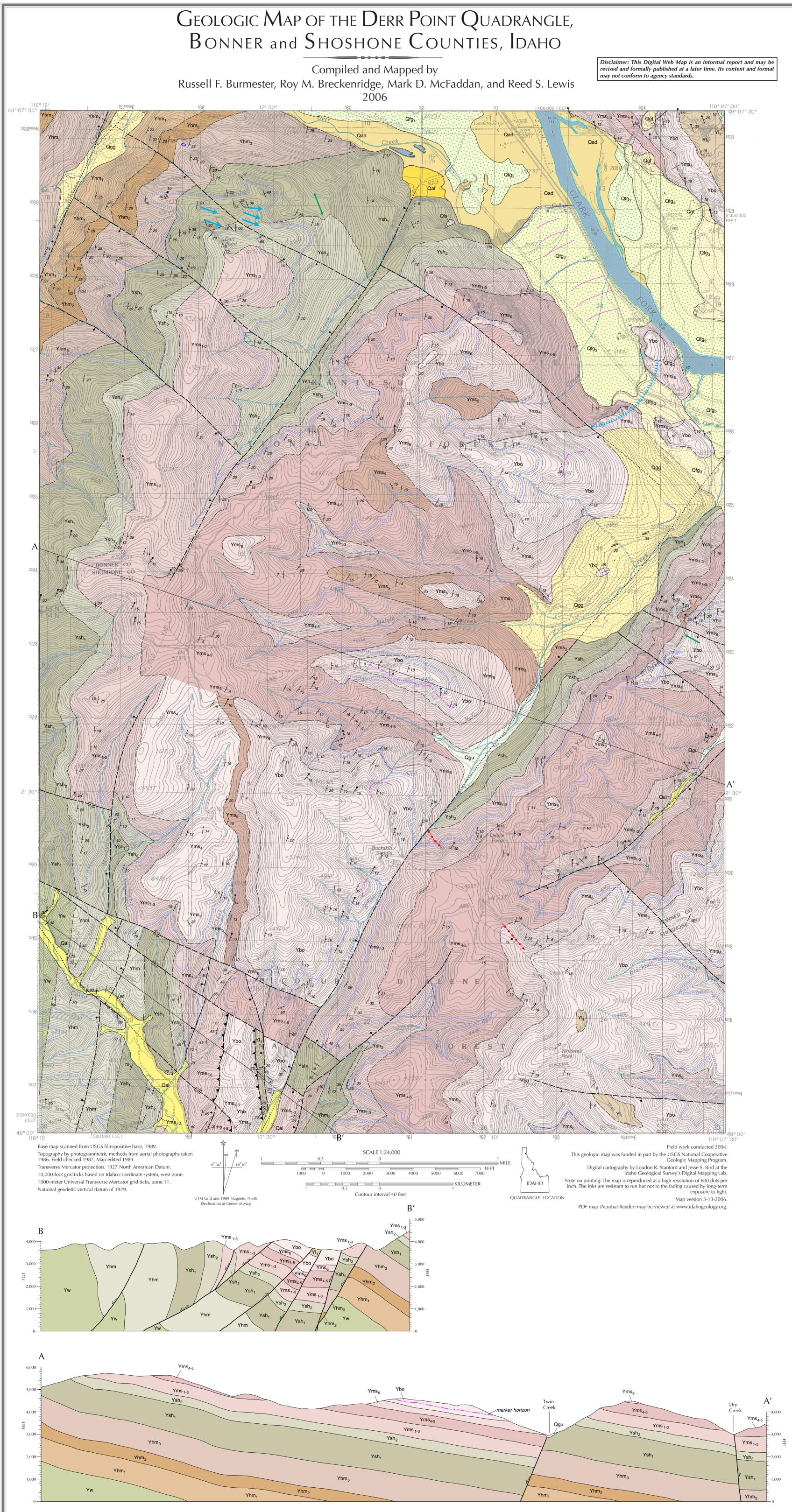
DIGITAL WEB MAP 59
MOSCOW-BOISE-POCATELLO
BURMESTER AND OTHERS

Metasedimentary

YI₂ YI₁ Ybo

Rocks



CORRELATION OF MAP UNITS

Alluvial and Lacustrine Deposits

Deposits

Alluvial and Lacustrine Deposits

Glacial and Flood Related Deposits

**Glacial

INTRODUCTION

Geology depicted on this 1:24,000-scale Derr Point 7 1/2' quadrangle is

based partly on previous 15' mapping by Harrison and Jobin (1963). The

area was remapped at a larger scale primarily to show glacial and flood-

related deposits that record Quaternary events. In addition, we remapped

the bedrock during five weeks of fieldwork in 2004 to apply some different

unit definitions and contact placements for consistency with more current

mapping. See Harrison and Jobin (1963) for the history of naming units in

the area; departures from their naming scheme are explained below within

descriptions of affected units. Overall, the bedrock areas of the map differ

little from Harrison and Jobin (1963); visual differences are attributable to

slight changes in placement of contacts and the more detailed topography

of the 1:24,000 base map. Substantive differences result from assignment

of some rocks, primarily those originally assigned to the Wallace and Striped

Peak formations in the southwestern part of the quadrangle by Harrison and

Jobin (1963), to the Striped Peak and Bonner formations, which requires

Bedrock in the Derr Point quadrangle is low metamorphic grade

metasedimentary rock of the middle and upper parts of the Belt-Purcell

Supergroup, Precambrian in age. Sediments in the Clark Fork drainage date

from Pleistocene glaciation and catastrophic floods from glacial Lake Missoula.

DESCRIPTION OF MAP UNITS

Grain size classification of unconsolidated and consolidated sediment is

based on the Wentworth scale (Wentworth, 1922). Bedding thickness and

lamination type are after McKee and Weir (1963) and Winston (1986).

Thickness and distances are given in abbreviation of metric units (e.g.,

dm=decimeter). Multiple lithologies within a rock unit are listed in order

of decreasing abundance. Soil series are after Weisel and others (1982).

ALLUVIAL AND LACUSTRINE DEPOSITS

in modern stream valleys. Some coarse gravel clasts are reworked from older

Holocene and Pleistocene alluvial and glacial units. Soils are silt to sandy

loams of the Capehorn and Colburn series. Varied thickness usually 1-3 m

fans at the mouth of local drainages. Mostly subangular to angular platy

clasts derived locally from the Belt-Purcell Supergroup. Soils mainly of the

Colburn, Pend Oreille, and Bonners series. Thickness 1-10 m (3-33 feet).

rock slide deposits related to jointing in oversteepened valleys. Varied

