



Yqpi Yqgr

feldspathic quartzite. Exposed only at the western edge of the map. Base of

unit not exposed. Similar quartzite along strike to the northwest in the

Homer Youngs Peak quadrangle contains more potassium feldspar than

plagioclase (Lonn and others, 2008). Minimum thickness in that quadrangle

Central Sequence

Between the eastern and western strands of the Beaverhead Divide fault is

a near-vertical, east-facing, 5300 m (17,000 ft) thick stratigraphic sequence

of feldspathic, very fine- to medium-grained quartzite and subordinate

siltite. Correlation of this sequence to units either west or east is uncertain.

Most of this sequence is similar to the western sequence described below,

but the lowest unit (*Yqm*, medium-grained quartzite) resembles rocks of the

eastern sequence. We divided the central sequence into four informal units

feldspathic quartzite that has a pinkish cast on fresh surfaces. Typically

flat-laminated m to dm beds with little siltite or argillite. Includes more mud

chips and muscovitic parting surfaces than underlying unit. One quartzite

sample contains about 40 percent plagioclase and no potassium feldspar.

The plagioclase in that sample is highly recrystallized. Top of unit not

quartzite. Typically m- to dm-thick beds of flat-laminated to non-laminated

quartzite and varied dark green siltite, most as graded tops to thick quartzite

beds. Rare red argillite skins in upper part. Commonly weathers white but

has surface stain of rusty red. Includes rare mud chips and muscovitic

parting surfaces. Ten quartzite samples contain about 30-50 percent

plagioclase and 0-10 percent potassium feldspar. Some of the potassium

feldspar is patchy and probably secondary. One quartzite sample from the

uppermost part of the unit contains about 16 percent plagioclase and 15

percent potassium feldspar. Appears to grade upward into Yqpi with

increase in grain size through a zone of alternating colors. Grades

downward into Yqf with a decrease in siltite and an increase in dark

laminations that define trough cross beds and decrease in ripple cross

fine-grained, medium- to thick-bedded light-weathering feldspathic

quartzite and minor darker siltite and argillite. Many beds appear to have

about 30 percent feldspar; one quartzite sample contains about 18 percent

plagioclase and 7 percent potassium feldspar. Bedding defined by dark

laminations of specular hematite in discontinuous, non uniform

foliation, the dark laminations define large, low-angle trough cross

bedding. High-angle planar, ripple, and climbing ripple cross lamination as

degree) truncate underlying laminations, defining loads that apparently grew during deposition. Argillite is present as thin layers or skins (some

discontinuous) on quartzite parting surfaces, rarely as light-colored mud

chips, and as graded tops of darker siltite and argillite couples within the

unit. The lower contact with Yqm is obscured by strong northwest-striking,

southwest-dipping cleavage developed at an acute angle to bedding, but

Yqf appears to grade down section into Yqm. An alternate explanation is

that the contact is a fault. Yqf is lithologically similar to the Yqff unit of the

western sequence exposed to the northwest in the Homer Youngs Peak and

Bohannon Spring quadrangles that is tentatively correlated with the

Gunsight Formation of the Lemhi Group (Lonn and others, 2008; Lewis and

others, 2009). Some folding in this unit makes thickness estimates

quartzite in upward-fining sequence. Upper part is 15-30 cm thick flat-laminated quartzite beds interbedded with 7- to 10-cm-thick green

argillite and siltite. Fewer and more diffuse heavy mineral laminations,

more argillite, and thinner beds than the overlying Yqf unit. Lower part is

more thickly bedded white quartzite. Two quartzite samples contain about

14 percent plagioclase and 10-11 percent potassium feldspar. Base of unit

not exposed, but thickness at least 600 m (2000 ft). Approximately 1200 m

Western Sequence

West of the western strand of the Beaverhead Divide fault is a folded

sequence consisting of siltite, fine- to very fine-grained feldspathic

quartzite, and argillite. Carbonate cement is present locally. We correlate

this sequence with the Lemhi Group of the Belt Supergroup because of

similarities to known Lemhi Group rocks south of Salmon. This correlation

is in agreement with Evans and Green (2003), although we have been

conservative by applying lithologic unit assignments and only offer

tentative correlations to specific Lemhi Group formations. To the west in the

Bohannon Spring quadrangle we divided this sequence into six informal

units based on grain size, presence of carbonate, and sedimentary

structures (Lewis and others, 2009). Only the three lowest of those units are

uncommon pale pink very fine-grained to rarely medium-grained quartzite

and subordinate siltite. Orange to white weathering. Locally contains

carbonate cement, or voids between silicate grains formerly occupied by

carbonate, particularly near the upper part of the unit and, in places,

appreciable magnetite. Two quartzite samples contained about 40-56

percent plagioclase and no potassium feldspar. A third contained patchy

(late?) potassium feldspar (about 4 percent) and about 38 percent

plagioclase. Thickness uncertain due to folding and erosion, but

approximately 700 m (2300 ft) immediately west of map. Tentatively

correlated with the Big Creek Formation of the Lemhi Group (Ruppel, 1975)

