Geologic Map of the St. Maries 30 X 60 Minute Quadrangle, Idaho

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2000

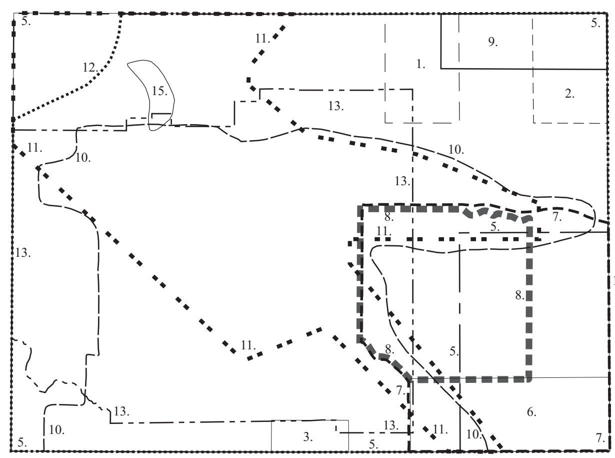
INTRODUCTION

Preparing the geology of the 1:100,000-scale St. Maries 30' x 60' quadrangle relied extensively on previous mapping, and we supplemented that with twelve weeks of field work in 1998. The principal source was the 1:250,000-scale map of Griggs (1973) and included his unpublished 1:62,500-scale field maps that formed the basis of his research. All sources and their areal extent are shown on Figures 1 and 2. The geology of the St. Maries quadrangle is also available in a digital version.

The distribution of the Columbia River Basalt Group was taken largely from work by Swanson and others (1979a) and unpublished mapping by Margaret Jenks (written commun., 1998). Basalt stratigraphy, chemistry, and magnetic polarity were based on work by Wright and others (1973) and Swanson and others (1979b). Chemical types and polarity were confirmed by field sampling. The location of Tertiary sediment overlying the basalt is largely taken from unpublished mapping by Margaret Jenks (written commun., 1998) and Carl Savage (Idaho Geological Survey, unpublished files, 1979).

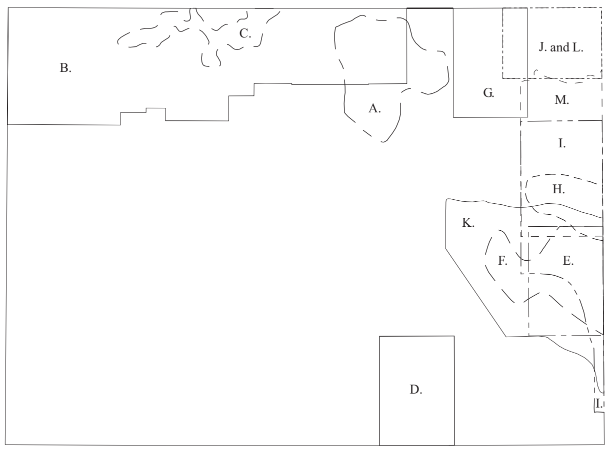
The oldest and most abundant rocks in the St. Maries quadrangle are Precambrian in age. These are low-grade metasedimentary rocks of the Belt Supergroup and high-grade (amphibolite facies) metamorphic rocks whose protolith may have been the Belt Supergroup. The high-grade rocks are exposed in uplifted regions in the northwest and southeast corners of the map area. Included in the uplifted regions is amphibolite as well as deformed granitic rock (orthogneiss) of probable Cretaceous age. Younger intrusive rocks of probable Eocene age include two granodiorite stocks and several rhyolite and dacite dikes. The Onaway basalt of Oligocene age is exposed in the southwest corner of the map area. Flows of Miocene Columbia River basalt are widely exposed in the central and northwestern part of the map area. In many places these flows are covered with sediments, and loess deposits blanket much of the lower elevations in the western part of the area.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.



1. Campbell and Good, 1963
2. Clough, 1981
3. Cunningham, unpublished geologic map
4. Griggs, 1973 (entire map area)
5. Griggs, unpublished geologic maps
6. Hietanen, 1963a
7. Hietanen, 1967 (plate 1)
8. Hietanen, 1967 (plate 2)
9. Hobbs and others, 1965
10. Jenks, unpublished parent material maps
11. Kauffman, 1998 field mapping
12. Lewis and Burmester, 1998 field mapping
13. Savage, unpublished geologic maps
14. Swanson and others, 1979a (entire map area)
15. Breckenridge and Othberg, unpublished geologic map

Figure 1. *Previous mapping used as primary sources of data.*



A. Appelgate, unpublished geologic maps
B. Anderson, 1940
C. Bookstrom and others, 1999
D. Clark, 1963
E. Cockrum, 1986
F. Harrison, unpublished geologic maps
G. Hayden, 1992
H. Holland, 1947
I. Pardee, 1911
J. Ransome and Calkins, 1908
K. Reid and others, 1981
L. Umpleby and Jones, 1923
M. Wagner, 1949

Figure 2. *Previous mapping used as secondary sources of data.*

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qal—Alluvial deposits (Holocene)—Stream deposits in modern drainages. Most deposits are composed of stratified and laterally discontinuous beds of pebbles, cobbles, sand, and silt. Includes reworked loess in the western part of the area near Tensed.

Qls—Landslide deposits (Holocene)—Unconsolidated poorly sorted rubble, typically as boulders of basalt in a finer grained matrix. Includes large blocks of Columbia River Basalt Group near St. Maries interpreted by Griggs (1973) as landslide deposits, but which lack hummocky topography and other obvious landslide features. Few deposits are known with certainty to be landslides, perhaps because they are relatively old features without recent movement.

Qp—Palouse Formation (Pleistocene)—Loess deposits of silt in the western part of the area. Shown only as an overlay pattern without well-defined boundaries. Map distribution taken directly from Griggs (1973), who noted the presence of buried soil horizons, some of which have well-developed clay layers. May include Tertiary sediment (*Ts*) in places or may be only a thin mantle over *Ts* deposits.

Qg—Glacial deposits (Pleistocene)—Unsorted boulders and finer grained unconsolidated material in the valleys of the highest drainages. Possibly outwash.

Ts—Sediment (Oligocene? and Miocene)—Mostly deeply weathered yellow to orange silt and clay, but also quartzite pebbles and cobbles, and sand. Clasts derived primarily from the Belt Supergroup. Near Clarkia, lakebeds of clay and silt contain extremely well-preserved leaf fossils (Smiley and Rember, 1979; Rember, 1991). Locations taken largely from unpublished maps of M.D. Jenks (written commun., 1998) and C.N. Savage (Idaho Geological Survey, unpublished files, 1979). Most deposits overlie flows of the Columbia River Basalt Group or rocks of the Belt Supergroup at elevations well above present stream levels, but several ages of deposits are preserved in the area. Younger (late Miocene? or Pliocene?), more bouldery terrace remnants are present at lower elevations along the major rivers. These remnants are deeply eroded and lack subhorizontal upper surfaces that would be expected if they were Quaternary terraces. Thickness of *Ts* is varied, but a well in the Tensed area passed through 265 feet (81 m) of sediment before intersecting basalt (well 44/4-18N1; Ko and others, 1974). Typical thickness is about 30 feet (10 m).

COLUMBIA RIVER BASALT GROUP

Wanapum Formation

Tpr—Priest Rapids Member (Miocene)—Medium gray to dark gray basalt that typically has a grainy, felty texture caused by abundant small plagioclase and olivine phenocrysts and by microvesicles and diktytaxitic cavities. The denser parts of the flows are dark gray to black and fine grained; they lack the grainy texture, although small plagioclase phenocrysts are apparent. Outcrops weather gray-brown to reddish brown. In thick flows, large, poorly defined basal columns 3-6 m thick change upward to slabby, platy zones that are typically medium bluish gray on fresh surfaces. Above the platy zones, flows commonly have a thick blocky to hackly entablature that is 15 m or more thick, and in places well-developed thin, vertical to radiating columns. The top of the entablature grades into an increasingly vesicular, rubbly in places, flow top. Thin flows are more vesicular throughout and generally have only weakly developed basal columns and a vesicular flow top. Pillow-palagonite complexes are locally common at the base of flows or flow units (series of chemically similar thin flows that grade laterally into a single flow). Hyaloclastic material is also present locally at the top of some units; this material is well exposed on a logging road built in 1998 on the southeast side of Trout Creek, about 4 miles west of Calder.

The Priest Rapids Member typically consists of one or more flows of Rosalia chemical type and has reverse magnetic polarity. A flow of Lolo chemical type is present in the Clarkia area. The Priest Rapids Member is the uppermost unit in the Plummer-St. Maries-St. Joe River area and directly overlies basement rocks in the upper St. Joe River drainage, where it partly fills the prebasalt topography. In the St. Maries area, it overlies the *Ted* unit, and near Harrison it overlies Tgn_2 flows. Thicknesses of individual flow units range from 8 to 25 m for thin units to >180 m for thick, valley-filling sequences in the St. Joe River drainage.

Eckler Mountain Member

Ted—Basalt of Dodge (Miocene)—Medium gray, coarse-grained and highly plagioclase-phyric basalt to dark gray and dense basalt with fewer but still abundant plagioclase phenocrysts. Freshly broken fragments have a coarse, irregular surface texture. Phenocrysts range in size from less than 1 mm to at least 5 mm. The smaller phenocrysts are typically lath shaped, and the larger ones are more equant. Most exposures are of the massive basal columnar part of the unit. The well-formed basal columns are 1-2 m in diameter and in places 7 m or more in length. The unit commonly weathers gray-brown to dark gray. Hyaloclastic material is associated with the Dodge basalt exposed in the railroad tunnel portal north of Benewah Lake campground.

The basalt of Dodge is a valley- and basin-filling unit of normal magnetic polarity exposed around the southern end of Coeur d'Alene Lake and near and south of St. Maries. The Dodge basalt was not found in the basalt section south of Harrison along State Highway 97, although it is present on the west side of the lake south of Browns Bay. A probable Dodge vent is at Cedar Creek campground 3 miles north of Clarkia (Swanson and others, 1979a). The Dodge basalt overlies Tgn_2 basalt and is overlain by Tpr flows. Maximum thickness is approximately 40 m.

Grande Ronde Formation

Tgn_2—Grande Ronde N_2 magnetostratigraphic unit (Miocene)—Dark gray to black, fine-grained aphyric to very sparsely plagioclase-phyric basalt. Locally at least one flow near the top of this unit has a Priest Rapids-like grainy, felty texture. Large columns of the basal colonnade are generally exposed only in quarry cuts. Natural exposures are typically of the thick entablature, consisting of either thin, well-developed and commonly radiating columns, or poorly developed columns with a blocky, hackly character. These entablature exposures are typically cliff-forming masses that can be traced laterally for several miles. Individual flows are usually over 30 m thick and may be more than 60 m thick. Locally, hyaloclastic material is associated with the top of individual flows, especially near contacts with basement rocks. In the Hells Gulch section north of St. Maries, an extensive hyaloclastic unit, with incorporated pods of ropy spatter and other ejecta-like debris, is at least 25 m thick and forms erosional hoodoo pillars at several locations. In other areas, the hyaloclastic material has crude stratification.

Grande Ronde N2 has normal magnetic polarity and is the lowermost basalt unit exposed on most of the St. Maries quadrangle; generally, its base is either not exposed or lies directly on prebasalt basement rocks. However, on the east side of Coeur d'Alene Lake near the north edge of the St. Maries quadrangle, the top of a Tgr_2 flow is exposed along the shoreline beneath the base of Tgn_2. This Tgr_2 flow is also present beneath the Tgn_2 along the west shoreline at Rockford Bay, but is too thin to show at map scale. Tgn_2 is overlain by either *Ted* or *Tpr* flows.