Flood deposits (Holocene- Pleistocene)—Interbedded alluvium and deltaic

deposits near the mouth of the Clark Fork River. Consists of soft clayey silt;

at depth is locally underlain by late glacial outwash, till, or Missoula Flood

and associated proglacial outwash and glacial sediments. Unstratified to

poorly bedded, unsorted to moderately sorted. Mostly isolated remnants of

moraines and terraces, preserved on slopes along valley sides and in smaller

tributaries. May include some interbedded lake sediments.

to boulder gravel. Generally lacks interstitial fines (boxwork texture).

Moderately stratified to unstratified depending on the depositional landform.

Forms the lowest of three terrace levels of flood gravel at about 630-640

meters (2065-2100 feet) in the lower Clark Fork River valley. Locally mantled

by silt of the latest phases of glacial Lake Missoula that post-date episodes

of catastrophic flooding. Soils of the Odenson and Wrencoe series.

Gravels of Missoula Floods, terrace 2 (Pleistocene)—Moderately sorted pebble

to boulder gravel. Generally lacks interstitial fines (boxwork texture).

Moderately to stratified to unstratified depending on the depositional landform.

In the Derr Point quadrangle, the surface of this unit exhibits giant current

ripples deposited by the latest floods from Glacial Lake Missoula about

12,000 years ago. Forms the middle of three terrace levels of flood gravel

at about 625-645 meters (2080-2150 feet) in the lower Clark Fork River

valley. Locally mantled by silt of the latest phases of glacial Lake Missoula that post-date episodes of catastrophic flooding. Soils of the Odenson and

Gravels of Missoula Floods, terrace 3 (Pleistocene)—Moderately sorted pebble

to boulder gravel. Generally lacks interstitial fines (boxwork texture).

Moderately to stratified to unstratified depending on the depositional landform.

Forms the highest of three terrace levels of flood gravel above 660 meters

(2200 feet) in the lower Clark Fork River valley Locally mantled by silt of

the latest phases of glacial Lake Missoula that post-date episodes of catastrophic

boulders deposited by the Clark Fork tongue of the Purcell Trench Lobe.

Compact basal till includes ground moraine and some proglacial deposits

formed by calving and meltwater discharge into Glacial Lake Missoula. Soils

of the Pend Oreille and Vay-Ardtoo series. Thickness varies; may exceed 50

proglacial outwash and englacial drift deposits. Probably deposited by a

post-Missoula floods advance of the Clark Fork ice tongue up the Clark Fork

valley into a late Glacial Lake Missoula. Forms a large deposit at the mouth

of Twin Creek. Soils of the Pend Oreille series and Vav-Ardtoo association.

