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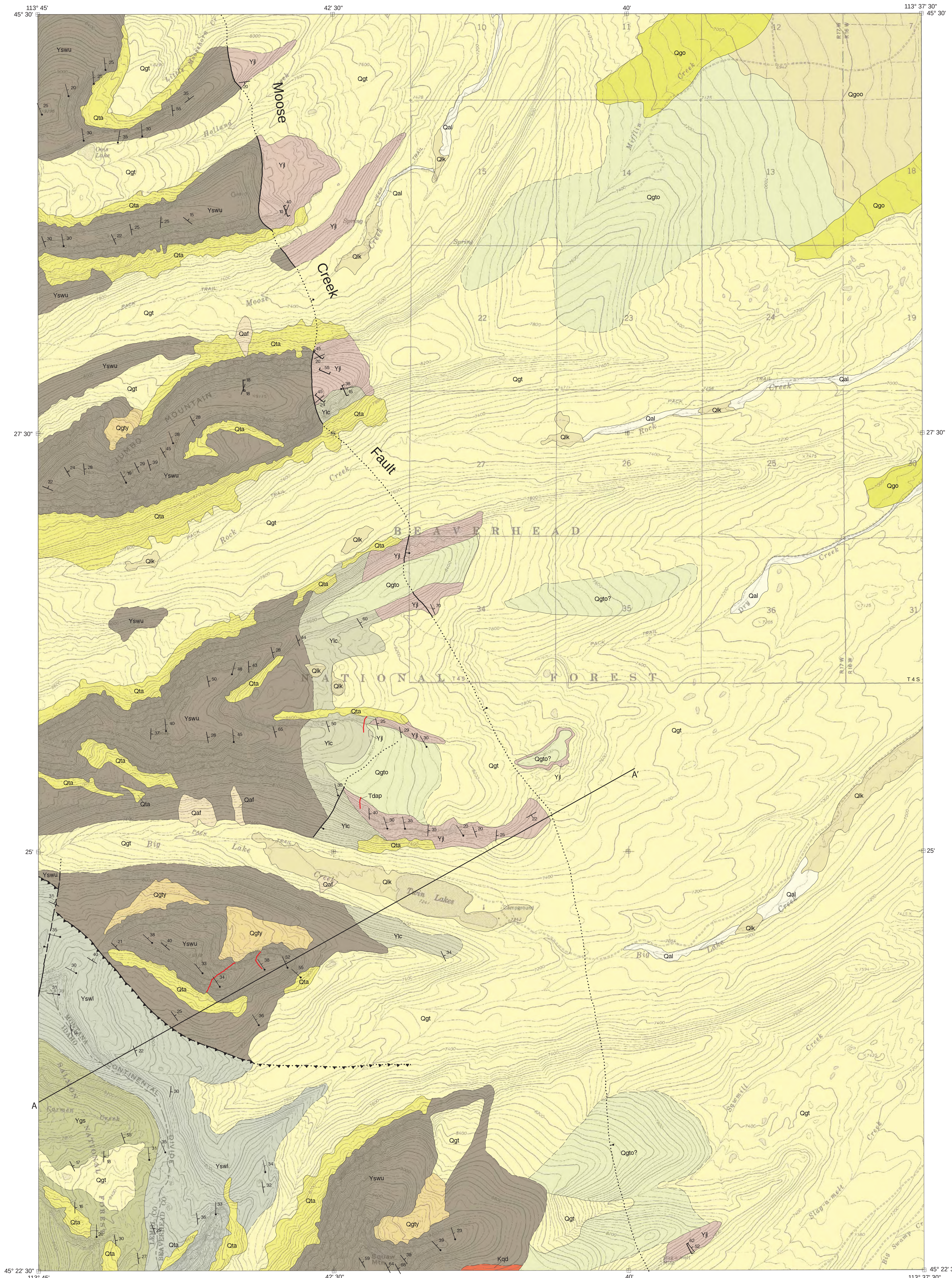

Base from U.S. Geological Survey
Jumbo Mountain 7.5' topographic quadrangle
Map date: 1966
Projection: UTM zone 12; 1927 NAD
UTM grid declination 1°55' West
1966 Magnetic North Declination 19° East
Contour Interval 40 feet; NGVD of 1929