Tgr_2—Grande Ronde R_2 magnetostratigraphic unit (Miocene)—Dark gray to black, fine-grained aphyric to very sparsely plagioclase-phyric basalt similar to Tgn_2. One flow, with reverse magnetic polarity, is the lowermost basalt unit exposed in the map area. Only the vesicular flowtop and upper part of the entablature are exposed along the east shoreline of Coeur d'Alene Lake north of Harrison.

OLDER VOLCANIC ROCKS

Ton—Onaway basalt (Oligocene)—Dark gray, fine-grained porphyritic basalt. Mapped south of the study area by Duncan (1998) who noted a distinctive brown weathering rind in places and plagioclase phenocrysts that average 1 cm in length but may exceed 5 cm. Flows have normal magnetic polarity. Originally thought to be either the upper part of the Wanapum Formation (Camp, 1981) or part of the Saddle Mountains Formation (Bush and others, 1995) of the Columbia River Basalt Group. Recent work by John Bush (oral commun., 1999) indicates that these flows are actually older than the Columbia River Basalt Group. Extruded from local vents and flowed into valleys. May also have flowed over and intruded into sediments (*Ts*). Thickness uncertain but may locally exceed 60 m.

INTRUSIVE ROCKS

Tr—Rhyolite dikes (Eocene)—Light gray, aphanitic to very fine-grained rhyolite with sparse (2-10 percent) phenocrysts of quartz and rare potassium feldspar. Large mass along the St. Joe River east of St. Maries is a composite body containing dikes of sparsely porphyritic rhyolite and subordinate dikes of porphyritic rhyolite (or dacite?) with conspicuous K-feldspar, quartz, and plagioclase phenocrysts.

Td—Dacite dikes (Eocene)—Gray dacite, typically porphyritic, with an aphanitic groundmass. Phenocrysts, where present, include quartz (up to 8 mm in diameter, commonly embayed) as well as plagioclase, biotite, and hornblende. Present east of Fernwood as well as north of the Merton Creek stock.

Tgd—Biotite granodiorite and hornblende-biotite granodiorite (Eocene)—Gray, medium-grained, porphyritic biotite granodiorite of the Merton Creek stock, and hornblende-biotite granodiorite and biotite granodiorite of the Herrick stock (Holland, 1947). Potassium feldspar phenocrysts, 1 to 2 cm in length, compose 5 to 10 percent of the rock in some areas. Contains mafic inclusions and sparse aplite and pegmatite dikes. Weathers to coarse grus. Plagioclase in Merton Creek stock is compositionally zoned (An_{16} to An_{28}); most zoning is oscillatory. The southern margin of the Herrick stock is compositionally diverse and includes intermingled hornblende-rich phases, some of which are well foliated. Foliation there is subhorizontal and may result from igneous flow. Foliation at Mud Cabin Creek near the northern margin is mylonitic. Age unknown, but rock resembles the Roundtop pluton to the southeast that has been dated at 52 ± 7 Ma by U-Pb methods (Marvin and others, 1984).

TKdd—Diabase and diorite dikes (Tertiary or Cretaceous)—Mafic dikes mapped by Hobbs and others (1965) and Campbell and Good (1963) in and near the Coeur d'Alene mining district.

TKla—Lamprophyre dikes (Tertiary or Cretaceous)—Mafic dikes with biotite phenocrysts mapped in and near the Coeur d'Alene mining district by Hobbs and others (1965) and Campbell and Good (1963). Single dike analysis indicates high K_2O content (6.15 percent).

TKgb—Gabbro (Tertiary or Cretaceous)—Black to dark gray, medium- to fine-grained pyroxene gabbro. Typically has red weathering rind and develops red soil. Largest body northeast of Clarkia has squarish outline, perhaps because its emplacement was controlled by orthogonal faults or fractures; smaller intrusions are dike-like elsewhere in the south-central part of the map area. Includes diabase and gabbro dikes of Clark (1963) and Hietanen (1963a), who report plagioclase compositions of An_{47} and An_{53}. Major-element concentrations similar to those of *Tpr*, but trace-element concentrations dissimilar to any known Columbia River basalt.

Kog—Orthogneiss (Cretaceous)—Gray, strongly foliated, moderately lineated hornblende-biotite tonalite, biotite tonalite, granodiorite, and quartz diorite. Exposed on the eastern, upthrown side of the White Rock fault in the southeast quarter of the map area. Orthogneiss is medium grained and contains allotriomorphic granular to recrystallized mosaics of quartz and feldspar between larger biotite flakes. Hornblende typically blocky. Contains euhedral epidote interpreted as a magmatic phase. Rocks mapped as *Kog* are heterogeneous and samples contain a range of SiO_2 from 57 to 74 percent; K_2O varies from 0.75 to 4.25 percent. Some of the compositional variation may have originated as schlieren or mafic inclusions. Contains amphibolite bodies up to 100 m wide with contacts approximately parallel to foliation. Intercalated with muscovite schist. Foliation is overprinted locally by s-c fabric (Simpson and Schmid, 1983) with top-to-the-west sense of shear. Cut by irregular masses of pegmatite that lack flattening fabric, and on Freezeout Ridge, by a north-striking undeformed rhyolitic dike. Includes Marble Creek gneiss bodies of Reid and others (1981) and Cockrum (1986). Age is poorly known but orthogneiss is considered to be Cretaceous based on similarities with approximately 94 Ma deformed phases of the Cretaceous Idaho batholith near Lowell (Toth and Stacey, 1992).

KYam—Amphibolite (Cretaceous or Proterozoic)—Black to dark gray, fine- to medium-grained, foliated to lineated hornblende-plagioclase rock. Mostly garnetiferous, with garnets up to 2 cm in diameter locally; some contain biotite instead of or in addition to hornblende. Present in schist correlated as metamorphosed Prichard Formation (Hietanen, 1967; Cockrum, 1986) and thus may be metamorphosed Proterozoic sills. However, those associated with *Kog* unit and those with pyroxene are probably Cretaceous.

BELT SUPERGROUP

Yl—Libby Formation (Middle Proterozoic)—Light green to dark gray siltite, darker green argillite, dolomitic siltite, and white, very fine-grained quartzite. Rocks low in the unit have mudchips and mudcracked and rippled surfaces in siltite. Quartzite increases upward. Minor dark gray argillite, alone and as carbonate-free caps on reddish weathering ferroan calcitic or dolomitic siltite and quartzite northwest of Emida, possibly in the middle of the unit. Locally, one or more stromatolite horizons occur in this interval. Siltite and white quartzite dominate the upper part to the erosional top. The presence of carbonate led Savage (1973) to assign these rocks to the Wallace Formation. Stratigraphic relations are more consistent with the carbonate being part of the Libby Formation, as mapped by Griggs (1973).

Ysp—Striped Peak Formation, undivided (Middle Proterozoic)—Gray to white to pale red quartzite with lesser amounts of siltite and argillite. Shown where a lack of mapping or poor exposure prevented subdivision. Consists largely of Ysp_1 and Ysp_4 as defined by Harrison and Jobin (1963) near Clark Fork. Thin intervals of carbonate (Ysp_2) and dark gray, thinly laminated argillite (Ysp_3) were noted at a few localities but not mapped as separate units. Includes rocks along Renfro Creek northeast of Santa previously mapped as Striped Peak Formation (Griggs, 1973), but which are more highly deformed and possibly at higher metamorphic grade than Striped Peak rocks to the southwest. An alternative explanation is that these are quartzitic rocks of the Ravalli Group in thrust contact with the Wallace Formation.

Ysp_4—Striped Peak Formation, member four (Middle Proterozoic)—Light gray to red, medium- to fine-grained arkosic quartzite. Beds up to 1 m thick with some intervening siltite and argillite. Fine-grained beds are similar to the Ysp_1 quartzites but have less magnetite, more yellow rusty spots, and more K-feldspar. Characteristic, however, are well-rounded, medium-size (0.3-0.5 mm) quartz grains, either as isolated grains (floaters) in a finer grained matrix or as major constituents of the rock. Ripple cross lamination and rippled surfaces more abundant than cross lamination. Includes plane lamination, some of which has hematite concentrations. Rocks are characteristically but not ubiquitously feldspathic. Visual estimates of twelve etched and stained hand specimens indicate 9 to 23 percent K-feldspar (mean of 17 percent) and 5-15 percent plagioclase (mean of 8 percent). Some K-feldspar appears detrital, but much is present as diagenetic(?) rims on plagioclase. Common yellow-brown spots may result from weathering of ferroan calcite. Equivalent to Ysp_4 near Clark Fork (Harrison and Jobin, 1963) and to the Bonner Quartzite in the Missoula area (Nelson and Dobell, 1961). Thickness uncertain but may be as much as 1,000 m in the southwestern part of the area.

Ysp_{1a}—Striped Peak Formation, argillitic part of member one (Middle Proterozoic)—Purplish red and subordinate green siltite and argillite. Layering typically 1 to 3 cm thick, with some rippled and mudcracked surfaces. Salt casts present in western part of area south of Plummer, but unit not subdivided in that region. Minor carbonate occurs within and at the top of the member in the northeastern part of the area. This uppermost carbonate interval thickens north of the area and is mapped as Ysp_2 by Harrison and Jobin (1963) near Clark Fork. Unit is equivalent to member three of the Mount Shields Formation, described to the northeast (Harrison and others, 1986). Thickness uncertain but probably about 90 to 120 m in the northeastern part of the area and 300 m in the east-central part (north of Calder at Spooky Butte) and in the western part (southwest of Emida at West Dennis).

Ysp_{1q}—Striped Peak Formation, quartzitic part of member one (Middle Proterozoic)—Pale purplish red, fine-grained, flat-laminated quartzite, and subordinate argillite and siltite. Rare ripple cross lamination and even rarer trough cross lamination in 10-to-30-cm-thick beds. Commonly contains macroscopic magnetite octahedra and some mud flakes. Base of unit is placed at lowest quartzite beds. Above them is an interval of very thinly laminated green argillite-siltite similar to that of the Ywu_3 unit below, with color grading upward from dark to light and the reverse. This argillite-siltite gives way upward to the quartzite-dominated part of the unit. Visual estimates of eleven etched and stained hand specimens indicate 12-20 percent plagioclase (mean of 17 percent). Only three of these samples contain K-feldspar (7 percent or less), in contrast to the K-feldspar-rich Ysp_4 quartzite. Equivalent to the lower part of Ysp_1 mapped by Harrison and Jobin (1963) near Clark Fork. Also equivalent to the lower two members of the Mount Shields Formation to the northeast described by Harrison and others (1986). Thickness at Striped Peak, immediately east of the map area, is about 820 feet (250 m; Vance, 1981). Thickens to 300 m at Spooky Butte north of Calder and to more than 450 m at West Dennis southwest of Emida.

Ywu—Wallace Formation, upper member, undivided (Middle Proterozoic)—Predominantly dark gray siltite and argillite, but locally contains unmapped carbonate intervals equivalent to member two. Shown where a lack of mapping or poor exposure prevented subdivision. Includes rocks at Lolo Pass 6 miles northeast of Tensed mapped as *Ywu* by Griggs (1973) but which could alternatively be Ysp_3 of Harrison and Jobin (1963) mapped to the north near Clark Fork. Total thickness at Striped Peak, immediately east of area, is 1,500 feet (460 m; Shenon and McConnel, 1939). Thickens to about 1,200 m in south-central part of area at Baby Grand Mountain southeast of Emida.

Ywu_3—Wallace Formation, upper member three (Middle Proterozoic)—Microlaminated and thinly laminated light green siltite and darker green argillite, green siltite, and black argillite. Subordinate 10 to 20 cm thick, locally carbonate-bearing siltite and very fine-grained quartzite.