BELT-PURCELL SUPERGROUP

Libby Formation (Middle Proterozoic)—Laminated to microlaminated dark gray

to black argillite and white to light gray to pale green siltite, tan-weathering dolomitic siltite, oolite and stromatolites. Highly resistant, chert-like material

superficially resembling argillite commonly occurs as silicified mudcracked

tops of siltite and argillite couplets and mud chips. We followed Harrison

and Jobin's (1963) subdivisions of the Libby because the same system was used to the east in Montana (Harrison and others, 1992). Poorly and

Libby Formation, member 2 (Middle Proterozoic)—Laminated to less

commonly microlaminated pale green to olive siltite and lighter green

argillite. Siltite layers, commonly a few cm thick with much thinner argillite

caps, commonly display loaded bases and internal low angle cross-lamination.

Deep mudcracks to 5 cm disrupt both siltite and argillite layers; some may

be dewatering structures. Thin mudchips of pale green argillite ubiquitous

and commonly silicified. Silicification of strata most common within the mm-thick argillite layers, although patchy silicification affects both siltite

and argillite throughout unit. Upper contact not exposed in map area. Unit similar to Kidder's (1988) member B but excludes gray argillite at top and

base that is included in B; corresponds to calcareous member of Harrison

Libby Formation, member 1 (Middle Proterozoic)—Laminated to

microlaminated light gray to white to green siltite and dark gray to black

argillite and minor dolomitic gray siltite and stromatolites. Lamination mostly

wavy and uneven. Graded gray siltite and black argillite couplets locally

disrupted by ptygmatic silt-filled cracks. Elsewhere, lamination thinner with

more distinct siltite and argillite lamina. Commonly rusty weathering. Includes

scattered and discontinuous gray siltite layers to 5 cm thick, with olive-

colored cm-scale siltite beds more abundant in upper part and low domal

stromatolites at the top. Upper contact poorly exposed in northeast corner

of map is placed above the stromatolitic zone that is above the highest

occurrence of the microlaminated white siltite and black argillite. Distinct

white and black striped appearance, ptygmatic siltite dikelets, and parallel

laminated intervals that include contorted and folded microlaminations and

laminations distinguish this black argillite unit from others. Best exposed in

northeast corner of map area, incompletely exposed in roadcuts along along

Buckskin Creek. Similar to Kidder's (1988) member A but includes about 10

m (30 feet; Harrison and Jobin, 1963) of carbonate-bearing (stromatolitic)

layers to the east in the Cabinet map area included in Kidder's member B.

Thickness about 80 m (250 feet); corresponds to laminated argillite and

siltite member of Harrison and Jobin (1963), who reported a thickness of

grained feldspathic quartzite, siltite, and argillite typically forming resistant

cliff outcrops in the map area. Characterized by 10-30 cm, tabular beds of

flat-laminated pink quartzite with microlaminated to laminated red argillite

caps. Internal lamination of quartzite beds commonly defined by discontinuous

wisps of red argillite or mm thin red argillite mudchips. Some parting surfaces

nearly covered with detrital muscovite flakes up to 4 mm across. Plagioclase feldspar is more abundant (20-35 percent) than potassium feldspar (0-8

percent). Base is gradual transition from the underlying dark green and gray

cm tabular light to medium green quartzite beds. These have thin,

laminated siltite and argillite of *Yms*₆ with increasing abundance of 10-30

discontinuous lenses or lags of well-rounded medium quartz grains, less

feldspar than overlying red quartzite, and typically mm-thick, cracked light

green argillite caps. Some green siltite with mm-thick black laminated caps

also present. Well-rounded medium quartz grains also occur in wispy lenses

of white sand lags typically less than one cm thick at bases of some red

quartzite beds higher in the section. Interstratified with the red quartzite are

intervals of laminated pink quartzite and red argillite and wavy laminated

green siltite and green argillite in zones 10-30 cm thick. These zones decrease

upwards from constituting about half to about one quarter of the strata. At

the top of *Ybo* are minor very thin beds of green quartzite, overlain by several

beds of white quartzite 5-10 cm thick with well-rounded medium grains.