SCALE 1:24,000
CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Maps may be obtained from:
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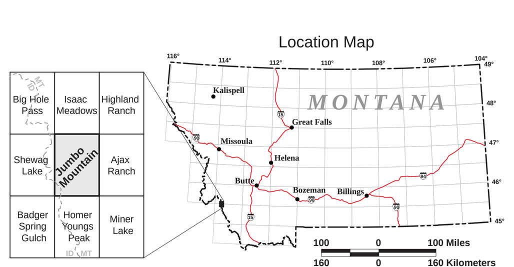
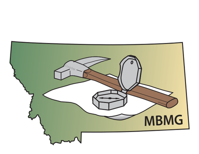
Location Map





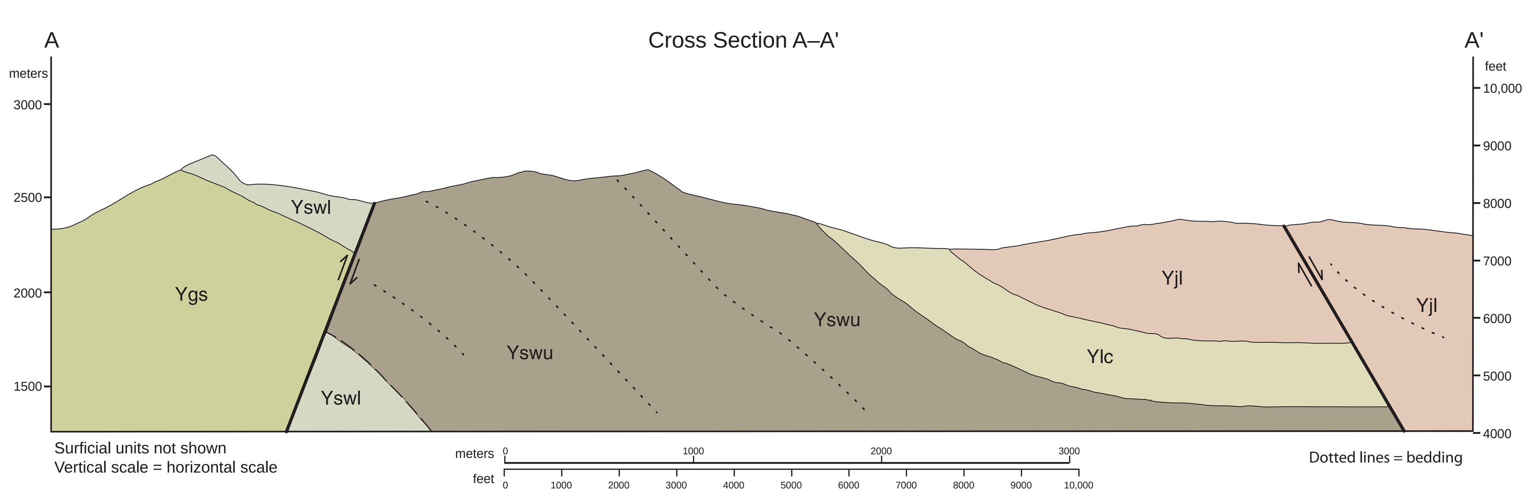
MBMG Open-File Report 634

Geologic Map of the Jumbo Mountain 7.5' Quadrangle, Beaverhead County, Montana and Lemhi County, Idaho

Jeffrey D. Lonn, Loudon R. Stanford, Mark D. McFaddan, Reed S. Lewis, and Russell F. Burmester

2013

Cross Section A–A'



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GIS production: Ken Sandau and Paul Thale, MBMG. Map layout: Susan Smith, MBMG.