Bedding commonly uneven and wavy. Weathers yellowish brown. Thickness about 500 feet (150 m) on north side of Striped Peak just east of area (Shenon and McConnel, 1939). Thickens to the southwest, with approximately 230 m at Spooky Butte north of Calder, 335 m at St. Maries, and 490 m in the area south of Bald Mountain Lookout south of Emida.

Ywu_2—Wallace Formation, upper member two (Middle Proterozoic)—Green dolomitic siltite that weathers orange, green thinly laminated and microlaminated siltite and argillite, and thin lenticular quartzite beds. Contains mudcracks and ripple marks, which are uncommon in the other two members of the upper Wallace Formation. Equivalent to the Shepard Formation present in western Montana (Lemoine and Winston, 1986). Thickness about 500 feet (150 m) on the north side of Striped Peak immediately east of the area (Shenon and McConnel, 1939). Thickens to approximately 335 m at St. Maries, but apparently thins to the southwest where it has not been mapped separately.

Ywu_1—Wallace Formation, upper member one (Middle Proterozoic)—Dark gray to white, thinly laminated siltite and black argillite. Lower and upper parts have uneven, wavy laminations with graded bedding and rare ripple lamination. Middle(?) part is typically parallel laminated without grading. It commonly contains pyrite (or pyrrhotite?) and weathers rusty brown. Scapolite occurs low in the unit, mostly south of the St. Joe River, as 2-5 mm diameter poikiloblastic white ovoids and more rarely as green-brown prisms with square cross sections (Hietanen, 1967; Mora and Valley, 1989). Thickness about 500 feet (150 m) on northeast side of Striped Peak (Shenon and McConnel, 1939) and 450 to 900 m to the southwest.

Ywml—Wallace Formation, middle and lower members, undivided (Middle Proterozoic)—Quartzite and siltite, typically carbonate-bearing, and argillite. Shown where lack of mapping or poor exposure prevented subdivision. Equivalent to the lower Wallace unit of Griggs (1973) and Hobbs and others (1965).

Ywm—Wallace Formation, middle member (Middle Proterozoic)—White quartzite, siltite, and black argillite. Siltite and quartzite commonly contain dolomite and calcite. Characterized by uneven bedding (pinch and swell sediment type of Winston, 1986a) that consists of graded couples or couplets of quartzite or siltite-argillite in which scours and loads of quartzite cut or deform tops of subjacent black argillite. Argillite caps commonly contain ptygmatically folded siltite-filled cracks that taper downward. Carbonate typically confined to coarsest parts of bases; some carbonate-bearing quartzites develop open cross fractures that do not continue into the bounding argillite. White quartzite also occurs as hummocky cross-stratified planar beds 15-30 cm thick. Similarly thick siltite beds with the highest concentration of carbonate in the unit contain calcite ribbons, pods, and molar tooth structures. Rare stromatolites and brecciation are associated with carbonate-rich zones. Argillite in this material is typically gray instead of black and lacks siltite-filled cracks. South of the St. Joe River, scapolite is also commonly spatially associated with these zones. Where contact metamorphosed by the Herrick stock along the St. Joe River in the eastern part of the area, quartzites commonly contain abundant fine-grained epidote, and argillite is converted to hornfels. Equivalent to the middle member of the Wallace Formation as mapped by Harrison and others (1986). Thickness highly uncertain but probably as much as 1200-1500 m.

Ywl—Wallace Formation, lower member (Middle Proterozoic)—Massive green siltite and thinly laminated green siltite-argillite couplets with lesser amounts of carbonate, commonly as pods in siltite. Subdivided only in a few localities northwest of Calder. Equivalent to the lower member of the Wallace Formation as mapped by Harrison and others (1986). Thickness uncertain but probably as much as 250-300 m.

Ysw—Schist and phyllite of the Wallace Formation (Middle Proterozoic)—Gray muscovite and muscovite-biotite phyllite and schist, and fine-grained biotite-feldspar quartzite or granofels. Schistosity at small to large angle to relict bedding. Commonly contains pale lavender to more opaque red garnet and is the source for the Emerald Creek garnet deposits northwest of Clarkia. Is continuous with *Ywu* along the west boundary of the garnet zone, with distinction drawn at the garnet isograd. Toward the south also contains normally small, rarely 1-2 cm long, staurolite porphyroblasts, perhaps confined to certain layers. Also retains 1-2 cm wide, 10-to 30-cm-long muscovite concentrations with square cross sections interpreted as pseudomorphs after andalusite (Hietanen, 1963a). Atypical garnet-poor schist east of Clarkia may be metamorphosed Ywu_3, *Ywl,* or *Ysr*.

Yqw—Quartzite of the Wallace Formation (Middle Proterozoic)—Fine-grained white quartzite, biotite quartzite, granofels, and calc-silicate horizons. Most of unit probably is a metamorphic equivalent of *Ywm*; some in Emerald Creek drainage northwest of Clarkia may be metamorphosed Ywu_2, and that east of Clarkia possibly represents more carbonate-rich parts of *Ywl*. Metamorphic grade increases southward, as indicated by a southward progression from small muscovite porphyroblasts to phlogopite or biotite clots around 1 to 4 mm void spaces, and then to amphibole and rare diopside. Tremolite-actinolite is more common toward the east and hornblende toward the west. Voids are interpreted as former calcite grains. Red-brown weathering, carbonate-rich siltite zones persist at this grade. Scapolite occurs in some of the biotite-rich (black argillite protolith) layers as poikiloblastic white, stubby, irregular prisms and ovoids. At the highest metamorphic grade, stubby, ragged prisms of light green tremolite occur in calc-silicate granofels.

Ysr—St. Regis Formation (Middle Proterozoic)—Pale purple to gray siltite, argillite, and quartzite. Also light green siltite and darker green argillite or dark green siltite-light green argillite couplets. Typically mudcracked 1-cm-thick siltite-argillite couplets, but with thin (2-5 cm) and rarer thick (10-20 cm) fine-grained quartzite beds with green argillite caps, similar to those of the Revett Formation. Thickness uncertain but probably as much as 450 to 600 m.

Ysrv—Schist of the Ravalli Group (Middle Proterozoic)— Muscovite-rich schist, thin quartzite intervals, and minor calc-silicate rocks. Exposed only in the extreme eastern part of map. Unit is probably equivalent to the St. Regis Formation of the Ravalli Group but may include part of the Revett Formation. Tentatively assigned to the Ravalli Group on the basis of stratigraphic position.

Yrb—Revett and Burke Formations, undivided (Middle Proterozoic)—A combined unit utilized by Griggs (1973) where rocks are poorly exposed in isolated hills and ridges. Mostly light gray to greenish gray siltite and white vitreous quartzite.

Yr—Revett Formation (Middle Proterozoic)—Quartzite with siltite and argillite. Characteristically 20-cm to rare 1-m-thick beds of fine-grained to rare medium-grained quartzite. Some vitreous; most feldspathic with orange-brown spots. Much is flat laminated. Rippled tops and cross lamination more common than trough cross lamination. Rare mud clasts 2-10 cm long occur in lower parts of some thicker beds; also rare load casts and convolute bedding. Zones of white-weathering quartzite 10-50 m thick alternate with zones of brown-stained, thinner bedded quartzite and siltite with mud cracked surfaces; thickest beds appear low in the unit. Brown color associated with higher density of brown spots, perhaps the residue from weathering of ferroan calcite. Visual estimates of nine etched and stained hand specimens indicate 5 to 12 percent K-feldspar (mean of 10 percent) and 8-17 percent plagioclase (mean of 12 percent). One sericitized(?) sample from along Big Creek in the northeastern corner of the area lacks feldspar. Some K-feldspar appears detrital, but much is present as diagenetic(?) rims on plagioclase. Thickness ranges from 1,800 feet (550 m) at the junction of Calusa Creek and Pine Creek in the northeast part of the map area (Campbell and Good, 1963) to 3,400 feet (1,035 m) for a nearby(?) section along Pine Creek (Shenon and McConnel, 1939).

Yb—Burke Formation (Middle Proterozoic)—Pale green siltite, typically with macroscopic magnetite octahedra, in 10-20-cm thick beds. Darker green argillite partings. Includes flat-laminated, fine-grained, gray to white quartzite. Total thickness of partial sections in the Twin Crags area is about 3,000 feet (915 m; Campbell and Good, 1963). Clough (1981) reports a thickness of about 2,600 feet (800 m) at a location west of Silver Hill in the northeast part of map area.

Yqrv—Quartzite of the Ravalli Group, undivided (Middle Proterozoic)—Fine- to medium-grained, commonly foliated to lineated micaceous to feldspathic quartzite with muscovitic parting spaced at 2-30 cm intervals. Garnets occur on some parting surfaces. Unit occurs within the southeastern metamorphic complex, but most or all is probably equivalent to the Burke and Revett formations. Mapped where metamorphic grade, deformation, or lack of exposure makes internal division difficult.

Yp—Prichard Formation, undivided (Middle Proterozoic)—Gray, rusty-weathering siltite and minor quartzite. Minor discontinuous carbonate layers. Rare mudcracks. See Griggs (1973) or Cressman (1989) for more detail.

Ypu—Prichard Formation, upper part (Middle Proterozoic)—Map unit of Griggs (1973) described as dark to medium gray, very thinly bedded argillite commonly interlaminated with light gray siltite and also containing some siltite beds. Grades upward into interbedded and interzoned argillite, siltite, and quartzite sequence. Griggs (1973) suggests a range in total thickness of 2,500 to 3,500 feet (760-1,070 m).

Ypl—Prichard Formation, lower part (Middle Proterozoic)—Map unit of Griggs (1973) described as predominantly medium to light gray, thin- and regularly bedded siltite, and laminated in part; some argillite laminae and beds. Some beds or zones of gray to white quartzite have been subdivided locally (*Yqp* unit). Thickness 7,500+ feet (2,290+ m) according to Griggs (1973); base not exposed.

Yqp—Quartzite of the Prichard Formation (Middle Proterozoic)—Nearly white to light gray impure to pure quartzite mapped by Hobbs and others (1965) in the northeast part of the area. Individual quartzite zones may be as much as 50 feet thick and are discontinuous. Contains about 5 percent plagioclase and no K-feldspar on the basis of two etched and stained samples.

BELT SUPERGROUP OR PRE-BELT METAMORPHIC ROCKS

Yq—Quartzite (Middle Proterozoic)—Gray to dark gray, white to brown weathering, medium- to coarse-grained micaceous quartzite. Most is foliated, some highly lineated. Some has lighter (muscovitic) and darker (biotitic) layers 1-2 cm thick. Parting on micaceous layers 1 to 40 cm. Micaceous interlayers contain flattened and elongated garnet in highly lineated and sheared rocks.

Ys—Schist (Middle Proterozoic)—Dark brown, muscovite-quartz, biotite-muscovite-quartz, and muscovite-biotite-feldspar-quartz schist. Includes some biotite quartzite and locally preserves compositional layering that reflects probable siltite-argillite protolith. Schistosity is locally axial planar to folds in compositional layering and is itself commonly folded and crenulated. Farthest southeast exposures are migmatitic and multiply deformed. Rarely contains garnet, but northeast of Grandmother Mountain, east of Clarkia, porphyroblasts are 1-2 cm in diameter and in close association with kyanite(?). Includes schists correlated with Prichard and St. Regis formations (Hietanen, 1967; Cockrum, 1986).

YXs—Schist of the Priest River metamorphic complex (Proterozoic)—Fine-grained garnetiferous schist. Meta-igneous rocks to the north and northwest within this complex have been dated at about 1580 Ma, indicating a pre-Belt age (Evans and Fischer, 1986; Armstrong and others, 1987). However, the unit may include younger overlying Belt rocks (Prichard?) as well. Mapped as Prichard Formation by Griggs (1973).