Upper white quartzite is less feldspathic than lower pink quartzite. Upper

contact placed at lowest appearance of dark gray argillite and gray to white

siltite of overlying Yl_1 . Zircons from a thin tuff at this contact about 40 km

NE yielded an age of 1.401 Ga (U-Pb; Evans and others, 2000). Three or

more distinct marker horizons that may be other tuffs are present within the

Bonner Formation. The markers consist of 3-20 cm thick couplets to couples

of dark purple to nearly black, flat-laminated siltite and thinner light green

argillite. The marker horizons are distinctly smooth and fracture conchoidally

the lowest two occur approximately 60 m (200 feet) from the base of the

unit where predominately green quartzite passes upward into predominately

red quartzite; the next marker is approximately 200-300 feet (60-90 m)

higher in the section within predominately red quartzite on Delyle Ridge.

Bonner resembles Mount Shields members 1 and 2 except has more and

coarser detrital muscovite, coarser grained quartzite and less common rippled

Ybo Bonner Formation (Middle Proterozoic)—Pink, red, and green fine- to medium-

and Jobin (1963), with reported thickness of 600 feet (180 m).

Gravels of glacial origin (Pleistocene)—Poorly rounded unsorted gravels; includes

flooding. Soils of the Odenson and Wrencoe series.

Cgt Till deposits (Pleistocene)—Dense clayey pebble and cobble till with local

Gravels of Missoula Floods, terrace 1 (Pleistocene)—Moderately sorted pebble

GLACIAL AND FLOOD-RELATED DEPOSITS

Alluvial fan deposits (Holocene)—Mixed pebble to cobble gravel deposited as

Qal Alluvium (**Holocene**)—Mixed fine- to coarse-grained sand and gravel deposits

Clis Landslide deposits (Holocene-Pleistocene)—Poorly sorted and poorly stratified

Qad Alluvium and deltaic deposits of the Clark Fork River, includes deltaic Missoula

Qgu Glacial deposits, undivided (Pleistocene)—Gravel, sand, and silt deposits of till

deposits. Soils include Colburn and Wrencoe series.

thickness as much as 15m (50 feet).

Wrencoe series.

Thickness 15 m (50 feet).

incompletely exposed in map area.

230 feet (70 m).

different structural relations.

Mount Shields Formation (Middle Proterozoic)—Red, green, and gray quartzite, red and green siltite, red, green, and gray to black argillite and minor carbonate. Previously assigned to the Striped Peak Formation (Harrison and Jobin, 1963) but reassigned here because strata are more like strata mapped to the east as Mount Shields Formation (Harrison and others, 1992) than strata on Striped Peak southwest of Wallace, Idaho (Lewis and others, 1999).

Yms₆

Mount Shields Formation, member 6 (Middle Proterozoic)—Rusty weathering, unevenly laminated to planar microlaminated, white to dark greenish gray siltite and dark greenish gray to black argillite, and rare gray to greenish-

and mudcracked surfaces. Distinguished from the Mount Shields Formation

siltite and dark greenish gray to black argillite, and rare gray to greenish gray siltite and quartzite in tabular beds up to 20 cm thick. Small and very thin dark gray argillite chips occur sparsely within some 10 cm dark gray argillite layers. Rare cm-wide, long, straight cracks and parallel cracks are present, and fine-grained muscovite is common on bedding plane partings. Includes intervals of soft sediment deformation and truncated laminations throughout the unit; scour channels up to 30 cm wide and 20-40 cm deep commonly exhibit loaded lower margins, and are infilled with lenses of horizontally microlaminated to laminated and cross-laminated siltite and argillite. Some load structures exhibit possible channel erosion at their margins. Upper contact placed at lowest appearance of thin (cm) layers of medium-grained feldspathic quartzite. Unit typically provides poor root support for trees and forms open grassy slopes in map area, although may form prominent cliff outcrops in areas of steep topography, such as those eroded by glacial ice. Best exposure of base is on ridge at the headwaters of Ruen Creek and of top is along highway southwest of the Clark Fork River. Thickness approximately 90 m (300 feet). Mapped as Striped Peak 3 by Harrison and Jobin (1963) who also estimated thickness as 300 feet (90 m). Unit equivalent to the Mount Shields Formation member 6 to the northeast in the Kalispell quadrangle (Harrison and others, 1992).

Mount Shields Formation, members 4 and 5 (Middle Proterozoic)—Tanweathering, bluish-gray and bluish-green dolomitic siltite and white stromatolitic dolomite. Unit commonly weathers recessively, forming topographic benches and subdued topography. Consists of members 4 and 5 described below where mapped together. Thickness approximately 150 m (500 feet) (400 feet where mapped as Striped Peak 2 by Harrison and Jobin, 1963). Difference in thickness may be partly real and partly from different criteria in picking base of carbonate beds in areas of poor exposures. Best exposed in cliffs west of abandoned lookout on Delyle Ridge. Discontinuously and poorly exposed most places due to weathering of carbonate.

