspathic quartzite of *Yqcs* between Lick and Powder creeks about 2 km (1.2 mi) east of Highway 93.

Measurement ID	Map Unit	Latitude	Longitude	Median	N
23RBms0364	Tsc	45.5177	-113.9121	0.067	22
23RBms0389	Tsc	45.5324	-113.9454	0.148	40
12RL216	Trt	45.5467	-113.9812	0.020	1
12RL218	Trt	45.5216	-113.9834	0.030	1
23RBms0387	Trt	45.5465	-113.9810	0.098	15
23RBms0351	Tdt	45.5504	-113.9841	1.022	15
23RBms0354	Tdt	45.5399	-113.9695	2.618	10
23RBms0386	Tdt	45.5469	-113.9815	3.555	10
23RBms0393	Tdt	45.5301	-113.9480	3.574	10
12RL219	Tdt	45.5068	-113.9878	7.200	1
23RBms0353	Tdt	45.5364	-113.9692	9.846	20
23RBms0352	Tdt	45.5504	-113.9815	9.948	15
23RBms0446	Td	45.6166	-113.9892	0.174	11
23RBms0440	Kcs	45.6145	-113.9851	0.514	6
23RBms0447	Kcs	45.6157	-113.9867	13.821	15
12DS67.5	Ymi?	45.5379	-113.9477	2.870	1
22RBms033	Ymi	45.6202	-113.8930	0.919	10
22RBms034	Ymi	45.6192	-113.8921	2.406	10
12RL217	Yajl	45.5509	-113.9876	0.050	1
23RBms0356	Yajl	45.5429	-113.9626	0.107	10
23RBms0384	Yajl	45.5536	-113.9904	0.109	10
23RBms0357	Yajl	45.5405	-113.9528	0.120	10
23RBms0390	Yajl	45.5303	-113.9438	0.161	12
23RBms0355	Yajl	45.5415	-113.9664	0.173	10
24RBms0615	Yajl	45.5116	-113.9948	0.323	9
07RL589	Ys	45.5026	-113.9462	0.010	1
99RL242	Ys	45.5552	-113.9977	0.030	1
23RBms0392	Ys	45.5250	-113.9406	0.036	10
22LKms333	Ys	45.5958	-113.9631	0.038	10
23RBms0382	Ys	45.5648	-113.9961	0.071	20
23RBms0380	Ys	45.5635	-113.9969	0.072	15
23RBms0437	Ys	45.6132	-113.9755	0.080	16
23RBms0383	Ys	45.5733	-113.9962	0.086	15
23RBms0526	Ys	45.6163	-113.9736	0.097	15
23RBms0350	Ys	45.5548	-113.9982	0.110	15
22RBms031	Ys	45.6202	-113.9102	0.136	11
07RL590	Ys	45.5950	-113.9625	0.800	1
23RBms0438	Yg	45.6143	-113.9805	0.104	7
22RBms032	Yg	45.6207	-113.8959	0.107	15
08RL660	Yg	45.6122	-113.9933	0.110	1
23RBms0445	Yg	45.6174	-113.9914	0.121	10
23RBms0512	Yg	45.6214	-113.9862	0.145	10
23RBms0362	Yqcs	45.5217	-113.9043	0.051	12
23RBms0369	Yqcs	45.5330	-113.8966	0.105	12
12ES31b	Yqcs	45.5364	-113.8901	0.110	1
23RBms0374?	Yqcs	45.5356	-113.8849	0.120	15
23RBms0359	Yqcs	45.5289	-113.9047	0.133	8
23RBms0376a	Yqcs	45.5358	-113.9001	0.150	15
22LKms342	Yqcs	45.5940	-113.8984	0.156	10
23RBms0370	Yqcs	45.5396	-113.8773	0.178	10
23RBms0360y	Yqcs	45.5236	-113.9104	0.190	8
23RBms0379	Yqcs	45.5435	-113.9153	0.190	11
23RBms0360x	Yqcs	45.5236	-113.9104	0.205	10
23RBms0376b	Yqcs	45.5358	-113.9001	0.217	10
23RBms0378	Yqcs	45.5447	-113.9198	0.264	15
22LKms347	Yqcs	45.5574	-113.8920	0.293	10
22RBms037	Yqcs	45.6191	-113.8781	0.296	15
22RBms035	Yqcs	45.6175	-113.8831	1.465	16
13ES07	Yqcs	45.5224	-113.9051	1.500	1
22LKms343	Yqcs	45.5861	-113.8921	7.186	10
22LKms344	Yqcs	45.5671	-113.8799	18.557	10

Table 1. Magnetic susceptibility measurements of rocks in the Gibbonsville quadrangle. Values determined from outcrop faces or fresh talus typically on 10 measurements per exposure, or from hand samples (N=1). The median of multiple measurements is reported; averages from single samples reported as median. Instruments were KT-9, and KT-10 Kappameters from Exploranium G.S. Ltd and Terre Plus. Values reported in SI units (× 10^{-3}). WGS84 Datum.

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