Geologic Map of the Leonia Quadrangle, Bonner and Boundary Counties, Idaho, and Lincoln County, Montana

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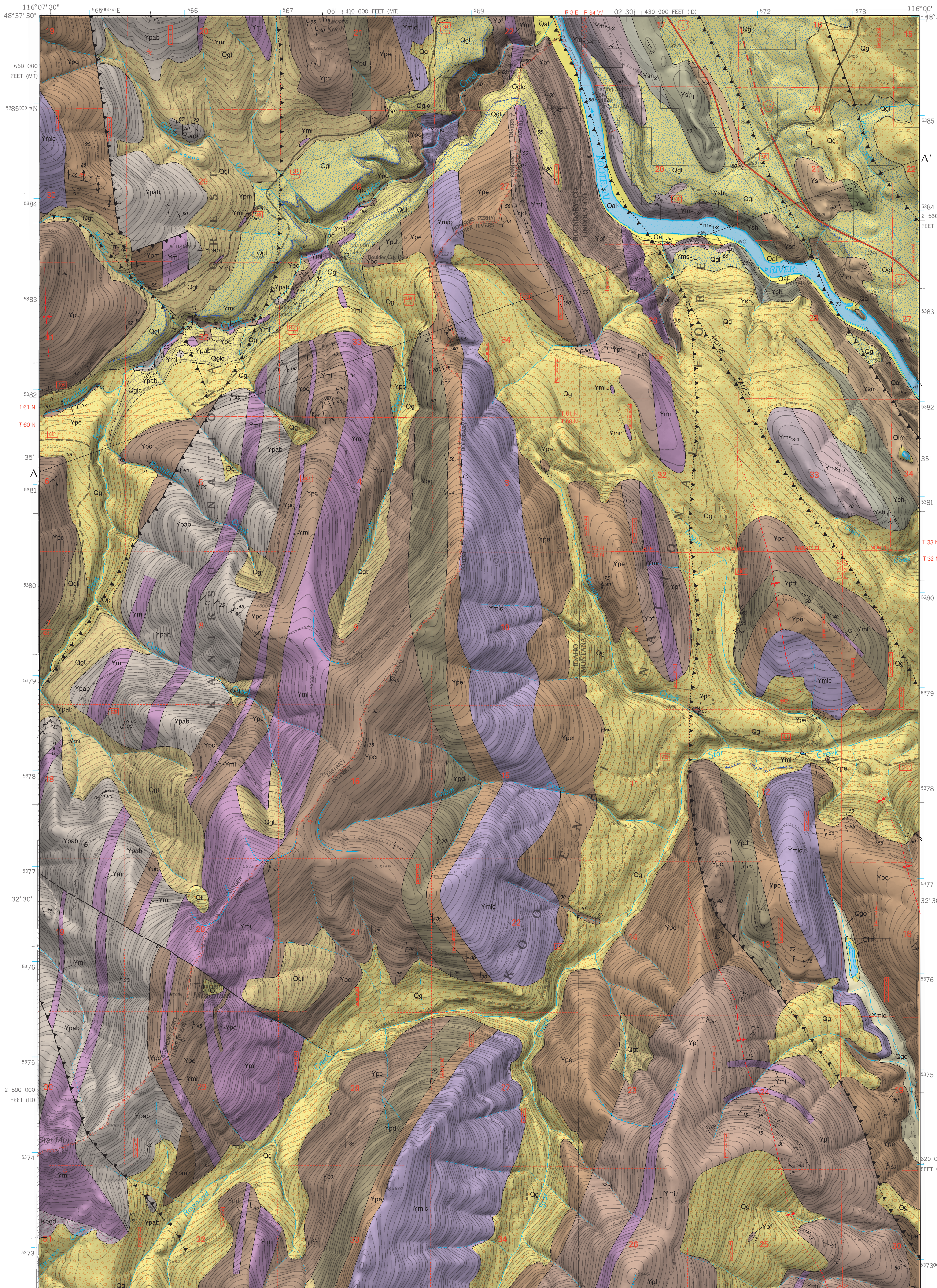


Base Map Credit

Base digitally scanned from 24,000-scale USGS film separates, 1997.