Mount Shields Formation, member 5 (Middle Proterozoic)—Grav to tanweathering, locally resistant bluish-gray and white dm-scale beds of stromatolitic dolomite. Characterized by distinctive "boxwork" weathering pattern formed by etching out of resistant, mm-thick vertical and horizontal siliceous sheets along joints and cryptalgal laminations. Algal mats typically flat, but intergrown with rare low domal stromatolites 5-10 cm high and 10-30 cm across. Also contains common cm to dm horizons of cm-laminated oolite, as well as rare, cm-scale silicified oolite. Contains common 1-2 m intervals of cm-parting dolomitic siltite and argillite that is generally poorly exposed, and salt casts in carbonate bearing and brown weathering siltite and argillite most common in the middle of unit. "Boxwork" commonly forms lag boulders in areas of subdued topography where outcrop is sparse. Best exposures of the unit occur in roadcuts along the west side of Dry Creek Canyon. Upper contact placed above uppermost "boxwork" carbonate at lowest occurrence of rusty weathering, resistant, laminated dark siltite and argillite of overlying Yms₆. Thickness approximately 20 m (60 feet). Equivalent to member five of the Mount Shields Formation to the northeast in the Kalispell quadrangle (Harrison and others, 1992).

Mount Shields Formation, member 4 (Middle Proterozoic)—Tan-weathering, bluish-gray and bluish-green and light green cm-scale dolomitic siltite, rare white stromatolitic dolomite and oolite, and carbonate-poor green, and lesser red, siltite and argillite. Salt casts common on green argillite parting surfaces. Grades upward from *Yms*₁₋₃ with increasing carbonate content. Includes common cm-thick, rarely carbonate-rich silitite with tan weathering rinds, but retains salt casts. Rare 5-20 cm oolite layers occur near middle of unit, and thin layers of "boxwork" carbonate occur near the base and irregularly scattered throughout the unit. Unit weathers recessively, forming topographic benches and poor outcrop; commonly represented by float of platy, tan-weathering, cm-thick light green siltite. Upper contact placed at the lowest occurrence of stratigraphically continuous, prominent resistant gray calcitic or dolomitic "boxwork" carbonate beds. Thickness approximately 130 m (440 feet).

Mount Shields Formation, members 1, 2, and 3 (Middle Proterozoic)—Pale purplish-red, fine-grained, flat-laminated quartzite, and green and red argillite and siltite; minor carbonate and stromatolites. Coarser grained and thicker bedded toward the middle; mudcracks, mudchips, and ripple marks more common near base and top. Distinguished from Bonner Formation in having sedimentary structures, such as mudcracks and ripples, more abundant and better preserved on bedding surfaces. Overall thickness of Yms₁₋₃ uncertain, but approximately 180 m (600 feet) (600 feet; Harrison and Jobin, 1963). Previously mapped as Striped Peak 1 (Harrison and Jobin, 1963). Equivalent to lowest three members of the Mount Shields Formation mapped to the northeast in the Kalispell quadrangle (Harrison and others,

Upper part (Mount Shields member 3)—Characterized by, green and red siltite and argillite couples and couplets, less abundant cm-dm pink guartzite beds, and abundant salt casts, mudcracks, and mudchips. Limited mineralogical data indicate that potassium feldspar is more abundant than plagioclase in the quartzite, opposite the relationship in Ybo. Salt crystal casts range in size from mm-scale cubes to 2 cm hollow hopper crystal casts. Basal part of unit transitional from underlying *Yms*₂ is cm to mm scale unevenly laminated dark green siltite and light green argillite with subordinate dm light green quartzite. A few 5-30 cm layers of flat cryptalgal laminations are present in the lower part of Mount Shields 3. Middle part of unit dominantly couplets to couples of pink quartzite with thin red argillite drapes and subordinate laminated light green siltite and argillite. Upper part consists of couplets of light green siltite and argillite, with abundant characteristic 10 cm apple-green siltite. Throughout the unit, irregular ovoid vugs 5 cm across and 3 cm high commonly contain partial fillings of relict carbonate or secondary silica. Quartzite is most abundant in lower part of unit; distinctive dark green and apple-green siltite beds more abundant in upper part. Best exposures in map area occur in cliff outcrops on west side of Delyle Ridge below abandoned lookout. Upper contact of Yms₁₋₃ placed below increase in carbonate (lowest occurrence of "boxwork" carbonate or domination of cm-scale, tan-weathering siltite in overlying Yms₄ or *Yms*₄₋₅), which commonly makes topography subdued or slopes gentler. Estimated thickness 90-120 m (300-400 feet).