to thinly bedded light green siltite, darker argillite, and white,

carbonate-bearing fine-grained feldspathic quartzite. More gray and less green

in upper part of unit. Siltite and argillite as distinct, laterally discontinuous laminae and graded couplets but deformation obscures these characteristics

where unit becomes a light colored phyllite. Local ptygmatically folded silt in

non-polygonal "crinkle cracks". Includes 5-10 percent dm-scale or thinner

siltite and quartzite that display hummocky and thin ripple cross lamination,

loads, and convolute bedding. These share many characteristics with *Ysq*, but

color and grain size variation typically more diffuse. Locally, some of these

layers contain MnCO₃, judging by solubility in weak acid and

chocolate-brown weathering, but some of this may be remobilized instead of

original. Carbonate is most abundant in the Cowbone Lake area and may be

more common low in the unit. Thicker skins of dark argillite have rare fluid

escape structures to 3 cm wide. Highly folded, but a minimum thickness of

800 m (2600 ft) likely. Tentative correlation with the West Fork Formation of the

green siltite and dark argillite. Coarser intervals have quartzite as thin (cm)

bases of beds grading to dark siltite and darker argillite, and as thick layers

commonly in groups of several beds. Siltite layers dm scale approximately

equal in volume to cm scale siltite and argillite couplets. Thick siltite beds have

diffuse multi-mm to cm laminations that are planar or gently undulating as if

hummocky cross laminations, in addition to soft sediment deformed

Argillite both green and dark gray. Zones with green argillite tend to have more

mud chips and coarse quartz lag deposits a few cm thick. These alternate on a

scale of 10-100 m with zones characterized by red-tan weathering slaty, very

dark gray argillite that locally displays pinch and swell sediment type

characteristics including clastic dikelets. Quartzite commonly has bedding

defined by dark mm-scale laminations. Planar lamination most common load,

convolute, and cm-scale ripple cross lamination in stacks to dm thickness less

common; the last are more common in this unit than any other. Nine quartzite

samples contain about 35-40 percent plagioclase and 0-8 percent potassium

feldspar. Where present in these samples, potassium feldspar is patchy,

interstitial, and likely not detrital. One sample from ridge east of the West Fork

of Wimpey Creek near the southern map boundary contained only 6 percent

plagioclase and about 8 percent detrital(?) potassium feldspar. Another sample

from the next ridge to the east contained about 30 percent plagioclase and 18

folded and commonly cleaved to foliated, with cleavage in graded beds

curving from more normal in coarser bases to more bedding-parallel in

argillitic tops. Cleavage in finer beds is axial planar to similar folds of the siltite

and argillite couplets. Similar to, but overall coarser than, *Ysac* unit. Thickness

highly uncertain, but minimum thickness of 2400 m (8000 ft) likely. Tentatively

correlated with the type Inyo Creek Formation of the Lemhi Group (Ruppel,

1975) along with rocks below the Inyo Creek that are not exposed in the Lemhi

STRUCTURE

The most prominent structure in the map, the Beaverhead Divide fault, was

first described by MacKenzie (1949), who referred to the structure as the

Miner Lakes fault. Anderson (1959) mapped its extension northwest and

Tucker (1975) extended it southeast. Ruppel and others (1993) interpreted

it as a major structure separating the Missoula Group to the northeast from

the Mesoproterozoic Yellowjacket Formation and Lemhi Group to the

southwest. Evans and Green (2003) mapped it as a thrust reactivated as a

normal fault, separating Missoula Group from Lemhi Group. More recently,

O'Neill (2005) interpreted it as a low-angle normal fault that has been

rotated to vertical, with unmetamorphosed upper plate rocks now to the

Our mapping suggests that the Beaverhead Divide fault is a southwestt-

dipping zone of both ductile and brittle deformation whose activity may

span a long time (Proterozoic? to Eocene). On the Homer Youngs Peak

quadrangle (Lonn and others, 2008), two closely spaced strands of the

Beaverhead Divide fault were mapped. The eastern and western strands

trace southeastward into the Goldstone Pass quadrangle, where they

diverge and separate the map area into three major structural domains,

each containing a distinct stratigraphic package, here termed the eastern,

central, and western sequences. The eastern domain is a thick east-facing

interpreted this panel as the west limb of a huge east-verging syncline

similar to the gigantic folds mapped by Tysdal (2002) in the Lemhi Range

southwest of the map area. Cleavage in this domain is weakly developed,

but roughly parallels the strong northwest-striking, steeply southwestt-

dipping cleavage of the central domain. The eastern strand of the Beaver-

head Divide fault separates weakly foliated, east-facing vertical strata on

the northeast (Yqmc and Yqcu) from strongly foliated east facing rocks on

the southwest (*Ygm* and *Ygf*). The fault zone strikes northwest to west, dips

southwest to south, and is characterized by chloritic breccia containing a

mixture of strongly foliated and non-foliated clasts. The portions of the fault

panel of overturned to moderately east-dipping strata (Yga, Ygcu, Ygmc, *Yqcl*), tentatively assigned to the Missoula Group. Lonn and others (2008)

northeast and metamorphosed lower plate rocks now to the southwest.

percent potassium feldspar, some of which may have been detrital. Highly

laminations. Some zones characterized by graded siltite and argillite couples.