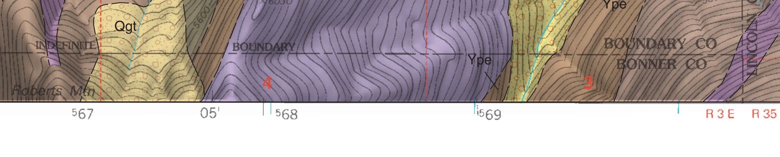
Shaded elevation from 10 m DEM.

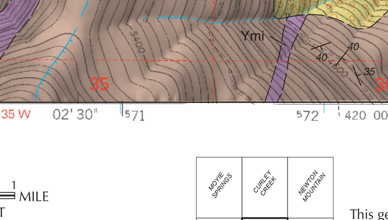
Topography compiled 1963. Planimetry derived from imagery taken 1992 and other sources.

Projection: Idaho coordinate system, west zone (Transverse Mercator). 1927 North American Datum.

10,000-foot grid ticks based on Idaho coordinate system, central zone.

1000-meter Universal Transverse Mercator grid ticks, zone 11.





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Field work conducted 2009-2011.
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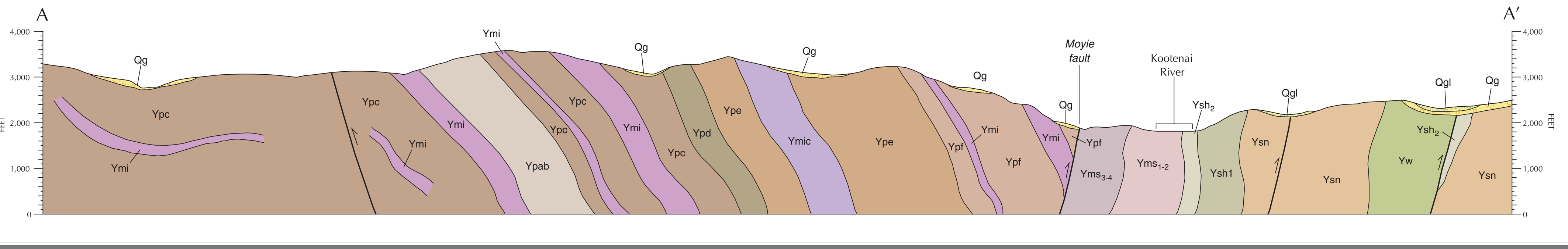
Digital cartography by Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.
Reviewed by John D. Kauffman, Idaho Geological Survey; Susan Vuke and Catherine McDonald, Montana Bureau of Mines and Geology.
Map version 11-15-2012.
PDF (Acrobat Reader) map may be viewed online at www.idahogeology.org.

INTRODUCTION

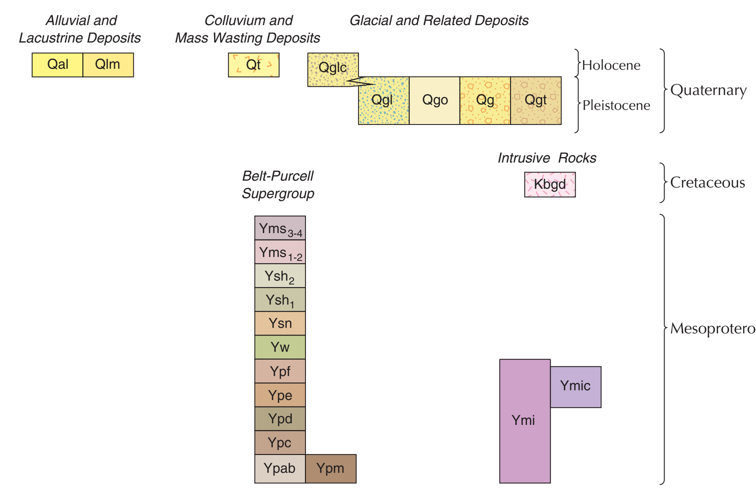
Quaternary deposits on the Leonia quadrangle were mapped in 2010-2011 by R.M. Breckenridge. Bedrock was mapped in 2009 and 2011 by R.F. Burmester, R.S. Lewis, M.D. McFadden, and J.D. Lonn to modify previous mapping (Burmester, 1986) for consistency with unit definitions and contact placements used in current mapping in the region. Attitudes from mapping around Leonia Knob by Miller (1973) were used to supplement the structural data collected by the authors.