Middle part (Mount Shields member 2)—Characterized by flat-laminated 0.3 to rare 1.0 m beds of fine- to nearly medium-grained pink to gray quartzite that forms cliffs with blocky talus. Quartzite contains K-spar well in excess of plagioclase. Diffuse, roughly horizontal non-resistant brown wisps of carbonate within the quartzite of upper part of unit average a few cm in thickness and 10-15 cm in length. Uppermost part is medium grained and distinctly coarser than all other quartzite in area except the thin sand lags near the base and some beds near the bottom and top of Ybo. Commonly rippled tops of the quartzite beds have thin red argillite drapes. Mudcracks and mudchips less common than in underlying or overlying intervals. Salt casts increase in abundance upward. Uppermost approximately 40 m (120 feet) of unit contains numerous 10 cm to 0.5 m (rare 1.0 m) layers of buffweathering flat cryptalgally laminated carbonate and low domal stromatolites up to 30 cm high and 60 cm across. Also present are scattered beds of oolite 10 cm thick with low-angle internal cross-laminations. Upper stromatolitic zones best exposed near base of cliff outcrops on ridge west of abandoned Delyle Ridge lookout; less well-exposed east of Mosquito Creek.

Lowest part (Mount Shields member 1)—Characterized by fine- to very-fine-grained pink, flat-laminated quartzite in even beds 20-30 cm thick, capped by red argillite up to 3 cm thick. Base characterized by 10-20 cm beds of forest-green to pink, fine- to medium-grained quartzite and green siltite, both with mm-thick green argillite caps. Rare low-angle cross beds present within quartzite beds. Pink quartzite with red argillite drapes become predominant up section, with minor interstratified mm laminated green siltite and light green argillite. Detrital muscovite flakes generally less than 1 mm common on partings within the green quartzite. Mudcracks to 5 cm deep present within some beds; mudchips common. Nature of exposures in map area makes differentiation of Mount Shields members 1 and 2 difficult: combined thickness estimated 60-90 m (200-300 ft).

Shepard Formation (Middle Proterozoic)—Couplets and couples of dolomitic green siltite and light green argillite, dolomitic, dark gray, very fine-grained quartzite, and laminated and thinly laminated siltite and argillite. Occupies same stratigraphic level as top of the Wallace Formation previously mapped here (Harrison and Jobin, 1963) and to the south (Lewis and others, 1999, 2002). Renamed Shepard Formation here because it is not markedly different from the Shepard Formation at its type locality and is separated from the carbonate-bearing pinch and swell strata typical of the Wallace Formation as found near Wallace, Idaho by carbonate-free dark laminated strata. Total thickness of Shepard Formation about 540 m (1800 feet) (1930 feet, Harrison and Jobin, 1963).

Shepard Formation, member 2 (Middle Proterozoic)—Rusty weathering, laminated and thinly laminated white, green and dark gray siltite and dark gray to black argillite, and white siltite and quartzite. Lower part is unevenly laminated light green to white siltite with thin gray to commonly black argillite caps. Rare beds up to cm thick of very fine-grained white quartzite contain scattered black mudchips. Rare curved cracks up to 5 cm deep on bedding plane surfaces resemble fluid-escape structures. Up section are 5-10 cm beds of slightly dolomitic, dark green siltite interstratified with uneven laminae and couplets of dark green siltite and pale green argillite, identical to lithologies present in Ysh_1 . Rare 10—20 cm layers of low domal stromatolites. Uppermost part of unit unevenly laminated medium greenishgray siltite and pale greenish-gray argillite similar to lower lithologies, but lacking carbonate and including rare black argillite. Includes rare 10 cm thick beds of light green quartzite and green, dm-scale siltite beds. Some discontinuous cm-scale siltite occurs in lenses, apparently as a result of softsediment compaction. Incompletely but well-exposed on Derr Point; less well-exposed on west side of ridge south of there. Contact with the overlying Mount Shields Formation is lowest occurrence of cm-scale, very fine-grained pink quartzite with red argillite caps or muscovitic forest-green quartzite. Thickness about 120 m (400 feet). Previously mapped as the laminated argillite and siltite member (Wallace 5) by Harrison and Jobin (1963) who also estimated a thickness of 400 feet. Equivalent to Ywu₃ to the south (Lewis and others, 2002), to upper part of the Shepard Formation in Western Montana (Lemoine and Winston, 1986), and to Argillite of Half Moon Lake to the north (Miller and Burmester, 2003).