INTRODUCTION

The Montana Bureau of Mines and Geology (MBMG) and the Idaho Geological Survey (IGS) selected the Jumbo Mountain 7.5' quadrangle in the northern Beaverhead Mountains along the Montana-Idaho border for a 1:24,000-scale collaborative mapping project as part of a larger project designed to understand the structural and stratigraphic relationships between two dissimilar Mesoproterozoic sedimentary rock packages. To the north, in the Anaconda Range (fig. 1), are exposures of known Belt Supergroup rocks (Ruppel and others, 1993; Lonn and McDonald, 2004), whereas to the southwest in the Lemhi Range and Salmon River Mountains of Idaho are the reference sections of the Lemhi Group, Swauger Formation, and Yellowjacket Formation (Ross, 1934, 1947; Ruppel, 1975). In the intervening Beaverhead Mountains, previous workers have proposed very different stratigraphic and structural interpretations (MacKenzie, 1949; Coppinger, 1974; Tucker, 1975; Hansen, 1983; Ruppel and others, 1993; Winston and others, 1999; Evans and Green, 2003; Tysdal and others, 2005; O'Neill, 2005; O'Neill and others, 2007; Burmester and others, 2011a). These previous geologic maps disagree on the stratigraphy, and on the presence and type of tectonic structures, making regional correlation of the Mesoproterozoic sedimentary packages—the Belt Supergroup and the Lemhi Group/Yellowjacket Formation—very controversial (Winston and others, 1999; Evans and Green, 2003; Ruppel and others, 1993). Since 2007, the MBMG/IGS team has mapped thirteen other 7.5' quadrangles in the region (Burmester and others, 2011b, 2012; Lewis and others, 2009a, 2009b, 2011, 2012; Lonn and Lewis, 2011, 2012; Lonn and others, 2008, 2009a, 2011, in preparation 2013a; Othberg and others, 2011) in an ongoing attempt to resolve some of the long-standing controversies. The stratigraphic and structural interpretations presented here rely extensively on the concepts developed during this previous mapping.

PREVIOUS WORK

The entire quadrangle was included on a small-scale map by Ruppel and others (1993; scale 1:250,000). Lonn and others (2008) mapped the south-adjacent Homer Youngs Peak 7.5' quadrangle, and Stewart and others (in preparation) included the west-adjacent Shewag Lake 7.5' quadrangle on a 1:40,000-scale map.

GEOLOGIC SUMMARY

Mesoproterozoic sedimentary rocks are exposed on the high ridges in the western part, but are covered by extensive Quaternary glacial deposits in the major valleys and across the eastern half of the quadrangle. The Mesoproterozoic strata have affinities with the strata of the Lemhi subbasin of the Belt basin (Burmester and others, in preparation). The strata form an east-dipping homocline, exposing a stratigraphic section correlated with the Gunsight formation (*Ygs*) of the Lemhi Group grading up through the Swauger (*Yswl, Yswu*) and Lawson Creek (*Ylc*) formations, and into a newly recognized formation, the quartzite of Janke Lake (*Yjl*) (Burmester and others, in preparation). The strata are part of an immensely thick (> 10,000 m [32,000 ft]) east-facing succession of quartzite that underlies the entire east side of the Beaverhead Mountains northeast of the Freeman thrust, a northwest-striking, southwest-dipping, top-to-the-northeast thrust fault that lies about 10 km (6 miles) west of the map area (Lonn and others, 2008, 2009a, in preparation 2013b).

A few relatively minor faults cut the bedrock of the Jumbo Mountain quadrangle; the most notable is a north-northwest-striking, down-to-the east normal fault that is labeled "Moose Creek fault". North-northwest-striking, northeast-dipping cleavage appears to be associated with this fault. A northwest-striking, northeast-directed reverse fault has been extended from Stewart and others' (in preparation) west-adjacent map into the southwestern part of the map area. It separates pebble-bearing lower Swauger formation (*Yswl*) from non-pebbly upper Swauger (*Yswu*).

Extensive glaciation occurred in the Pleistocene, and the resulting outwash and till cover almost the entire eastern half of the map.

DESCRIPTION OF MAP UNITS

Grain-size classification of unconsolidated and consolidated sediment is based on the Wentworth scale (Lane, 1947). Bedding thicknesses and lamination type are after Winston (1986) and McKee and Weir (1953). Multiple lithologies within a rock unit description are listed in order of decreasing abundance.

ALLUVIAL DEPOSITS

Qal **Alluvium (Holocene)**—Rounded to subrounded pea to boulder gravel and coarse sand. Mostly derived from re-worked till and outwash gravels. Thickness 1-3 m (3-10 ft).

Qlk **Lake deposits (Holocene-Pleistocene)**—Silt and sand deposited behind moraines and in glacially scoured depressions. Thickness 1-4 m (3-13 ft).

Qaf **Alluvial and stony debris-flow fan gravels (Holocene)**—Angular to subangular poorly sorted boulder gravels and sand. Found on steep valley walls. Thickness 1-8 m (3-26 ft).