The oldest and most abundant rocks in the quadrangle are low metamorphic grade metasedimentary rocks of the Mesoproterozoic Belt-Purcell Supergroup. The oldest strata are west of the Moyie fault and host penecontemporaneous mafic and differentiated sills. The youngest are exposed east of the Moyie fault on the west flank of the Sylvanite anticline (Fig. 1).

During Pleistocene glaciations, the Purcell Trench Lobe of the Cordilleran Ice Sheet repeatedly advanced southward from Canada and dammed the north-flowing Kootenai River, forming Glacial Lake Kootenai. Cosmogenic ^{10}Be surface exposure ages (mean weighted) constrain the glacial maximum ice limit near the Clark Fork ice dam of Glacial Lake Missoula at 14.1 ± 0.6 ka (Breckenridge and Phillips, 2010). Kame deposits near the United States-Canada border constrain the ice recession (^{10}Be range) from 13.3 to 7.7 ka (William Phillips, written commun., 2011). Locally, tributary valley glaciers of the Purcell Mountains contributed to the ice stream. Sections of glacial till, outwash, and lacustrine deposits filled the Kootenai valley and its tributaries. After retreat of the continental ice, mountain valley glaciers persisted in the higher cirques of the Purcell Mountains.



CORRELATION OF MAP UNITS



SYMBOLS

Contact: dashed where approximately located.

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

Syncline axial trace; dashed where approximately located; dotted where concealed.

Strike and dip of bedding.

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

Estimated strike and dip of bedding.

Strike and dip of bedding, strike variable.

Strike of vertical bedding.

Horizontal bedding.

Strike and dip of overturned bedding.

Strike and dip of foliation.

Strike and dip of cleavage.

Bearing and plunge of small fold axis.

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

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

Terrace escarpment.

Cirque headwall: ticks on glaciated side.

Moraine crest or kame ridge.

DESCRIPTION OF MAP UNITS

Intrusive rocks are classified according to IUGS nomenclature using normalized values of modal quartz (Q), alkali feldspar (A) and plagioclase (P) on a ternary diagram (Streckeisen, 1976). Mineral modifiers are listed in order of increasing abundance for igneous rocks. Grain size classification of unconsolidated and consolidated sediment is based on the Wentworth scale (Lane, 1947). Bedding thicknesses and lamination type are after McKee and Weir (1963) and Winston (1986). Grain sizes and bedding thicknesses are given in abbreviation of metric units (e.g., dm=decimeter). Unit thicknesses and distances are listed in both metric and English units. Elevations are given in feet only. Multiple lithologies within a rock unit description are listed in order of decreasing abundance. Soil descriptions for Quaternary units are after Chugg and Fosberg (1980) and Weisel (2005).

ALLUVIAL AND LACUSTRINE DEPOSITS

Qal **Alluvium (Holocene)**—Alluvial deposits of the Kootenai River and its tributary streams. Moderately sorted to well-sorted silt, sand, and local pebble and cobble gravels. Mostly reworked glacial deposits in the river valley and postglacial colluvium in the surrounding mountains. Schnoorson-Ritz-Farnhampton soils association; typical soils are very deep silty clay loams, silt loams, and mucky silt loams in basins and swales and on low terraces, flood plains, and natural levees. Thickness is several meters to more than 10 m (6 to >30 ft).

Qlm **Lacustrine and mud deposits (Holocene)**—Organic muck, mud, and peat bogs in poorly drained paleoglacial outwash channels, kettles, and scoured bedrock depressions. Interbedded with thin layers of fine sand, silt, and clay. Soils of the Pywell series. Thickness 1-5 m (3-16 ft).

COLLUVIAL AND MASS WASTING DEPOSITS

Qt **Talus (Holocene)**—Blocky and tabular, poorly sorted angular clasts of Belt-Purcell Supergroup rocks form talus deposits below cirque headwalls and cliffs oversteepened by glaciation. Generally no soil development. Thickness varies, usually 3-9 m (10-30 ft).

GLACIAL AND RELATED DEPOSITS

Qglc **Glaciolacustrine deposits and colluvium (Holocene to Pleistocene)**—Mixed deposits of silt, sand, and gravel colluvium, slope wash, and small landslides. Steep slopes of reworked and locally transported *Qgl*. Soils are silt loams of the Wishbone-Crash association. Thickness as much as 10 m (30 ft).