YXq—Quartzite of the Priest River metamorphic complex (Proterozoic)—Strongly lineated and foliated light gray to white quartzite. Coarsely recrystallized and feldspar-poor (2 percent plagioclase).

STRUCTURE, TECTONICS, AND METAMORPHISM

Relatively low-grade metasedimentary rocks of the Belt Supergroup underlie much of the St. Maries quadrangle (Figures 3 and 4), but high metamorphic grade (amphibolite facies) and highly strained rocks are present in its northwest and southeast corners. Exposure of the high-grade rocks has been attributed to unroofing of two metamorphic core complexes: the Priest River complex in the northwest and the Boehls Butte complex in the southeast (Rehrig and Reynolds, 1981; Seyfert, 1984; Sheriff and others, 1984;

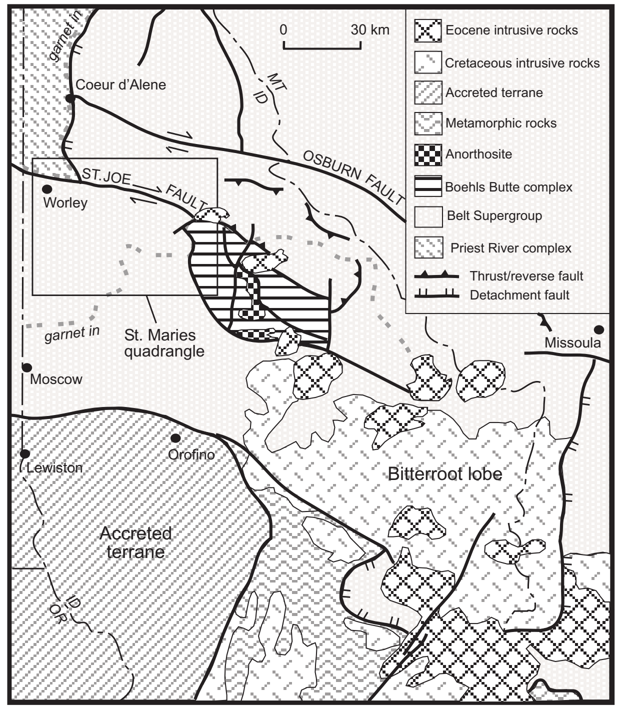


Figure 3. *Regional geologic map of pre-Miocene rocks in northern Idaho and western Montana.*

Rehrig and others, 1987; Doughty and others, 1990, Doughty and Price, 1999). Both complexes have been considerably uplifted relative to the surrounding rocks, but the mechanics of this uplift are not well understood. While the Priest River complex may well represent a metamorphic core complex of the type described in Crittenden and others (1980), the bounding fault for the Boehls Butte complex appears to be steep, and we did not map it as a detachment fault. The central part of the St. Joe fault appears to connect the Priest River and Boehls Butte complexes and may have acted as a transform fault during uplift of the two areas. However, the St. Joe fault may have had an earlier history along its entire length. The following discussion explores the history of the area from oldest events to youngest.

Little is known of the tectonic setting of the area during the Precambrian. Archean basement and younger (1576 Ma) augen gneiss have been recognized north of the area near Sandpoint (Clark, 1973; Evans and Fischer, 1986; Doughty and others, 1998). The Archean basement is overlain by high-grade metasedimentary rocks whose protolith may be the Belt Supergroup. Deposition of the lower and middle parts of the Belt Supergroup occurred from about 1470 to 1440 Ma (Anderson and Davis, 1995; Evans and others, 2000) and was probably controlled at least in part by block faulting. Winston (1986b) recognized significant thickness differences across an east-west line (Jocko line) coincident

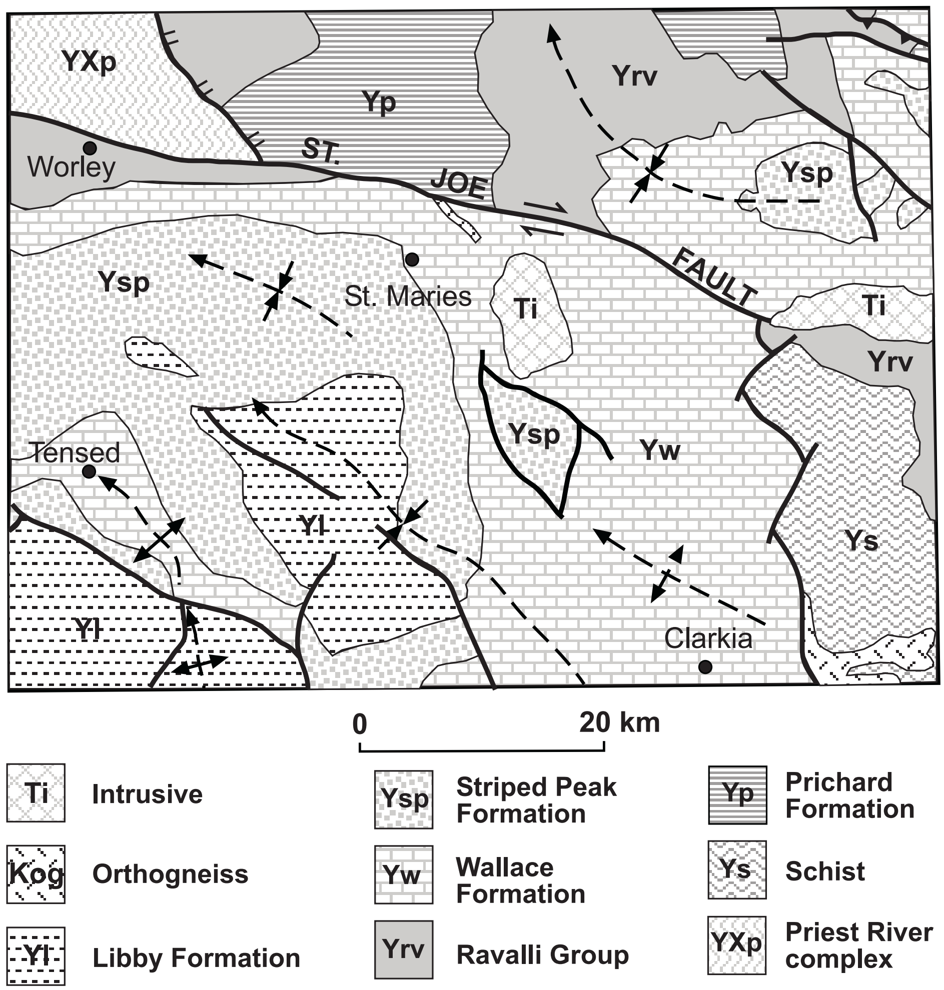


Figure 4. *Simplified geologic map of pre-Miocene rocks in the St. Maries quadrangle.*

with the Osburn fault (Figure 3) and suggested it was a down-to-the-south growth fault during deposition of the Ravalli Group and Wallace Formation. The postulated growth fault may actually be slightly south of the Osburn fault in the western part of the Coeur d'Alene mining district because the section is thin as far south as Striped Peak (center column in Figure 5). The section thickens from Striped Peak south and west across the St. Maries quadrangle. Thickness does not appear to change across the St. Joe fault, but it is difficult to find comparable sections with which to document this. The East Kootenai orogeny at about 1300-1350 Ma affected rocks to the north in Canada (McMechan and Price, 1982) and may have affected rocks in the study area as well. The western part of the Belt basin is thought to have rifted away during the Late Proterozoic, perhaps forming part of eastern Australia (Ross and others, 1992; Doughty and others, 1998).

The first recognized metamorphic-tectonic event appears related to contraction in the Cretaceous. This resulted in development of schistosity (S1), folds, including rarely seen isoclinal folds (F1), and some early (M1) metamorphic mineral assemblages (Hietanen, 1963a ,1963b, 1967; Lang and Rice, 1985a, 1985b; Carey and others, 1992; Grover and others, 1992). Large-scale northwest-trending folds in the less metamorphosed rocks (Figure 4) probably formed during this time. Open folds and poorly developed cleavage with inconsistent attitudes in the southwest part of the area indicate low strain there. Tighter folds with well-developed cleavage that dips steeply southwest in the northeast corner of the map indicate higher northeast-southwest shortening strain there. Contractional faults also formed in the northeast part of the area, and at the present level of exposure all of these faults are relatively steep (i.e., reverse faults). We believe these structures are related to regional thrusting in the Cretaceous and refer to them as thrust faults regardless of dip angle. Significant north-northeast-directed faulting

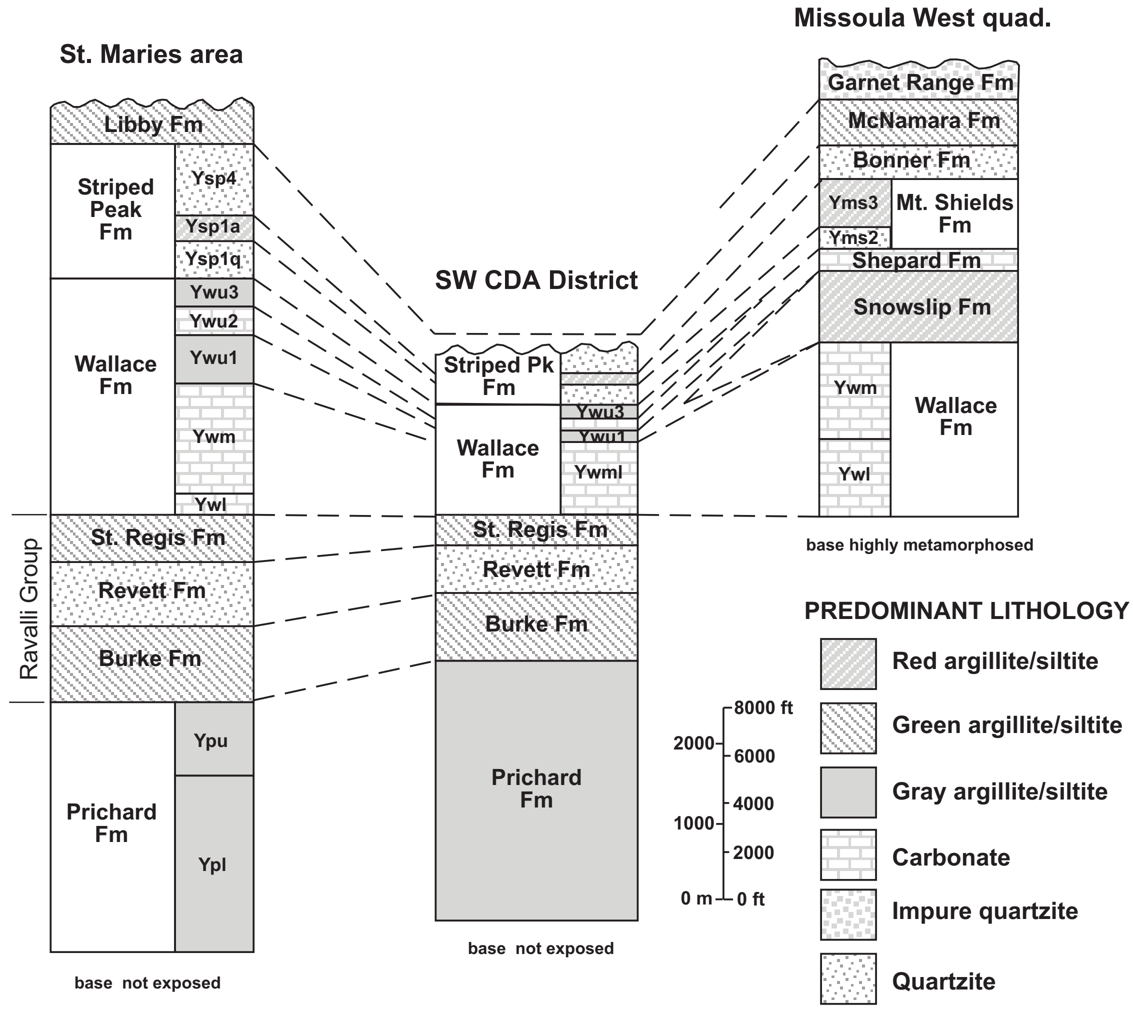


Figure 5. *Belt Supergroup stratigraphic sections for the St. Maries area, the southwest part of the Coeur d'Alene mining district (SW CDA district) and the area west of Missoula, Montana (Missoula West quad.). Thickness estimates for the Coeur d'Alene district are from Hobbs and others (1965), Griggs (1973), and Lewis and others (1999). Those for the Missoula West quadrangle are from Lewis (1998).*

occurred along two of these faults (Big Creek and Striped Peak). Southward-verging small-scale parasitic folds common to the southeast part and an expanse of overturned strata just to the east (Reid and Greenwood, 1968; Reid and others 1981; Lewis and others, 1999) suggest that local southward-directed thrusting accompanied folding. The St. Joe fault may have been active as a south-directed thrust during this time and exposed older rocks on the north side of the fault. Postulated thrusting along a north-striking fault east of Santa is speculative, but helps explain the highly deformed rocks in this area.