Lemhi Group (Ruppel, 1975) because it appears below Ygsc.

based on similarity with rocks described in its type section.

exposed in the Goldstone Pass quadrangle.

(4000 ft) is present on the Bohannon Spring quadrangle to the west.

Medium-grained quartzite (Mesoproterozoic)—White, medium-grained

problematic, but it is roughly 900 m (3000 ft) thick.

well as flat laminations are less common. Some steep laminations (30-60

laminations up to 2 mm thick. Despite well-developed cleavage or

lamination. Thickness approximately 2200 m (7000 ft).

based on grain size, color, and sedimentary structures.

exposed, but thickness at least 900 m (3000 ft).

MESOPROTEROZOIC

Figure 1. Location of Goldstone Pass 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.

that are more northwesterly are interpreted as having moved as thrust faults during Cretaceous compressional deformation, while the more easterly trending portions are likely to have had a large component of left-lateral motion during that time. Brittle deformation probably post-dates thrusting, Conglomeratic quartzite (Mesoproterozoic)—White to light gray, poorly and may represent reactivation of the thrust as a normal fault. sorted, medium- to coarse-grained, trough and planar crossbedded,

> The central domain consists of near vertical, east-facing strata of uncertain correlation (*Yqpi*, *Yqgr*, *Yqf*, and *Yqm*). This panel of central sequence strata roughly parallels that of the eastern domain, and it is possible that the central and eastern stratigraphic sequences are part of the same giant fold and that they were originally in stratigraphic contact. Strong northwesttstriking, southwest-dipping cleavage is developed in the central domain; this cleavage is approximately parallel to the northwest-striking parts of both strands of the Beaverhead Divide fault, and is also parallel to the mylonitic foliation associated with the western strand. The western strand of the Beaverhead Divide fault is a zone of 25° to 60° southwest-dipping mylonitic foliation that approximately parallels the northwest to west strike of the zone. Because the western strand Beaverhead Divide fault and the Freeman thrust of the Homer Youngs Peak quadrangle (Lonn and others, 2008) merge just northwest of the Goldstone Pass quadrangle, the western strand here represents the combined displacement on both faults. It separates units Yqm and Yqf of the central sequence from Ysac of the western sequence. This ductile shear zone contains mafic sills (Tdi) that exhibit foliation parallel to that of the shear zone. Lineation within these sills plunges to the southwest with s-c fabric indicating top to the west normal motion. Like the sub-parallel eastern strand, this northwest-striking fault jogs eastward in the Goldstone Pass quadrangle. The portions that strike northwest are interpreted as having moved as thrust faults during Cretaceous compressional deformation, while the east-west striking portions are thought to have had a large component of left-lateral motion. Both strands of the Beaverhead Divide fault appear to turn southward just east of the quadrangle and become the Bloody Dick Creek fault zone of the Kitty Creek quadrangle (Lewis and others, 2009).

> The western domain is complexly folded and faulted. Two ill-defined thrust faults were mapped. The northeastern of the two that passes through Cowbone Lake is characterized by strong foliation. Rocks in its hanging wall are tightly folded and locally overturned. The other fault southwest of Cowbone Lake is characterized by both ductile and brittle deformation. Mylonite and chloritic shears are present in the saddle south of Cowbone Lake and mylonite is present on the ridge near the west map boundary. Northeast-facing strata in its hanging wall are overturned or steeply northeast dipping. An asymmetric fold in it indicates some top to the west motion so it is probable that it, like the western strand of the Beaverhead Divide

SYMBOLS

 Contact: dashed where approximately located. Oblique thrust fault: teeth on upper plate; arrows indicate direction of motion; dashed where approximate; dotted where concealed.

Thrust fault: teeth on upper plate; dashed where approximately located; dotted where concealed. Reactivated thrust fault: teeth on upper plate; bar and ball on

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

Anticline axial trace, approximately located; dotted where concealed; arrow indicates plunge direction.

Syncline axial trace, dashed where approximately located; dotted where concealed; arrow indicates plunge direction. \\20 Strike and dip of bedding.

✓ Strike of vertical bedding. \$65 Strike and dip of bedding; ball indicates bedding known to be

Strike and dip of bedding, strike variable.

Strike and dip of bedding known to be overturned.

80 Strike and dip of bedding interpreted to be overturned. Horizontal bedding.

24 Strike and dip of foliation.

Strike and dip of mylonitic foliation.

Strike and dip of foliation where present with bedding or Strike and dip of cleavage.

Strike of vertical joint.

Bearing and plunge of mylonitic lineation. Bearing and plunge of mineral lineation.

⁵ Bearing and plunge of asymmetrical small fold showing counterclockwise rotation viewed down plunge.

⁵ Rearing and plunge of asymmetrical small fold showing clockwise rotation viewed down plunge.

¹⁵ ★► Bearing and plunge of small fold axis.

Vein.

🦎 Dike.

△△△ Fault breccia. Date sample location and number.

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