Qgl **Glaciolacustrine deposits (Holocene to Pleistocene)**—Massive to well-bedded and finely laminated clay, silt, and sand deposited in Glacial Lake Kootenai at the northward retreating ice margin in the Purcell Trench. Exhibits well-developed rhythmites and beds of sand and silt with scattered dropstones. Contorted bedding and loading structures are common. This unit forms several prominent terrace levels from an elevation about 2,200 to 2,400 feet; also forms discontinuous terraces in tributary valleys. Mostly well sorted and finely laminated. Overlain by glaciofluvial outwash deposits on terraces and in tributary valleys. Soils are silt loams of the Wishbone-Crash association. Exposed thickness as much as 150 m (500 ft).

Qgo **Outwash deposits, undivided (Holocene to Pleistocene)**—Bouldery and sandy gravels. Moderately sorted and rounded pebbles and cobbles. Includes small unmappable deposits of alluvium. Soils are sandy loams and loamy sands of the Selle-Elmira Association. Maximum thickness about 20 m (60 ft).

Qg **Till and kame deposits, undivided (Pleistocene)**—Poorly stratified and compact silty to sandy boulder lodgment till; locally includes ground moraine, kame deposits, and some interbedded proglacial and ice contact deposits related to the Purcell Trench ice lobe. Soils include silt loams and gravelly silt loams of the Stien-Pend Oreille association. Thickness varies; may exceed 50 m (160 ft).

Qgt **Till deposits (Pleistocene)**—Dense silt, pebble, and cobble till with boulders deposited by alpine valley glaciers. Poorly stratified till of locally derived sources forms moraines with interbedded proglacial deposits. Includes kame terraces and some outwash in valleys. Soils include silt loams and gravelly silt loams of the Pend Oreille-rock outcrop and the Stien-Pend Oreille associations. Thickness varies, 1-30 m (3-100 ft).

INTRUSIVE ROCKS

Kbgd **Biotite granodiorite (Cretaceous)**—Poorly exposed coarse-grained biotite granodiorite in southwest corner of map. Locally contains minor amounts of hornblende. Contact metamorphism is minor, consistent with high level of emplacement. Appears to be northeastern end of sill-like swath of intrusions into Ypac that include the Rapid Lightning Creek pluton of the Sandpoint 30 x 60 minute quadrangle (Lewis and others, 2008).

Ymi **Mafic intrusive rocks, undivided (Mesoproterozoic)**—Fine- to medium-grained, rarer coarse-grained, hornblende gabbro and quartz diorite. Variants have laths of plagioclase, quartz as large blue grains, or quartz in granophyre. Grain size, quartz content, and mafic mineral content vary between intrusions and commonly within single bodies, both along and across strike. Medium-grained quartz diorite and biotite granophyre differentiates more common near tops of sills, but are not everywhere present. Not all are Moyie sills. Locally concordant, but some laterally pinch and swell, include rafts of country rock, branch into multiple sills, end abruptly, or gradually pinch out (Bishop, 1976). Although sills lower and higher in the Aldridge Formation (Prichard correlative in Canada) are similar in chemistry (Anderson and Goodfellow, 2000), they seem to have intruded in at least two separate events. Early intrusions were at shallow levels closely following sedimentation of the Lower Aldridge (Höy and others, 2000; Gorton and others, 2000; Cressman, 1989; Sears and others, 1998, Poage and others, 2000). Generation of Ypm was probably synchronous with this shallow emplacement. Higher intrusions have chilled margins and contact aureoles, evidence that they invaded consolidated rock at a later time. Age of the early intrusion sills is probably close to U-Pb dates on zircons from near Kimberley, British Columbia, about 125 km (80 mi) to the north (1.468 Ga; Anderson and Davis, 1995) and from Plains, Montana, about 160 km (100 mi) southeast (1.47 Ga; Sears and others, 1998).