MASS MOVEMENT DEPOSITS

Qta **Talus and glacial deposits, undifferentiated (Holocene)**—Angular unsorted to poorly sorted boulder to large boulder gravels. Mostly pro-talus ramparts, talus aprons, and slumps derived from moraine remnants and recent frost-wedged quartzite debris. Found on glaciated valley walls and in cirques. Includes some alluvial-fan gravel and young glacial and periglacial deposits. Thickness less than 18 m (60 ft).

GLACIAL DEPOSITS

Qgty **Young glacial and periglacial deposits (Holocene?)**—Poorly sorted angular to subangular boulder gravel, large boulder gravel, and till. Sandy boulder till on some moraines. Includes pro-talus ramparts and talus aprons, inactive rock glaciers, and moraines of the Little Ice Age and older (?) deposits in cirques and northeast-facing protected areas above 2,500 m (8,200 ft). Lichens common on all but youngest deposits. Lateral moraines found in the largest deposits have trees growing on distal slopes. Thickness as much as 35 m (114 ft).

Qgt **Glacial till of last local glacial maximum (Pinedale) (Pleistocene)**—Poorly sorted sandy to clayey boulder to large boulder till. Clasts subangular to subrounded. Also includes younger till deposited on or just below cirque floors up to 2600 m (8530 ft). Includes end moraine, recessional moraine, and some outwash. Soils weakly developed. Thickness as much as 100 m (328 ft).

Qgo **Glacial outwash gravels of last local glacial maximum (Pinedale) (Pleistocene)**—Subrounded to rounded, well-sorted sandy cobble to boulder gravel and cobbly sand (Soil Survey Staff, 2012). Thickness at least 2 m (6 ft).

Qgto **Glacial till older than the last glacial maximum, undifferentiated (Pleistocene)**—Poorly sorted bouldery till. Mostly subangular to subrounded clasts. Thin remnant till present on interfluve surfaces . End moraines cut by younger Qgt advance in the northwest of the map. Soil development weak to moderate. Thickness highly varied, as much as 60 m (196 ft).

Qgoo **Glacial outwash gravels older than the last glacial maximum (Pleistocene)**—Subrounded to rounded, sorted sandy cobble to boulder gravel and cobbly sand (Soil Survey Staff, 2012). Soils weakly developed.

IGNEOUS ROCKS

Tdap **Dacite porphyry (Eocene?)**—Porphyritic dacite dikes with plagioclase phenocrysts.

Tdi **Diorite dikes (Eocene)**—Dark gray to dark green fine-grained mafic dikes. Similar dike rock in the Goldstone Pass quadrangle of the central Beaverhead range (Lonn and others, 2009a) was dated at 46 Ma by zircon U-Pb methods (Richard Gaschnig, written commun., 2009).

Kqd **Quartz diorite (Cretaceous)**—Biotite-hornblende quartz diorite. Part of the Carmen Creek stock extensively exposed on the south-adjacent Homer Youngs Peak quadrangle (Lonn and others, 2008). The following data are from Kilroy (1981): Composition 45-55 percent andesine (An 40-50) along with hornblende, biotite, quartz, and orthoclase. $^{40}Ar/^{39}Ar$ dating of hornblende from two samples collected in the Homer Youngs Peak quadrangle yielded ages of 81.5 ± 1.6 Ma and 80.3 ± 2.2 Ma. These hornblende ages of about 81 Ma are considered the minimum age for this unit. Younger $^{40}Ar/^{39}Ar$ ages of biotite from these two samples (51.1 ± 2.4 Ma and 70.0 ± 1.5 Ma) may reflect slow uplift and cooling, or reheating during the Eocene.

MESOPROTEROZOIC STRATA

Yjl **Quartzite of Janke Lake(Mesoproterozoic)**—Gray to pale green, thick-bedded, fine- to medium-grained, well-sorted, very feldspathic quartzite. Bedding is difficult to see, but when visible is commonly defined by dark laminations composed of hematite grains. Convolute bedding resulting from soft sediment deformation is common. Thin skins of green argillite commonly separate the meter-scale quartzite beds (fig. 2), and thin mud rip-ups are uncommon. Five slabbed and stained samples contained no potassium feldspar, 50-60% quartz, 25-40% plagioclase and sericite, and 0-10% black hematite grains. Grades downward into the Lawson Creek Formation in the headwaters of Dry Creek in the west-central part of the quadrangle. Thickness of 685 m (2,247 ft) is exposed on the quadrangle, but it is as much as 4,300 m (14,100 ft) thick on the Goldstone Pass 7.5' quadrangle to the south (Lonn and others, 2009a). See Burmester and others (in preparation) for a more detailed discussion of this newly recognized formation.