A strong, subhorizontal flattening fabric in the southeastern part of the area is especially well developed in the orthogneiss (*Kog*). It is cut by undeformed pegmatite-aplite bodies. If the orthogneiss is correlative with deformed hornblende-bearing tonalite in and around the Idaho batholith and if the crosscutting bodies are correlative with the undeformed main phase of the batholith, then this fabric was produced in the mid-Cretaceous, perhaps 90-72 Ma. The strain reflected in the flattening fabric is most easily attributed to Sevier-Laramide contraction. Alternatively, that fabric and the lineation-dominated fabric in overlying quartzite might result from extension, as Hodges and Walker (1992) suggested for other core complexes of the Cordillera after contractional thickening. Apparent static growth of M2 porphyroblasts (garnet and andalusite) must postdate this. A likely cause of M2 is regional heating by the later stages of the batholith (Lang and Rice, 1985a; Carey and others, 1992; Grover and others, 1992).

After M2, the entire region was affected by extension during the Eocene (Harms and Price, 1992). The Coeur d'Alene-Purcell fault and White Rock fault were active, and they facilitated the uplift of the Priest River complex and the Boehls Butte complex. Movement on these two faults may have been accompanied by dextral motion along the central connecting part of the St. Joe fault. The Purcell-Coeur d'Alene fault on the east side of the Priest River complex is nowhere exposed; however, mineral lineations plunge 15-35°E east in the footwall of the fault along the west shore of Coeur d'Alene Lake, indicating that it may be a low-angle detachment fault as suggested by Rehrig and Reynolds (1981). Alternatively, the Coeur d'Alene-Purcell fault may be a normal fault that cuts an earlier mylonite zone (Doughty and Price, 1999).

How much of the fabric in rocks east of the White Rock fault dates from Eocene deformation is uncertain. Garnets on foliation surfaces of some quartzite are elongated or smeared parallel to the lineation and perpendicular to extension joints. If these garnets are from M2, at least some of the lineation probably dates from the Eocene. These lineated rocks may be mylonites formed during unroofing of a core complex. Structurally lower schist and orthogneiss units in the southeast part of the area also are locally mylonitized. Kinematic sense from s-c relations is top-to-the-west relative motion consistent with the map sense of tectonic unroofing. East of the map area (near Monumental Buttes), top-to-the-east sense of motion marks the eastern side of the overall structure (Lewis and others, 1999).

The contrast in metamorphic grade and lithology varies along the White Rock fault. The most striking contrast in grade is near the north end along Mica Creek, where the weakly metamorphosed upper Wallace Formation is faulted against mica schist and lineated quartzite. There, the garnet isograd is offset approximately 10 miles (16 km) along the White Rock fault (Hietanen, 1967). Although the metamorphic contrast across the White Rock fault decreases to the south, younger rocks (Wallace Formation) continue on the west side of the structure, indicating significant stratigraphic offset. Also exposed along Mica Creek west of mylonitized quartzite is brecciated quartzite, which resembles chlorite breccia found in other metamorphic core complexes in the western U.S. However, similar breccia was not found elsewhere along the fault. Lineations near the fault typically have shallow plunges, but the straight trace of the fault gives the appearance of a relatively steep dip. In this way the White Rock fault is similar to the Coeur d'Alene fault and may be a normal fault that cuts an earlier detachment fault.

The presence of epidote-bearing orthogneiss (*Kog*) east of the White Rock fault, along with mineral compositions indicating pressures up to 11 kb (Grover and others, 1992), attest to the deep crustal levels now exposed at the surface. Uplift of these deep rocks may have been protracted. Postkinematic (M3) minerals include cordierite, corundum, and andalusite that formed at 4 to 6 kb (Grover and others, 1992). They probably formed during, or immediately before, Eocene uplift and unroofing, suggesting about half the uplift could have been in the Late Cretaceous. Early phases of uplift may have included strike-slip motion on the eastern part of the St. Joe fault from Calder east to the Roundtop pluton. There, a band of strongly lineated quartzite (L tectonite) within the *Yqrv* unit has shallow ESE- or WNW-plunging lineation consistent with strike slip parallel to the direction of extension. This band is present along the southern part of the Herrick stock and is interrupted by the Eocene Round Top pluton (east of the map area). The Round Top pluton may fill a trans-tensional gap, but the lack of tectonic fabric in the pluton, except for its southern border, indicates that most strike-slip motion was over before its intrusion. This northern margin of the Boehls Butte uplift appears to expose a more intact stratigraphic section than does the western margin, perhaps because it is oriented parallel to the Eocene extensional direction.

The trace of the St. Joe fault along the northern margin of the Boehls Butte complex was intruded by the Herrick stock. In general the stock is not deformed, but a subhorizontal flow(?) fabric is well developed in some places. Protomylonite was developed locally and is present along the upper part of Mud Cabin Creek. The Herrick stock intrudes the Wallace Formation on the north, perhaps as a sill, and apparently includes some subhorizontal metasedimentary screens as well. Lineated quartzitic metasediment (*Yqrv*) with ESE-plunging lineation is present along the southern margin of the stock. These observations suggest that the stock intruded the WNW-trending boundary (St. Joe fault) that separates the Wallace Formation from more highly deformed Ravalli Group rocks after most of the deformation and juxtaposition. If the stock is Eocene, its composition suggests it is related to the earlier, intermediate phase of Challis magmatism. Juxtaposition of the more deformed rocks to the south with less deformed ones to the north must have predated that and could have been coincident with the formation of the L tectonite farther east. Although there is a contrast in fabric across the fault, stratigraphic offset is not great. Another structure that may have had Eocene motion is the Hoodoo fault, which offsets the garnet isograd in the south-central part of the map area.

Dacite and rhyolite dikes related to the Eocene extensional event intruded NW- to NNW-trending faults both north and south of the St. Joe fault. Their orientation is consistent with right-lateral slip along the fault during WNW-ESE regional extension. Involvement of the rhyolite suggests that faulting persisted during the later phase of Challis magmatism. Associated with these is pervasive iron staining, brecciation, and argillic(?) or sericitic(?) alteration. The age and tectonic significance of NNW-striking mafic dikes in the Clarkia area (unit *TKgb*) are less clear. The orientation and relative freshness of these dikes suggests they may be related to the Columbia River Basalt Group, but the dikes differ chemically from the flows in the area, as discussed in the following section. These mafic dikes may instead be Eocene or Cretaceous in age. Flows of Miocene Columbia River basalt cover parts of many of the faults in the area and do not appear to have been offset. Recent dip-slip fault activity thus appears to have been minimal. Strike-slip motion on structures like the St. Joe fault is more difficult to discount, but no evidence of significant post-Middle Miocene offset has been found.

GEOCHEMISTRY

Over 100 samples from the St. Maries 30' x 60' quadrangle and an additional 13 samples from the Wallace 30' x 60' quadrangle were analyzed for major and trace element concentrations at Washington State University as part of this study. Major elements and selected trace elements were determined for all samples by X-ray fluorescence (XRF) methods. Sixteen samples of metasedimentary rocks were analyzed for additional trace elements, including rare-earth elements, using inductively coupled plasma mass spectroscopy (ICP-MS). Results for igneous intrusive rocks are presented in Table 1; those for metasedimentary rocks are listed in Table 2 (XRF) and Table 3 (ICP-MS), and those for basalts are listed in Table 4. Locations for samples in the St. Maries quadrangle are shown on the map. Latitude and longitude are listed in the tables for all samples, including those outside the map area in the Wallace quadrangle.

Chemical compositions of argillite-siltite from different formations of the Belt Supergroup were found to largely overlap; these results are consistent with those of previous workers (e.g., Harrison and Grimes, 1970; Harrison and Hamilton, 1971). One exception is Sr content. Average Sr concentrations are higher in noncarbonate rocks of the Prichard Formation than those of other formations, a feature previously recognized by Jack Harrison (written commun., 1992). However, Sr is apparently mobilized during metamorphism and can be found in elevated amounts in more schistose rocks. Concentrations of K_2O are highest in the argillite, as expected, but quartzite of the Revett and Striped Peak formations contain significant potassium (1.46-2.01 percent K_2O) given the high SiO_2 contents of these rocks.

Six orthogneiss samples (*Kog*) were found to have a wide compositional range (Table 1). SiO_2 ranges from 57 to 74 percent, and K_2O from 0.75 to 4.25 percent. One sample from Marble Creek (98TF819) with low Al_2O_3, Na_2O_3 , and Sr concentrations was mapped as *Kog*, but in some respects resembles feldspathic quartzite. The unusual chemical composition is perhaps the result of intense deformation and elemental mobilization of an original granitic body. Seven amphibolite samples are more uniform in composition (SiO_2 range of 49-52 percent). The three samples of *Tgd* from the Merton Creek and Herrick stocks are also similar chemically, but the Herrick stock contains more mafic lithologies that were not sampled. A biotite lamprophyre from the dump at the Palisade mine has an elevated K_2O content (6.15 percent), as expected.

All analyses of Columbia River basalt (Table 4) match well with previously published results (Swanson and others, 1979b; Wright and others, 1973, 1979, 1980). Significant differences exist in both major- and trace-element contents of the different units, but variation within a unit is minimal. For example, Tgn_2 flows are higher in CaO and MgO and lower in TiO_2 than Tgr_2 flows, but TiO_2 only ranges from 1.86 to 1.94 percent in six samples of Tgn_2. One important result was from sample BRETC collected on Titley Creek east of Clarkia. This sample of Priest Rapids basalt has Lolo chemical type (Wright and others, 1973; Swanson and others, 1979b) in contrast to the Rosalia chemical type present in the St. Maries, Worley, and Harrison areas. This confirms the Lolo type chemistry of sample 78-122 (Wright and others, 1980) collected at the mouth of Emerald Creek. A map showing the two chemical types of the Priest Rapids in the St. Maries quadrangle could be produced with additional sampling.

Two pyroxene gabbro samples (98RB004 and 98SC001) and one diabase sample (GC) from near Clarkia were sampled to check if they represented intrusive equivalents of the Columbia River Basalt Group. The pyroxene gabbro most resembles Priest Rapids flows with Lolo chemical type (such as sample BRETC), but the gabbro has lower P_2O_5 and Ba concentrations and higher Cu concentrations. Although the diabase dike has major- and trace-element concentrations somewhat similar to the basalt of Dodge (*Ted*), The TiO_2 Ni, Cr, Ba, and Sr concentrations are higher than any known *Ted* flow in the area. It seems unlikely that these gabbro and diabase dikes represent feeders to the Columbia River basalts.