Ymic **Mafic intrusive rocks, Crossport C sill (Mesoproterozoic)**—Fine- to coarse-grained hornblende gabbro and quartz diorite. Finer grained varieties are typically near top and bottom of sill. Centimeter-scale granophyre concentrations are near top at south edge of map but were not evident to the north. This sill is fault repetition of the middle or "C" sill of Bishop (1973, 1976) defined in the Moyie Springs quadrangle to the northwest. Best exposed along ridge of map on road southwest of Leonia Knob. Thickness near center of map about 360 m (1200 ft).

BELT-PURCELL SUPERGROUP

Missoula Group

The Missoula Group includes all Belt units above the Piegan Group as recently redefined by Winston (2007). It is similar to the Ravalli Group in that it is characterized as a clastic wedge consisting of quartzite, siltite, and argillite. Only the lowest three formations are mapped here.

Mount Shields Formation (Mesoproterozoic)—Quartzite, siltite, argillite, and dolomite. Although highly varied lithologically, formation is characterized by maroon and green color, domal stromatolites, "boxwork" dolomite, and abundant and varied sedimentary structures.

Yms$_{3-4}$ **Mount Shields Formation, members 3 and 4 (Mesoproterozoic)**—Siltite, argillite, and dolomite. Lower part dominated by green siltite with partings of green and maroon argillite. Polygonal mudcracks, mudchip breccias, oscillation ripple marks, and salt casts are common, especially in maroon rocks. Bedding generally thickens upward, but thin, light green siltite and dark green argillite couplets are scattered throughout. Carbonate rocks and carbonate-bearing rocks are more common toward the top where "boxwork" carbonate is formed from recessive weathering of dolomite relative to quasi-orthogonal silica veinlets. Dolomite is blue-gray where fresh and weathers light brown to orange. Thickness calculated from outcrop width in southern part of quadrangle is 420 m (1,300 ft), but upper contact is faulted. Best exposed along east side of Kootenai River at north edge of map. Corresponds closely to members 3 through 5 of Harrison and others (1992).

Yms$_{1-2}$ **Mount Shields Formation, members 1 and 2 (Mesoproterozoic)**—Red, pink, green, and gray quartzite, green and red siltite and argillite, and minor carbonate. Green and lighter colors are more common toward base. Quartzite is in 0.3 m to nearly 1.0 m beds. It is fine grained and mostly flat laminated, but also cross laminated. Potassium feldspar is well in excess of plagioclase. Diffuse, nonresistant brown wisps of carbonate within the quartzite of upper part of unit average a few centimeters in thickness and 10-15 cm in length. Commonly rippled tops of the quartzite beds have thin red argillite drapes. Siltite and argillite occur as graded and lenticular couplets and microlaminae. Both red and green couplets have dewatering structures, mudcracks, and mudchip breccias. Green strata may have more disrupted zones, but red strata have larger mudchips. Uppermost 35 m (115 ft) contains several 1-5 dm, rarely 10 dm, layers of purple, buff-weathering low domal stromatolites as much as 30 cm high and 1 meter across, with bases of oolite and coarse, well-rounded quartz grains. Top placed above highest domal stromatolite. Best exposed near south edge of section 20 along Kootenai River. Thickness calculated from outcrop width there about 300 m (1,000 ft). Corresponds closely to members 1 and 2 of Harrison and others (1992).

Shepard Formation (Mesoproterozoic)—Occupies same stratigraphic level as the upper two units of the Wallace Formation mapped to the south of the quadrangle (Harrison and Jobin, 1963; Lewis and others, 1999, 2000, 2002). Named 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 laminated strata (*Ysn*). Subdivision follows Lemoine and Winston (1986) and Burmester (1986).

Ysh$_2$ **Shepard Formation, member 2 (Mesoproterozoic)**—Microlaminated to laminated dark gray to black argillite, dark olive-green- to white-weathering siltite, and very fine-grained white quartzite. Laminations are commonly contorted, rarely cracked. Contortions are attributed to soft-sediment deformation. Siltite and quartzite are mostly in beds about 5 cm thick. Upper contact placed at base of lowest purple argillite or quartzite, or mudcracked siltite and argillite of Yms$_{1-2}$. Best exposed where unit crosses Kootenai River. Thickness about 120 m (400 ft). Previously also mapped as Argillite of Half Moon Lake (Miller and Burmester, 2004).