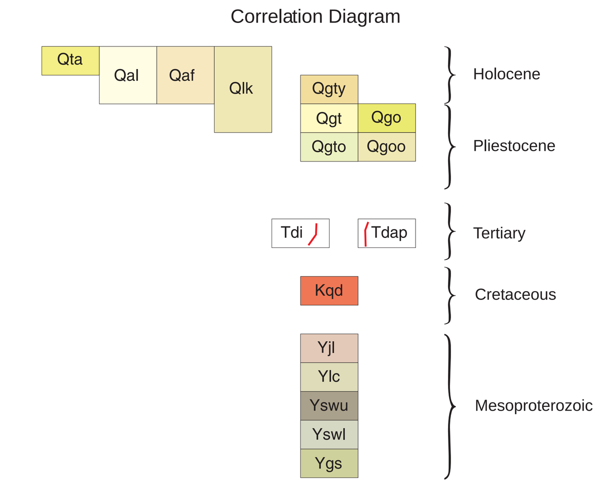
Ylc **Lawson Creek Formation (Mesoproterozoic)**—Couplets (cm-scale) and couples (dm-scale) of fine- to medium-grained white quartzite and purple, black, and green argillite. Lenticular and flaser bedding are common and characteristic (fig. 3). Mud rip-up clasts are uncommon, but present, and some are very large, as much as 15 cm (6 inches) in diameter (fig. 4). Quartzite intervals contain up to 10% black hematite(?) grains. In the headwaters of Dry Creek, a complete section is present, grading up into the Janke Lake quartzite and down into the Swauger Formation. Thickness approximately 340 m (1,115 ft).

Yswu **Swauger Formation, upper member, informal (Mesoproterozoic)**—White to light gray, poorly sorted, fine- to coarse-grained, trough and planar crossbedded, variably feldspathic quartzite in beds as thick as 2 m. Characterized by coarse well-rounded quartz grains. Beds of black argillite as much as 2 cm thick are common, and typically contain dessication cracks (fig 5). Thick black mud rip-ups are also common. Contains rare granules, but lacks the small pebbles found in the lower member of the Swauger Formation (*Yswl*). Eleven slabbed and stained samples contained from 7% to 30% feldspar with potassium feldspar in excess of plagioclase. Bottom not exposed, but is at least 1,400 m (4,593 ft) thick.

Yswl **Swauger Formation, lower member, informal (Mesoproterozoic)**—White to light gray, poorly sorted, medium- to coarse-grained, planar and crossbedded, feldspathic quartzite. Contains small pebbles of white quartzite and feldspar at the bases of beds that are probably lag deposits (fig. 6). The quartzite pebbles are well-rounded, while the feldspar pebbles are angular, suggesting different source areas. Beds are as much as 2 m thick. Interbeds of black argillite as much as 2 cm thick are common, and typically contain dessication cracks. Thick black mud rip-ups are also common. Grades downward into the Gunsight Formation (*Ygs*) in the headwaters of Carmen Creek in the southwestern part of the map area. Upper contact not exposed, but is at least 665 m (2,181 ft) thick. On the south-adjacent Homer Youngs Peak quadrangle, correlative strata are at least 1,800 m (5,905 ft) thick (Lonn and others, 2008).

Ygs **Gunsight Formation (Mesoproterozoic)**—Pale green to gray, well-sorted, fine- to very fine-grained, feldspathic quartzite. Massive, flat laminated, and cross-bedded beds are up to 1 m thick. Some intervals have a hornfels texture and a few contain calc-silicate minerals. Two slabbed and stained samples contained 60% to 70% quartz, 30% to 40% plagioclase and sericite, and no potassium feldspar, in contrast to the Swauger Formation. Grades up into Swauger Formation (*Yswl*). Lower contact not exposed. Thickness at least 300 m (984 ft).