ACKNOWLEDGMENTS

Field assistants Shari Christofferson and Kurt Steffen provided capable and cheerful help. Don Winston provided enthusiastic support for the mapping and shared his extensive knowledge of the Belt Supergroup. We are grateful for the hospitality of the U.S. Forest Service personnel during our stay at the Clarkia Work Center. Don Swanson of the U.S. Geological Survey kindly provided unpublished field maps of the area. Art Bookstrom, Steve Box, Roy Breckenridge, and Kurt Othberg contributed constructive and greatly appreciated technical reviews. Mapping and compilation were completed under contract with the U.S. Geological Survey office in Spokane, Washington. Basalt analyses in the Coeur d'Alene Lake area were obtained in cooperation with a U.S. Geological Survey STATEMAP project. Potlatch Corporation provided partial funding for digitizing the map.

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Appendix

Table 1. XRF analyses of intrusive rocks from the St. Maries 30' x 60' quadrangle. Samples without map numbers are from east of the area in the Wallace quadrangle.

Map no.	**1**	**2**	**3**	**4**		**5**	**6**	**6**
Sample no.	98TF812	98TF814	98TF816	98TF833	98TF848	98TF819	98TF811	98TF811R
Mineralogy	biotite-	biotite	garnet-biotite	biotite	epidote	biotite-quartz		
Lithology	tonalite	orthogneiss	orthogneiss	orthogneiss	orthogneiss	orthogneiss	amphibolite	duplicate
Form	sill	sill	sill	sill	sill	sill	sill	
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	Wallace	St. Maries	St. Maries	
7.5' quad.	Marble Mtn.	Marble Mtn.	Marble Mtn.	Marble Mtn.	Widow Mtn.	Marble Mtn.	Marble Mtn.	
Unit	Kog	Kog	Kog	Kog	Kog	Kog?	KYam	KYam
Lat.	47.12923	47.13051	47.17811	47.17492	47.04467	47.20778	47.12444	
Long.	-116.09709	-116.08063	-116.09517	-116.09868	-115.94944	-116.04411	-116.09583	
				Unnormalized results (weight %)				
SiO_2	56.79	73.96	67.36	72.44	67.40	73.24	52.04	51.50
Al_2O_3	20.17	14.60	15.63	14.26	15.59	12.37	14.42	14.18
TiO_2	0.666	0.135	0.612	0.300	0.454	0.377	0.762	0.756
FeO*	6.12	1.13	3.73	1.89	3.84	3.61	9.76	10.00
MnO	0.093	0.016	0.062	0.025	0.061	0.116	0.155	0.154
CaO	6.62	2.74	2.63	1.87	3.43	2.23	11.27	11.14
MgO	3.01	0.71	1.50	0.68	2.09	2.28	7.70	7.51
K_2O	1.85	0.75	2.85	4.25	2.91	2.09	0.53	0.53
Na_2O	4.45	5.00	4.53	3.31	3.45	2.80	2.32	2.30
P_2O_5	0.253	0.005	0.191	0.079	0.138	0.092	0.050	0.051
LOI	0.47	0.36	0.64	0.72	1.18	1.28	0.83	0.83
Total	100.49	99.41	99.73	99.83	100.54	100.49	99.84	98.95
				Normalized results (weight %)				
SiO_2	56.78	74.67	67.98	73.09	67.83	73.83	52.56	52.49
Al_2O_3	20.17	14.74	15.77	14.39	15.69	12.47	14.56	14.45
TiO_2	0.666	0.136	0.618	0.303	0.457	0.380	0.770	0.771
FeO*	6.11	1.14	3.76	1.91	3.86	3.64	9.86	10.19
MnO	0.093	0.016	0.063	0.025	0.061	0.117	0.157	0.157
CaO	6.62	2.77	2.65	1.89	3.45	2.25	11.38	11.35
MgO	3.01	0.72	1.51	0.69	2.10	2.30	7.78	7.65
K_2O	1.85	0.76	2.88	4.29	2.93	2.11	0.54	0.54
Na_2O	4.45	5.05	4.57	3.34	3.47	2.82	2.34	2.34
P_2O_5	0.253	0.005	0.193	0.080	0.139	0.093	0.051	0.052
				Trace elements (ppm)				
Ni	7	6	11	7	15	19	77	75
Cr	6	2	16	10	40	40	152	146
Sc	11	6	7	7	13	6	48	43
V	87	26	43	27	65	45	296	288
Ba	1282	289	909	1350	976	379	112	104
Rb	31	18	53	67	86	87	14	13
Sr	1112	264	329	303	509	123	177	179
Zr	83	169	279	130	165	196	81	77
Y	12	13	15	8	16	11	19	18
Nb	6.4	4.1	18.1	10.0	8.5	10.1	5.5	5.0
Ga	20	13	19	17	18	16	17	16
Cu	19	0	4	0	3	2	10	12
Zn	73	10	54	31	50	33	76	75
Pb	12	12	9	16	18	7	8	4
La	24	52	55	22	38	24	5	12
Ce	45	63	91	47	62	44	29	18
Th	6	16	0	7	3	21	0	0

Major elements normalized on a volatile-free basis; FeO is total Fe expressed as FeO; LOI is loss on ignition.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 1. XRF analyses of intrusive rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**6**	**7**	**8**		**9**	**10**	**11**	**12**
Sample no.	98TF811AV	98TF827	98TF838	98TF849	98RL004	98RL069	98RL075	98TF840
Mineralogy				garnet		biotite	biotite	hornblende-
Lithology	average	amphibolite	basalt	amphibolite	granodiorite	granodiorite	granodiorite	granodiorite
Form		sill	sill	sill	stock	stock	stock	stock
30' x 60' quad.		St. Maries	St. Maries	Wallace	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.		Grandmother	Marble Mtn.	Widow Mtn.	Marble Cr.	Santa	St. Joe Baldy	Marble Cr.
Unit	KYam	KYam		KYam	Tgd	Tgd	Tgd	Tgd
Lat.		47.09400	47.23742	47.04167	47.29295	47.23580	47.31841	47.25783
Long.		-116.11214	-116.02164	-115.94111	-116.08594	-116.42222	-116.44815	-116.05060
				Unnormalized results (weight %)				
SiO_2	51.77	49.52	49.75	49.95	69.55	69.62	69.05	70.23
Al_2O_3	14.30	12.32	12.61	12.93	16.06	15.53	15.83	15.29
TiO_2	0.759	3.214	2.790	1.764	0.325	0.260	0.300	0.272
FeO*	9.88	16.47	15.32	12.82	2.31	2.08	2.33	1.92
MnO	0.155	0.257	0.253	0.224	0.052	0.035	0.036	0.021
CaO	11.21	9.67	9.05	10.75	2.75	2.09	2.45	2.65
MgO	7.61	5.06	5.21	6.59	0.90	0.71	0.97	0.77
K_2O	0.53	0.39	0.91	0.54	3.11	4.06	3.58	3.43
Na_2O	2.31	0.94	1.90	1.97	4.26	4.09	4.22	4.15
P_2O_5	0.051	0.309	0.307	0.156	0.133	0.104	0.126	0.119
LOI	0.83	1.03	--	0.61	1.08	0.35	0.44	2.26
Total	99.40	99.18	98.10	98.31	100.53	98.93	99.33	101.12
				Normalized results (weight %)				
SiO_2	52.53	50.45	50.72	51.13	69.93	70.62	69.83	71.04
Al_2O_3	14.51	12.55	12.85	13.24	16.15	15.75	16.01	15.47
TiO_2	0.770	3.275	2.844	1.806	0.327	0.264	0.303	0.275
FeO*	10.02	†16.78	†15.61	13.12	2.33	2.11	2.35	1.94
MnO	0.157	†0.26	†0.26	0.229	0.052	0.036	0.036	0.021
CaO	11.37	9.85	9.23	11.00	2.77	2.12	2.48	2.68
MgO	7.72	5.16	5.31	6.75	0.90	0.72	0.98	0.78
K_2O	0.54	0.40	0.93	0.55	3.13	4.12	3.62	3.47
Na_2O	2.34	0.96	1.94	2.02	4.28	4.15	4.27	4.20
P_2O_5	0.051	0.315	0.313	0.160	0.134	0.106	0.127	0.120
				Trace elements (ppm)				
Ni	76	42	124	61	5	1	3	3
Cr	149	69	67	95	4	2	5	2
Sc	46	50	41	45	5	2	0	1
V	292	453	396	373	28	20	21	20
Ba	108	13	299	77	1200	1376	1059	1868
Rb	14	4	33	16	55	68	81	46
Sr	178	90	210	177	526	423	467	491
Zr	79	216	209	123	129	128	117	141
Y	19	46	44	27	10	9	11	7
Nb	5	23.0	22.3	12.1	12.9	11.4	12.9	8.9
Ga	17	21	24	19	18	16	17	13
Cu	11	162	†3094	58	0	0	0	4
Zn	76	135	210	96	36	23	17	7
Pb	6	9	2	6	19	23	20	12
La	9	10	20	2	38	33	26	117
Ce	24	49	63	17	54	42	28	180
Th	0	2	2	0	4	4	3	9

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO; LOI is loss on ignition.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 1. XRF analyses of intrusive rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**13**	**14**	**15**	**16**	**17**	
Sample no.	98RB004	98SC001	BREGC	98RL027	98RL011	98TF846
Mineralogy				biotite		biotite
Lithology	gabbro	gabbro	diabase	lamprophyre	rhyolite	anorthosite
Form	dike	dike	dike	dike	dike	pluton
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	Wallace
7.5' quad.	Clarkia	Clarkia	Merry Cr.	Twin Crags	St. Maries	Widow Mtn.
Unit	TKgb	TKgb	TKdd	TKl	Tr	Yan
Lat.	47.06888	47.08994	47.00479	47.43469	47.34009	47.04425
Long.	-116.26354	-116.30810	-116.16879	-116.35141	-116.50733	-115.92067
			Unnormalized results (weight %)			
SiO_2	49.60	48.84	51.48	52.21	75.50	53.04
Al_2O_3	12.67	12.27	15.58	14.43	14.25	26.37
TiO_2	3.373	3.317	2.177	1.308	0.008	0.205
FeO*	15.04	15.63	8.11	6.81	0.72	2.47
MnO	0.225	0.222	0.128	0.110	0.091	0.043
CaO	9.50	9.36	7.18	7.36	0.64	11.22
MgO	5.16	4.82	7.80	6.49	0.14	1.31
K_2O	0.81	1.31	1.54	6.15	3.83	0.25
Na_2O	2.29	2.10	3.57	2.17	4.41	4.71
P_2O_5	0.239	0.328	0.412	1.184	0.046	0.027
LOI	-0.72	0.10	--	5.42	1.26	1.98
Total	98.18	98.29	97.98	103.65	100.89	101.63
			Normalized results (weight %)			
SiO_2	50.15	49.74	52.54	53.15	75.78	53.23
Al_2O_3	12.81	12.50	15.90	14.69	14.30	†26.46
TiO_2	†3.41	†3.38	2.222	1.332	0.008	0.206
FeO*	†15.20	†15.92	8.28	6.94	0.72	2.48
MnO	0.227	0.226	0.131	0.112	0.091	0.043
CaO	9.61	9.53	7.33	7.49	0.64	11.26
MgO	5.22	4.91	7.96	6.61	0.14	1.31
K_2O	0.82	1.33	1.57	6.26	3.84	0.25
Na_2O	2.32	2.14	3.64	2.21	4.43	4.73
P_2O_5	0.242	0.334	0.421	†1.21	0.046	0.027
			Trace elements (ppm)			
Ni	49	46	192	150	5	11
Cr	74	68	285	217	1	18
Sc	35	47	19	17	1	4
V	470	433	223	152	0	45
Ba	74	119	733	†2433	125	105
Rb	28	74	41	226	166	5
Sr	195	191	587	1083	30	458
Zr	195	242	210	322	58	18
Y	38	48	24	22	30	3
Nb	20.0	24.9	21.8	18.2	43.9	2.4
Ga	20	20	21	20	21	21
Cu	†262	†329	71	38	0	0
Zn	127	101	82	88	14	23
Pb	5	4	4	13	3	2
La	17	0	22	32	20	0
Ce	41	48	62	87	26	22
Th	2	0	5	7	5	2

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO; LOI is loss on ignition.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries 30' x 60' quadrangle. Samples without map numbers are from east of the area in the Wallace quadrangle.