Ysh$_1$ **Shepard Formation, member 1 (Mesoproterozoic)**—Tan- and brown-weathering uneven couplets of green siltite and carbonate-bearing light green argillite. Includes intervals of unevenly laminated dark green siltite and light green argillite, and white quartzite. Nonresistant horizontal limestone pods and vertical ribbons are commonly weathered out. Contorted chip layers, soft-sediment deformation, and centimeter-scale loads and flames are typical. Siltite and quartzite occur as cross-laminated beds 1-3 dm thick or as starved ripples that form lenticular bedding. Upper contact placed at lowest black argillite of Ysh$_2$. Thickness uncertain because of faulting and transposition of bedding where folding is intense, but probably less than 500 m (1,500 ft).

Snowslip Formation (Mesoproterozoic)—Divided into three members where mapped to the south of quadrangle as argillite of Howe Mountain (Burmester and others, 2006). Total thickness there about 900 m (3,000 ft). Undivided where mapped as lower part of upper Wallace Formation farther south, near St. Maries (Lewis and others, 2000). Discontinuous exposure and faulting preclude accurate determination of thickness or subdivision within this map.

Ysn **Snowslip Formation (Mesoproterozoic)**—Pale green siltite and argillite, green siltite and dark gray argillite couplets, and green to gray siltite. Dominantly green, with mudcracks and water escape structures common except in middle part of formation. There, green argillite is sparse, beds and laminae are planar and uncracked, and pyrite is more abundant. Similar plane-parallel lamination is widespread in middle of unit elsewhere (Burmester, 1986; Burmester and others, 2006; Lewis and others, 1999, 2000). Upper contact placed below lowest carbonate-bearing uneven couplets or white quartzite of *Ysh$_1$*. Best exposed where swath crosses Kootenai River and along Highway 2.

Piegan Group

The Piegan Group was resurrected by Winston (2007) to provide group-level correlation across the Belt basin. It consists of only the Helena and Wallace formations, and only the latter is exposed in this quadrangle. Excluded from the Wallace are upper members mapped to the south in the past (e.g., Harrison and Jobin, 1963; Lemoine and Winston, 1986; Lewis and others, 1999, 2000, 2002).

Yw **Wallace Formation (Mesoproterozoic)**—Pinch-and-swell couplets and rarer couples of gray, tan-weathering, calcitic to dolomitic, very fine-grained quartzite or siltite grading to generally carbonate-free black argillite. Black argillite caps commonly contain ptygmatically folded siltite- or quartzite-filled cracks that taper downward. On bedding-plane surfaces, cracks are generally discontinuous and sinuous, appearing as isolated parallel or three-pointed star "birdsfoot" cracks. Includes minor dark bluish gray dolomite with molartooth calcite ribbons, and zones of uneven graded couplets of pale green siltite and calcitic argillite. Upper contact placed at the top of pinch-and-swell couplets. Top exposed poorly in northeast corner of map; base not exposed. Minimum thickness 220 m (700 ft), much less than that to the south (790 m, 2,600 ft; Burmester and others, 2004). Zircons from a tuff near the contact with Snowslip Formation about 170 km east yielded a U-Pb date of 1.454 Ga (Evans and others, 2000).

Lower Belt

Prichard Formation (Mesoproterozoic)—The Prichard Formation consists of the lowest strata of the Belt Supergroup. It is equivalent to the Aldridge Formation in Canada. Conspicuous bar code-like patterns in the middle of the Prichard, formed by alternating dark and light siltite, persist regionally (Huebschman, 1973) and have been used as markers for correlation by Cominco (Hamilton and others, 2000). Rusty nature of outcrop is due to weathering of abundant sulfides, commonly pyrrhotite. Dominant lamination style and concentration of sulfides vary between members. Quartzite is light weathering and averages about 60 percent quartz, 20 percent plagioclase; the rest is mostly white micas and biotite (Cressman, 1989). Previous mapping in this area and to the east (Cressman and Harrison, 1986) subdivided only the top of the Prichard. Here, we apply alphabetic member assignments of Cressman (1989). Presence versus absence of sedimentary structures recording strong currents or soft-sediment deformation are lithologic criteria used to distinguish adjacent members, but assigning quartzite packages with similar characteristics to different members was facilitated by release of mapping by Cominco with control based on "markers" (Michael Zientek, written commun., 2003). These markers served for the upper units down through Ype. Locations of some of these markers (Glombick and others, 2010) aided matching contacts across the international border. Cominco did not map below Ype, so our attempt to identify lower units is based partly on correlation of the lower-middle Aldridge contact with the top of a concentration of sills just north of the border (Glombick and others, 2010), or the Ypb-Ypc contact (Michael Zientek, written commun., 2003) and on the subdivisions of Finch and Baldwin (1984). However, we did not map the base of Ypc in this quadrangle and therefore included it with lower units as Ypac.