Correlation Diagram



MAP SYMBOLS

Contact: dashed where approximately located

Fault: dashed where approximately located; dotted where concealed, bar and ball on downthrown side

Reverse or thrust fault: teeth on upthrown block; dashed where approximately located; dotted where concealed

Strike and dip of inclined beds

Strike and dip of bedding where stratigraphic tops were confirmed using primary sedimentary structures

Cleavage

Dike

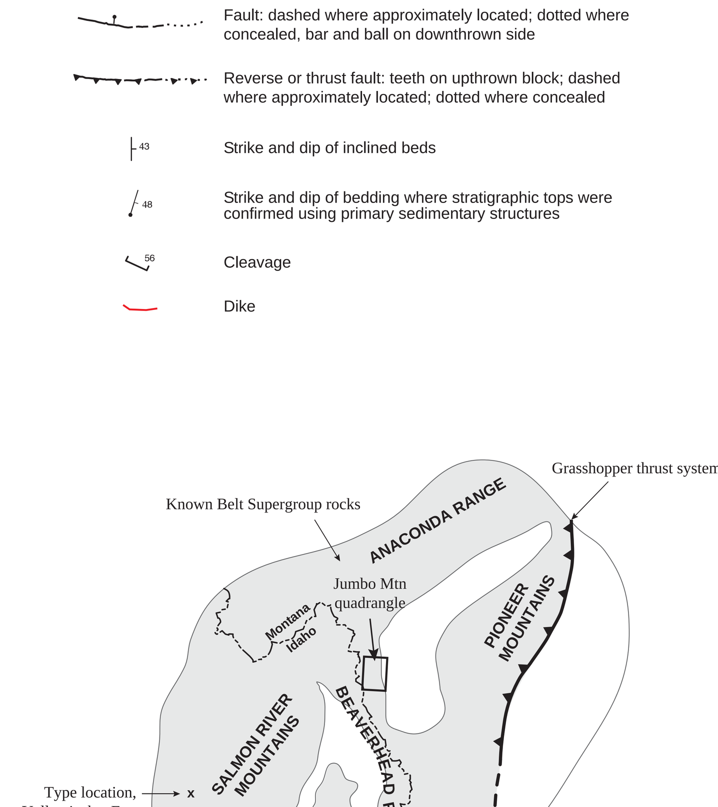


Fig. 1. Location of Jumbo Mountain 7.5' quadrangle with respect to known Belt Supergroup rocks and the reference and type sections of the Lemhi Group and Yellowjacket Formation. Shaded areas represent mountain ranges containing Mesoproterozoic sedimentary rocks.

Fig. 2. Thick, massive beds of fine-grained quartzite that lack or have only very thin argillite interbeds characterize the quartzite of Janke Lake (*Yjl*), headwaters of Dry Creek.

Fig. 3. Upper right half of photo shows lenticular beds of quartzite in argillite, characteristic of the Lawson Creek Formation (*Ylc*), headwaters of Dry Creek.

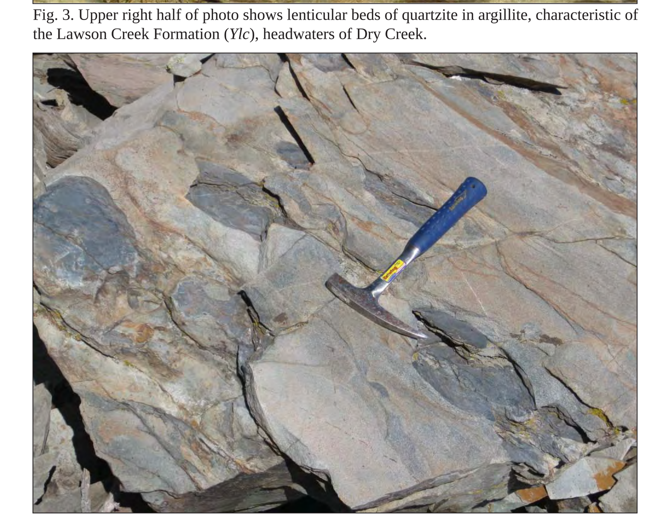


Fig. 4. Giant mud rip-up chips up to 15 cm in diameter occur uncommonly in the Lawson Creek Formation (*Ylc*), headwaters of Dry Creek.

Fig. 5. Polygonal mud cracks interpreted to have formed through dessication in the upper Swauger Formation (*Yswu*), Jumbo Mountain area.

Fig. 6. Small pebbles of white quartzite along a bedding plane in the lower Swauger Formation (*Yswl*), headwaters of South Fork of Lake Creek.

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