Map no.	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Sample no.	98RL014	98RL013	98RL015	98RL112	98RL032	98RL036	98RL037	98RB003
Mineralogy						carbonate		mica
Lithology	siltite-argillite	siltite-argillite	siltite-argillite	siltite-argillite	siltite-argillite	siltite	siltite-argillite	schist
Color	gray	gray	green	gray	gray		green/black	
30' x 60' quad.	St.Maries	St.Maries	St.Maries	St.Maries	St.Maries	St.Maries	St.Maries	St.Maries
7.5' quad.	Medimont	Medimont	Medimont	Black Lake	Masonia	Masonia	Masonia	Grandmother
Unit	Ypl	Ypu	Ypu	Ypu	Yp	Yp	Yp	Ys
Lat.	47.45618	47.41666	47.42882	47.45053	47.45329	47.48394	47.49016	47.07055
Long.	-116.60015	-116.60535	-116.62633	-116.71876	-116.18176	-116.23103	-116.23781	-116.07120
				Unnormalized results (weight %)				
SiO_2	67.80	71.38	62.03	67.25	64.10	73.60	70.30	70.30
Al_2O_3	19.19	15.29	21.85	18.95	20.44	13.01	16.29	17.06
TiO_2	0.839	0.649	0.816	0.710	0.695	0.506	0.622	0.628
FeO*	2.81	3.48	4.88	3.23	4.28	2.40	3.45	3.13
MnO	0.032	0.044	0.048	0.038	0.016	0.073	0.044	0.040
CaO	0.14	0.28	0.22	0.06	0.00	1.29	0.13	0.23
MgO	0.83	1.58	0.96	1.19	1.66	1.25	1.26	0.94
K_2O	4.75	4.14	4.93	4.87	4.92	3.24	3.76	4.59
Na_2O	1.94	1.59	1.86	1.32	1.60	2.20	2.19	1.06
P_2O_5	0.021	0.066	0.076	0.028	0.034	0.097	0.052	0.028
Total	98.35	98.50	97.67	97.65	97.75	97.66	98.10	98.01
				Normalized results (weight %)				
SiO_2	68.93	72.47	63.51	68.87	65.58	75.36	71.66	71.73
Al_2O_3	19.51	15.52	†22.37	19.41	20.91	13.32	16.61	17.41
TiO_2	0.853	0.659	0.835	0.727	0.711	0.518	0.634	0.641
FeO*	2.86	3.53	5.00	3.31	4.38	2.45	3.52	3.20
MnO	0.033	0.045	0.049	0.039	0.016	0.075	0.045	0.041
CaO	0.14	0.28	0.23	0.06	0.00	1.32	0.13	0.23
MgO	0.84	1.60	0.98	1.22	1.70	1.28	1.28	0.96
K_2O	4.83	4.20	5.05	4.99	5.03	3.32	3.83	4.68
Na_2O	1.97	1.61	1.90	1.35	1.64	2.25	2.23	1.08
P_2O_5	0.021	0.067	0.078	0.029	0.035	0.099	0.053	0.029
				Trace elements (ppm)				
Ni	2	5	13	6	5	9	15	7
Cr	60	49	73	55	63	32	48	59
Sc	13	13	23	18	17	14	10	13
V	96	66	91	78	106	40	52	57
Ba	996	907	974	584	659	735	726	894
Rb	193	184	204	202	239	144	169	210
Sr	114	94	113	44	48	157	80	59
Zr	224	236	212	210	194	273	283	244
Y	28	55	43	42	46	38	43	37
Nb	19.9	16.1	17.4	17.9	15.4	12.4	14.5	20.8
Ga	25	21	29	24	30	16	19	22
Cu	5	4	40	10	7	7	5	3
Zn	64	55	98	65	55	47	63	60
Pb	16	20	19	12	52	9	12	18
La	41	64	49	52	50	36	49	48
Ce	58	102	83	103	103	66	104	102
Th	18	8	21	20	24	4	13	11

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**26**	**27**		**28**	**29**	**30**	**31**	**32**
Sample no.	98RL018	98RL067	98RL094	98TF817	98TF828	98TF831	98TF836	98TF837
Mineralogy	muscovite	muscovite	garnet-biotite	mica	garnet-mica	muscovite	muscovite	quartz-mica
Lithology	schist	schist	schist	schist	schist	schist	schist	schist
Color								
30' x 60' quad.	St. Maries	St. Maries	Wallace	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	Huckleberry	Merry Cr.	Widow Mtn.	Marble Mtn.	Grandmother	Marble Mtn.	Marble Mtn.	Marble Mtn.
Unit	Ys	Ys	Ys	Ys	Ys	Ys	Ys	Ys
Lat.	47.22409	47.06877	47.07389	47.20914	47.11517	47.14867	47.21511	47.21944
Long.	-116.19808	-116.13683	-115.92389	-116.05003	-116.09253	-116.08486	-116.03814	-116.03486
	Unnormalized results (weight %)							
SiO_2	71.32	71.08	56.15	66.60	79.78	68.35	71.97	77.30
Al_2O_3	16.10	16.35	13.93	18.93	10.42	16.99	13.91	10.45
TiO_2	0.644	0.609	1.170	0.722	0.309	0.663	0.530	0.381
FeO*	2.69	3.71	11.56	3.93	2.53	4.49	3.68	3.09
MnO	0.027	0.042	0.092	0.038	0.029	0.052	0.166	0.054
CaO	0.37	0.47	0.55	0.21	0.45	0.58	2.21	1.84
MgO	0.92	1.27	8.53	1.15	1.41	1.25	1.51	2.01
K_2O	4.02	3.93	5.32	5.37	2.51	4.67	1.52	2.05
Na_2O	2.09	1.64	0.75	1.00	1.65	1.75	3.45	1.68
P_2O_5	0.034	0.047	0.273	0.033	0.056	0.035	0.081	0.143
Total	98.22	99.15	98.32	97.99	99.15	98.83	99.03	98.99
	Normalized results (weight %)							
SiO_2	72.62	71.69	57.11	67.97	80.47	69.16	72.67	78.09
Al_2O_3	16.39	16.49	14.17	19.32	10.51	17.19	14.05	10.56
TiO_2	0.656	0.614	1.190	0.737	0.312	0.671	0.535	0.385
FeO*	2.74	3.74	11.76	4.01	2.55	4.54	3.72	3.12
MnO	0.027	0.042	0.094	0.039	0.029	0.053	0.168	0.055
CaO	0.38	0.47	0.56	0.21	0.45	0.59	2.23	1.86
MgO	0.94	1.28	8.68	1.17	1.42	1.26	1.52	2.03
K_2O	4.09	3.96	5.41	5.48	2.53	4.73	1.53	2.07
Na_2O	2.13	1.65	0.76	1.02	1.66	1.77	3.48	1.70
P_2O_5	0.035	0.047	0.278	0.034	0.056	0.035	0.082	0.144
	Trace elements (ppm)							
Ni	4	8	56	6	8	5	12	19
Cr	47	45	45	54	18	52	40	34
Sc	17	13	26	22	11	14	15	9
V	71	66	172	77	23	80	53	26
Ba	796	813	975	1256	710	819	245	375
Rb	165	170	140	218	58	173	102	90
Sr	131	130	23	65	81	121	184	106
Zr	228	228	167	235	376	196	236	143
Y	35	40	20	47	25	31	35	17
Nb	15.1	15.8	23.6	18.8	10.9	16.4	16.1	11.4
Ga	21	21	25	28	11	21	15	12
Cu	17	22	48	16	7	13	16	3
Zn	41	61	144	70	90	84	66	53
Pb	21	40	3	15	35	16	30	21
La	42	56	31	58	31	42	41	13
Ce	94	75	52	78	57	84	75	42
Th	12	12	14	20	12	16	6	0

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.		**33**	**33**	**33**	**34**	**35**	**36**	**37**
Sample no.	98TF845	98TF851	98TF851R	98TF851AV	98RL023	98RL030	98RL031	98RL114
Mineralogy	garnet-mica	garnet-mica			magnetite			
Lithology	schist	schist	duplicate	average	siltite	siltite	argillite	siltite
Color					light green	light green	green	greenish gray
30' x 60' quad.	Wallace	St. Maries			St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	Widow Mtn.	Grandmother			Rochat Peak	Masonia	Masonia	Black Lake
Unit	Ys	Ys	Ys	Ys	Yb	Yb	Yb	Yb
Lat.	47.03908	47.01337			47.42972	47.45035	47.44506	47.47922
Long.	-115.91286	-116.07137			-116.44607	-116.24706	-116.17514	-116.71767
				Unnormalized results (weight %)				
SiO_2	62.02	66.34	66.30	66.32	69.63	70.80	67.29	69.93
Al_2O_3	23.49	17.15	17.30	17.23	16.05	16.35	20.01	15.34
TiO_2	0.809	0.722	0.729	0.726	0.567	0.647	0.857	0.621
FeO*	6.02	5.00	4.87	4.94	3.24	3.32	1.79	4.73
MnO	0.017	0.028	0.027	0.028	0.027	0.003	0.002	0.028
CaO	1.07	0.62	0.62	0.62	0.16	0.03	0.07	0.24
MgO	1.23	2.08	2.12	2.10	1.60	0.66	0.66	1.58
K_2O	3.02	5.09	5.10	5.10	5.06	5.59	6.98	5.07
Na_2O	1.27	1.40	1.41	1.41	1.65	0.88	0.09	1.47
P_2O_5	0.123	0.122	0.121	0.122	0.046	0.025	0.080	0.091
Total	99.07	98.55	98.60	98.58	98.03	98.30	97.83	99.10
				Normalized results (weight %)				
SiO_2	62.61	67.32	67.24	67.28	71.03	72.02	68.78	70.57
Al_2O_3	†23.71	17.40	17.55	17.47	16.37	16.63	20.45	15.48
TiO_2	0.817	0.733	0.739	0.736	0.578	0.658	0.876	0.627
FeO*	6.07	5.07	4.94	5.01	3.30	3.37	1.83	4.77
MnO	0.017	0.028	0.027	0.028	0.028	0.003	0.002	0.028
CaO	1.08	0.63	0.63	0.63	0.16	0.03	0.07	0.24
MgO	1.24	2.11	2.15	2.13	1.63	0.67	0.67	1.59
K_2O	3.05	5.16	5.17	5.17	5.16	5.69	†7.13	5.12
Na_2O	1.28	1.42	1.43	1.43	1.68	0.90	0.09	1.48
P_2O_5	0.124	0.124	0.123	0.123	0.047	0.025	0.082	0.092
				Trace elements (ppm)				
Ni	45	36	37	37	19	16	11	18
Cr	121	123	125	124	38	39	50	46
Sc	18	19	16	18	19	8	18	18
V	142	96	106	101	61	63	72	63
Ba	363	1102	1118	1110	678	632	1270	781
Rb	125	167	165	166	215	256	264	222
Sr	67	125	124	125	49	25	9	49
Zr	142	332	340	336	195	288	360	211
Y	31	12	13	13	58	35	64	32
Nb	19.0	15.2	15.6	15.4	14.6	15.4	20.0	15.3
Ga	31	25	23	24	19	20	25	22
Cu	25	8	9	9	0	0	0	3
Zn	78	242	244	243	66	14	16	56
Pb	12	52	52	52	10	2	0	6
La	43	38	26	32	60	52	68	33
Ce	105	52	57	55	74	92	116	76
Th	15	10	15	13	15	24	17	9