Shepard Formation, member 1 (Middle Proterozoic)—Tan-and brownweathering couplets of dolomitic green siltite and light green argillite with minor interstratified 10-20 cm beds of dolomitic or calcitic, very fine-grained quartzite. Siltite and argillite are unevenly thinly laminated, microlaminated, and in thin, graded beds (uneven couplets). Uneven laminations of dark green siltite and pale green argillite at the base pass upward into intervals of thicker uneven couplets of dark green siltite and pale green argillite. Weathered outcrops are distinctive brown (siltite) and tan (argillite). Dolomite content increases up section. Dolomitic and calcitic quartzite layers to 20 cm thick and rare low domal stromatolite horizons scattered throughout unit. Layers of flat-pebble rip-up conglomerate to 5 cm thick present near middle of the unit are commonly associated with cm-wide straight cracks that penetrate bedding to 10 cm depths in siltite and argillite couplets. Bedding locally discontinuous in middle and upper parts, with thin gray non-resistant limestone pods and silty and sandy ripple trains within the thicker argillites. Isolated "starved" ripples common. Upper part is uneven siltite and argillite couplets to couples and uneven laminations of slightly dolomitic siltite and argillite. Forms cliffs northwest side Derr point and along lower reaches of Derr Creek. Upper contact gradational; best placed above highest dolomitic siltite or highest thick dolomitic laminated unit. Thickness about 400 m (1300 feet) (1000 feet; Harrison and Jobin, 1963). Previously mapped as the upper calcareous member (Wallace 4) by Harrison and Jobin (1963). Equivalent to Ywu_2 to the south (Lewis and others, 2002), lower part of Shepard Formation present in western Montana (Lemoine and Winston, 1986) and all rocks assigned to Shepard Formation to the north

Argillite of Howe Mountain (Middle Proterozoic)—Rusty weathering gray and green siltite and dark green and gray argillite, subordinate pale green fine-grained quartzite, and minor carbonate. Gray argillite weathers lighter while accompanying siltite weathers dark rusty red. Green intervals weather yellowish. Corresponds to upper Wallace member 1 to the south (Lewis and others, 2002). Name changed to avoid confusion with upper Wallace that includes Shepard Formation interval elsewhere in Idaho. Corresponds to Snowslip Formation to the north (Burmester, 1986) and east (Harrison and others, 1992). Subdivided into three units where exposure adequate. Lowest

(Miller and Burmester, 2003).

unit corresponds closely to the argillite member (Wallace 2) of Harrison and Jobin (1963). Upper two units correspond closely with the argillite, siltite, and limestone member (Wallace 3) of Harrison and Jobin (1963). Age of the top of unit is approximately that of the Purcell lavas, which occur close to the Snowslip-Shepard contact to the northeast and east (Harrison and others, 1992). Rhyolite in the Purcell lava about 100 km NNE is 1.443 Ga (Evans and others, 2000). Thickness about 760 m (2500 feet). Unit is best exposed on ribs east of Johnson Creek in the northwest corner of the map.

Argillite of Howe Mountain, member 3 (Middle Proterozoic)—Dark green siltite and light green to black argillite as uneven microlaminae and wavy or uneven couplets, and subordinate intervals of unevenly laminated light gray siltite and black argillite. Thicker green siltite occurs in cm to dm thick layers. Black argillite commonly contains small ptygmatically folded white siltite crack filling. Decimeter-scale green siltite beds are more common than in Ysn_1 and Ysn_2 ; black argillite caps less common. Large, straight-sided cracks, visible on bedding-plane surfaces, commonly disrupt lamination to a depth of several cm in the green beds. These are interpreted as waterescape structures; only near the upper contact are true desiccation cracks and mudchips common. Top is gradational into overlying Ysh_1 with increasing carbonate content in the interval of microlaminated dark green siltite and light green argillite. Contact placed arbitrarily at lowest appearance of significant carbonate within laminated siltite and argillite beds. Thickness about 330 m (1100 feet). Mapped as part of Wallace 3 by Harrison and

Argillite of Howe Mountain, member 2 (Middle Proterozoic)—Planar-laminated couplets of greenish gray siltite and dark gray to black argillite. Some dm-scale gray siltite beds. Characteristic plane parallel lamination widespread at this stratigraphic level (Burmester, 1986; Lewis and others, 1992, 1999, 2000). Thin laminations part evenly on planar bedding surfaces, such that black argillites commonly display distinct, platy talus of smooth, slate-like appearance. Upper contact fairly sharp; placed at top of thick interval of planar laminated siltite-black argillite. Thickness about 150 m (500 feet). Mapped as lower part of Wallace 3 by Harrison and Jobin (1963).