Ypf **Prichard Formation, member f (Mesoproterozoic)**—Rusty-weathering, tabular, dark and light gray siltite, darker gray argillite, and minor lighter quartzite. Siltite is commonly in 1-20 cm tabular, structureless, or even-parallel laminated beds with slabby to platy parting. Quartzite is very fine to fine grained and feldspathic in tabular beds 6-20 cm thick, with tops graded to siltite or dark argillite. Bases of some beds are slightly uneven from loading into finer grained material. Carbonate concretions 30-50 cm in diameter are common in thicker beds. Upper part is mostly dark, pyrrhotite-bearing siltite with marker-bed-like color layering common. Hosts mafic sills "D" and "E" of Bishop (1973, 1976). Upper contact placed below rippled, cross-laminated, and unevenly bedded strata of Ypg. Thickness possibly 900 m (3,000 ft); uncertainty due to fault truncation and folding of upper part. Previously subdivided following Finch and Baldwin (1984) into lower member with more quartzite and upper member with more argillite (Burmester, 1986); upper part to the east was argillite member of Cressman and Harrison (1986).

Ype **Prichard Formation, member e (Mesoproterozoic)**—Light gray- to white-weathering siltite and quartzite, and darker argillite. Siltite dominates over very feldspathic quartzite. Beds of both are 1-10 dm thick; some are parallel laminated, but many exhibit features of current traction such as rippled tops, ripple cross lamination, and trough cross bedding. Soft-sediment deformation features are common; centimeter-scale load casts and ball-and-pillow structures are locally abundant. Some quartzite beds, coarser grained and less feldspathic than typical of the Prichard, have rounded medium quartz grains, especially at bed bases. Rounded medium grains also occur in argillite east of Star Creek. Hosts sill "C" of Bishop (1973, 1976). Upper contact placed above highest zone of quartzite with abundant current features and below thick section of uniformly parallel laminated, rusty-weathering siltite. Contact poorly exposed south of Leonia Knob. Thickness approximately 1,200 m (3,600 ft), including 360 m (1,200 ft) of Ymic.

Ypd **Prichard Formation, member d (Mesoproterozoic)**—Dark gray siltite, dark gray argillite, and white-weathering gray quartzite. Siltite, siltite and argillite couplets, and microlaminae are predominantly even and parallel laminated and less commonly uneven; all are rusty weathering. Less common are beds of white, very fine- to fine-grained quartzite. Quartzite is commonly thin and discontinuous, with quartzite generally over-represented in float. Upper contact placed at lowest occurrence of current-laminated siltite and quartzite below Ymic. Poorly exposed; mapped mostly as zone of poor outcrop dominated by fine, thin, and rusty-weathering float. Thickness uncertain due to poor exposure of contacts, but probably 200-500 m (600-1,600 ft).

Ypc **Prichard Formation, member c (Mesoproterozoic)**—Fine-grained to rare medium-grained quartzite similar to that of Ype but most beds are thinner. Some beds have ripples and cross lamination, coarser grains at bases and gradation to siltite at tops; other beds 1-3 m thick appear structureless. Circular brown spots 3-6 cm diameter with alteration "halos" probably formed from carbonate concentrations. Top placed above set of quartzite beds and below interval of rustier weathering, more evenly laminated siltite and argillite. Thickness estimated at 850 m (2,800 ft).

Ypab **Prichard Formation, members a and b (Mesoproterozoic)**—Dark siltite, rusty-weathering, unevenly laminated, dark gray siltite and argillite couplets, and light weathering quartzite. Lower part is finer grained. Couplets typically are not graded and less than one cm thick; argillite tops locally weather white. Siltite layers are both centimeter and decimeter scale. Rusty dark gray but weathering lighter. Some thicker beds have white mud chips in tops. Light gray to white-weathering quartzite occurs as isolated decimeter-scale beds and decimeter- to rarely meter-scale beds amalgamated up to several meters thick; these are more common toward top. Intimately associated with Ypm where slump folds (scattered orientations and no axial plane cleavage), convolute bedding and intraformational conglomerate of contorted clasts are concentrated. Foliation defined by white micas as large as 2 mm along and east of Boulder Creek is best developed in finer grained rocks but also occurs in quartzite. Base not exposed.

Ypm **Prichard Formation, massive unit (Mesoproterozoic)**—Structureless, poorly sorted quartzite and siltite to quartz-rich, fine-grained biotite granodiorite. Commonly has granoblastic texture with fine biotite and muscovite. Granophyre suggests an igneous or magmatic fluid contribution, but similar rock less than 10 km (6 mi) to the west has too much quartz to be entirely igneous (Redfield, 1986). Locally stratiform, but generally discontinuous laterally and nonuniform in thickness. Commonly floored by mafic sills. Locally contains 5-10 percent clasts of laminated siltite and argillite a few centimeters thick, some of which have apparent reaction rims; others appear deformed. Weathers more rusty than quartzite of *Ype* or *Ypc*. Generally hardest rock of the Prichard Formation, forming rounded exposures, abundant rounded float, and large blocky talus. May have formed from increased pore fluid pressure due to heating by the earlier sills (Anderson and Höy, 2000). Poorly exposed near southwest corner of map.

STRUCTURE

The major structure in this quadrangle is the Moyie fault. It is characterized regionally as an east-vergent thrust and juxtaposes older rocks on the west (hanging wall) against younger rocks on the east, consistent with this interpretation. However, strata of the hanging and foot walls face each other, giving the impression that the fault occupies a syncline. Support for a synclinal fold geometry comes from existence of a slightly east-verging, southward-plunging syncline west of the Moyie fault in this quadrangle, and an open, northward-plunging syncline north of the international border (Brown and others, 1995; Brown, 1998). One hypothesis is that these are remnants of a syncline that was paired with the Sylvanite anticline to the east (Fig. 1) before further contraction was accommodated by faulting. This situation is consistent with the interpretation that the Moyie fault cut down section into the Sylvanite anticline (Harrison and Cressman, 1993), so must be younger. However, in the Curley Creek quadrangle to the north, the Moyie fault is overturned and Yms$_{1-2}$ stromatolites dip steeply east, not the attitude expected of a thrust fault. This configuration could be explained if the fault and adjacent beds were folded as part of the west limb of the Sylvanite anticline as it continued or renewed growth after or during thrust faulting. This syncline-thrust system is complicated by an east-side-up fault west of the Moyie fault that repeats part of the Prichard section, and numerous faults to the east. Some of those mapped as east-vergent thrusts may date from late stages of folding or be coeval with the Moyie fault.

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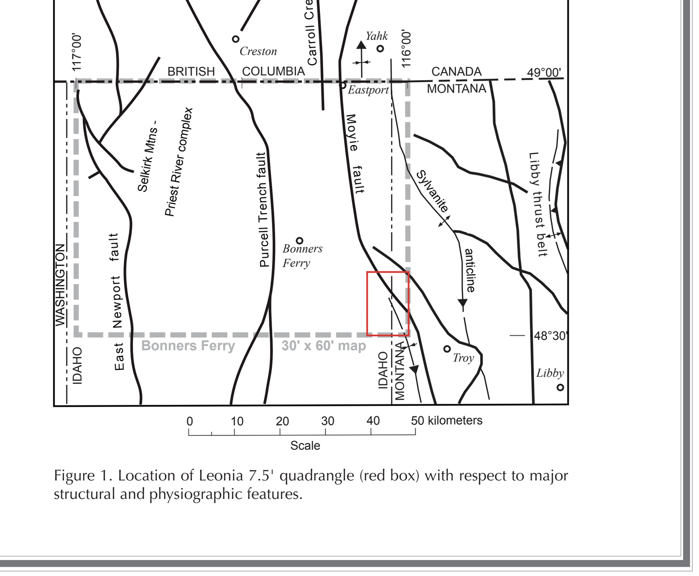

Figure 1. Location of Leonia 7.5' quadrangle (red box) with respect to major structural and physiographic features.