Argillite of Howe Mountain, member 1 (Middle Proterozoic)–Uneven couplets to microlaminae of gray to green siltite and black, to less commonly green argillite. Base includes some carbonate intervals. Some black microlaminated zones show soft sediment deformation. Includes thin zone of planar microlaminated siltite and black argillite similar to Ysn_2 about 200 m (600 feet) below top. Upper contact placed at the base of thick section of planar laminated siltite and black argillite. Thickness about 300 m (1000 feet). Includes the middle and upper part of Wallace 2 of Harrison and Jobin

Wallace Formation (Middle Proterozoic)—Pinch and swell couplets and couples of gray, tan-weathering calcareous to dolomitic, very fine-grained quartzite or siltite and black argillite, and lesser amounts of calcareous and noncalcareous white quartzite, dolomitic siltite and rare stromatolites Characterized by graded couplets and couples exhibiting pinch and swell sediment type of Winston (1986) in which scours and loads of quartzite cut or deform subjacent black argillite. Black argillite caps commonly contain ptygmatically folded siltite- or quartzite-filled cracks that taper downward. On bedding plane surfaces, the cracks are generally discontinuous and sinuous, occurring as isolated parallel or three-pointed star "birdsfoot" cracks. Exposed poorly only in southwest corner of map along the North Fork Coeur d'Alene River. In the Clark Fork quadrangle to the north, includes beds of distinct "molar-tooth" dolomitic siltite to 30 cm (in which non-resistant, irregular, vertical calcite ribbons have been removed by weathering); beds of conchoidally-fracturing brown weathering dolomite to 20 cm; a thin interval of green, dolomitic siltite and argillite and cm-scale white quartzite and hummocky cross-stratified white quartzite as tabular beds 15-30 cm thick; cycles of 20-30 cm thick white quartzites overlain by intervals of microlaminated black argillite common in upper part; rare horizons of stromatolites in the middle, and one thin stromatolite layer near the upper contact. Upper contact placed above highest occurrence of pinch and swell couplets. Thickness on the order of 800 m (2600 feet) to the north. Unit is upper part of the lower calcareous member (Wallace 1) of Harrison and Jobin (1963). Equivalent to the middle member of Wallace as mapped by Harrison and others (1986) and Lewis and others (2002). "Middle member" status dropped from name here because upper and lower Wallace units have

STRUCTURE

Structures in the area include folds, faults and tilted fault blocks. Overall, Belt strata homoclinally dip to the east-southeast. Dips are gentle over most of the area, but are steep in the southwest corner of the map. The major structures are described below.

NORTHEAST-STRIKING FAULTS

These are mostly down-to-the-west faults that repeat gently east-dipping strata and are probably normal faults. Harrison and Jobin (1963, 1965) called the fault along Johnson Creek the Packsaddle fault and apparently interpreted it as one of many "block faults" that accommodated block tilting. Another large structure is the Twin Creek fault, which repeats much of the section. Only in the southwest are there reverse or thrust faults that placed older strata on the west over younger strata to the east. Some of these are interpreted to have been reactivated as normal faults.

NORTHWEST-STRIKING FAULTS

Most appear to have small down to the southwest displacement and are mapped as terminating at northeast structures. Thus they are possibly older, or synchronous. Those in the southwest corner may include similar late motion but are interpreted as having an earlier left lateral strike slip history coincident with reverse or thrust faulting and accommodated differential shortening between the shallowly dipping strata to the north and the steep to overturned strata to the south.

e south.

SYMBOLS

Thrust fault: dashed where approximately located; dotted where concealed; teeth on upper plate.

Strike-slip fault: dashed where approximately located; dotted where concealed.

Contact: Line showing the boundary between one map unit and another; dashed where approximate. The location accuracy of contact is 80 feet or more on the ground.

High-angle fault: ball and bar indicates downthrown side of

a normal fault; dashed where approximately located;

Strike and dip of foreset beds in glacial deposits.

Strike and dip of bedding.

Quartz vein: Arrow indicates dip.

Strike and dip of overturned bedding.

Strike of vertical bedding.

Approximate strike and dip of bedding.

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

clockwise rotation viewed down plunge.

Strike and dip of bedding, ball indicates bedding known to be upright.

Marker horizon.

Maximum elevation of Glacial Lake Missoula approximately 4260 feet.

Direction of flow through flood gap.

Direction of ice flow (Clark Fork tongue).

Ice flow direction indicators (glacial striae).

Dry falls and cataracts of Missoula Floods.

Closed depression (sackung or scour feature).

Terrace scarp.

Giant current ripples.

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