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**38**	**38**	**38**	**39**	**40**	**41**	**42**	**43**
Sample no.	98RL115	98RL115R	98RL115AV	98RL024	98RL028	98RL038	98RL047	98RL048
Mineralogy								
Lithology	siltite	duplicate	average	quartzite	siltite-argillite	siltite	siltite-argillite	argillite
Color	light green				purple	purplish gray	purple	waxy green
30' x 60' quad.	St. Maries			St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	Black Lake			Rochat Peak	Twin Crags	Polaris Peak	Polaris Peak	Polaris Peak
Unit	Yb	Yb	Yb	Yr	Ysr	Ysr	Ysr	Ysr
Lat.	47.49377			47.44074	47.42722	47.48028	47.49187	47.49039
Long.	-116.72379			-116.38177	-116.36131	-116.04015	-116.06736	-116.06671
				Unnormalized results (weight %)				
SiO_2	75.00	74.49	74.75	94.98	70.63	75.52	70.88	73.00
Al_2O_3	13.66	13.53	13.60	2.89	16.07	14.03	16.35	17.08
TiO_2	0.478	0.478	0.478	0.046	0.620	0.543	0.635	0.591
FeO*	2.65	2.77	2.71	0.20	3.54	2.83	4.13	1.00
MnO	0.023	0.023	0.023	0.000	0.001	0.004	0.009	0.002
CaO	0.08	0.09	0.09	0.00	0.08	0.00	0.09	0.15
MgO	1.37	1.33	1.35	0.00	0.74	0.35	0.69	0.92
K_2O	4.42	4.41	4.42	1.56	5.46	5.07	5.63	5.69
Na_2O	1.53	1.51	1.52	0.00	1.05	0.12	0.08	0.13
P_2O_5	0.012	0.015	0.014	0.008	0.085	0.051	0.108	0.129
Total	99.22	98.64	98.93	99.68	98.28	98.52	98.60	98.70
				Normalized results (weight %)				
SiO_2	75.59	75.52	75.55	95.28	71.87	76.66	71.88	73.96
Al_2O_3	13.77	13.72	13.74	2.90	16.35	14.24	16.58	17.31
TiO_2	0.482	0.485	0.483	0.046	0.631	0.551	0.644	0.599
FeO*	2.67	2.80	2.74	0.20	3.61	2.87	4.19	1.02
MnO	0.023	0.023	0.023	0.000	0.001	0.004	0.009	0.002
CaO	0.08	0.09	0.09	0.00	0.08	0.00	0.09	0.15
MgO	1.38	1.35	1.36	0.00	0.75	0.36	0.70	0.93
K_2O	4.45	4.47	4.46	1.56	5.56	5.15	5.71	5.77
Na_2O	1.54	1.53	1.54	0.00	1.07	0.12	0.08	0.13
P_2O_5	0.012	0.015	0.014	0.008	0.086	0.052	0.110	0.131
				Trace elements (ppm)				
Ni	13	15	14	2	16	13	25	9
Cr	23	24	24	3	45	36	42	52
Sc	6	13	10	2	10	10	12	13
V	41	38	40	6	57	46	65	72
Ba	697	705	701	234	871	761	802	794
Rb	197	195	196	51	239	225	267	257
Sr	53	54	54	6	23	12	8	7
Zr	252	254	253	45	247	257	258	178
Y	36	38	37	8	36	43	49	34
Nb	16.0	16.0	16.0	3.8	14.9	13.8	16.0	15.6
Ga	17	17	17	2	22	18	22	22
Cu	0	0	0	4	2	3	2	2
Zn	31	30	31	0	40	5	18	24
Pb	4	5	5	7	4	3	4	2
La	17	14	16	6	83	89	104	55
Ce	59	35	47	21	170	153	162	109
Th	14	16	15	6	20	13	12	17

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.						**44**	**45**	**46**
Sample no.	98RL137	98RL092	98RL096	98RL100	98RL136	98RL050	98RL051	98RL070
Mineralogy	muscovite-	mica			muscovite-	dolomitic		
Lithology	schist	schist	phyllite	siltite-argillite	schist	siltite	siltite-argillite	siltite
Color			gray	gray		green	black	brown
30' x 60' quad.	Wallace	Wallace	Wallace	Wallace	Wallace	St. Maries	St. Maries	St. Maries
7.5' quad.	Fishhook Cr.	Widow Mtn.	Hoyt Mtn.	Hoyt Mtn.	Fishhook Cr.	Polaris Peak	Polaris Peak	St. Joe
Unit	Ysr	Yqrv	Ysrv	Ysrv	Ysrv	Ywl	Ywm	Ywml
Lat.	47.17528	47.06028	47.12972	47.24194	47.15500	47.43765	47.46697	47.26458
Long.	-115.84778	-115.94444	-115.98028	-115.9675	-115.85889	-116.07230	-116.06266	-116.34740
				Unnormalized results (weight %)				
SiO_2	67.45	69.92	71.33	67.81	64.99	63.45	70.22	71.19
Al_2O_3	17.86	15.21	14.08	15.74	17.95	14.33	13.18	14.23
TiO_2	0.665	0.631	0.565	0.498	0.672	0.555	0.562	0.335
FeO*	4.92	4.16	4.33	4.13	5.86	4.18	2.86	2.71
MnO	0.053	0.215	0.039	0.032	0.068	0.037	0.032	0.014
CaO	0.16	1.15	1.46	0.46	0.75	3.03	2.42	0.66
MgO	1.56	2.14	1.62	3.79	2.16	6.05	3.13	2.87
K_2O	4.91	4.00	2.58	5.56	4.22	3.48	3.79	5.73
Na_2O	0.85	1.29	3.50	0.40	2.00	1.29	1.42	1.42
P_2O_5	0.064	0.069	0.054	0.073	0.085	0.120	0.056	0.050
Total	98.49	98.78	99.56	98.49	98.76	96.52	97.67	99.21
				Normalized results (weight %)				
SiO_2	68.48	70.78	71.65	68.85	65.81	65.74	71.89	71.76
Al_2O_3	18.13	15.40	14.14	15.98	18.18	14.85	13.49	14.34
TiO_2	0.675	0.639	0.568	0.506	0.680	0.575	0.575	0.338
FeO*	5.00	4.21	4.35	4.19	5.93	4.33	2.93	2.73
MnO	0.054	0.218	0.039	0.032	0.069	0.038	0.033	0.014
CaO	0.16	1.16	1.47	0.47	0.76	3.14	2.48	0.67
MgO	1.58	2.17	1.63	3.85	2.19	6.27	3.20	2.89
K_2O	4.99	4.05	2.59	5.65	4.27	3.61	3.88	5.78
Na_2O	0.86	1.31	3.52	0.41	2.03	1.34	1.45	1.43
P_2O_5	0.065	0.070	0.054	0.074	0.086	0.124	0.057	0.050
				Trace elements (ppm)				
Ni	11	18	15	14	19	15	15	6
Cr	57	48	40	38	60	48	41	11
Sc	17	9	16	20	16	16	10	8
V	77	62	55	62	91	63	61	26
Ba	805	709	592	1397	602	1029	686	642
Rb	196	161	142	225	198	143	171	288
Sr	87	113	195	23	160	28	39	39
Zr	198	275	217	171	198	249	195	206
Y	37	28	30	30	43	46	30	29
Nb	15.4	16.3	13.8	15.7	16.2	17.8	14.7	19.2
Ga	23	21	19	20	25	21	17	20
Cu	19	5	8	0	16	0	5	0
Zn	47	67	76	43	98	75	†357	9
Pb	19	15	26	1	27	5	3	1
La	33	38	33	25	41	62	29	32
Ce	66	66	79	54	87	94	50	87
Th	13	3	17	5	12	6	19	23

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**53**
Sample no.	98TF822	98RL006	98RL010	98RL009	98RL053	98RL101	98RL016	98RL016R
Mineralogy			dolomitic				scapolitic	
Lithology	siltite	siltite-argillite	siltite	siltite-argillite	argillite	siltite-argillite	siltite-argillite	duplicate
Color	gray	black and		green	green	green	gray	
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	
7.5' quad.	Merry Cr.	St. Joe	St. Maries	St. Maries	Polaris Peak	Calder	Huckleberry	
Unit	Yqw	Ywu1	Ywu2	Ywu3	Ywu3	Ywu3	Ywu	Ywu
Lat.	47.05819	47.35668	47.33608	47.32786	47.42486	47.33746	47.22526	
Long.	-116.17667	-116.27741	-116.55755	-116.56716	-116.00930	-116.16518	-116.23396	
				Unnormalized results (weight %)				
SiO_2	73.14	78.50	75.55	63.13	55.98	70.60	66.11	66.17
Al_2O_3	12.50	13.34	9.35	19.78	25.95	15.16	19.58	19.64
TiO_2	0.522	0.566	0.442	0.857	0.419	0.705	0.635	0.633
FeO*	2.01	1.70	2.05	3.65	2.79	3.20	2.24	2.27
MnO	0.012	0.003	0.021	0.012	0.002	0.010	0.005	0.006
CaO	0.86	0.03	2.22	0.18	0.02	0.15	0.22	0.21
MgO	2.46	0.40	3.25	2.45	2.57	2.47	2.09	2.11
K_2O	5.21	3.37	2.53	6.11	9.82	4.52	6.72	6.73
Na_2O	2.37	0.32	1.69	1.06	0.14	1.40	0.31	0.32
P_2O_5	0.060	0.065	0.134	0.123	0.049	0.107	0.091	0.092
Total	99.14	98.30	97.23	97.35	97.74	98.32	98.00	98.18
				Normalized results (weight %)				
SiO_2	73.77	79.86	77.70	64.85	57.27	71.81	67.46	67.40
Al_2O_3	12.61	13.57	9.62	20.32	†26.55	15.42	19.98	20.00
TiO_2	0.527	0.576	0.455	0.880	0.429	0.717	0.648	0.645
FeO*	2.03	1.73	2.10	3.75	2.86	3.25	2.28	2.31
MnO	0.012	0.003	0.022	0.012	0.002	0.010	0.005	0.006
CaO	0.87	0.03	2.28	0.18	0.02	0.15	0.22	0.21
MgO	2.48	0.41	3.34	2.52	2.63	2.51	2.13	2.15
K_2O	5.26	3.43	2.60	6.28	†10.05	4.60	†6.86	†6.85
Na_2O	2.39	0.33	1.74	1.09	0.14	1.42	0.32	0.33
P_2O_5	0.061	0.066	0.138	0.126	0.050	0.109	0.093	0.094
				Trace elements (ppm)				
Ni	11	14	17	13	12	19	7	8
Cr	34	45	33	83	10	76	65	62
Sc	8	13	9	30	14	15	24	24
V	51	57	43	101	39	89	103	98
Ba	997	608	534	1616	†2432	1464	750	763
Rb	139	147	112	222	381	163	206	206
Sr	62	27	55	43	7	40	9	10
Zr	276	287	283	326	552	309	225	226
Y	30	32	29	48	149	34	33	34
Nb	14.9	13.5	9.4	20.5	29.8	16.1	15.2	15.0
Ga	17	18	14	28	46	19	28	25
Cu	†198	12	1	0	0	36	2	9
Zn	8	15	50	37	21	38	0	0
Pb	3	0	2	2	0	3	1	1
La	14	33	5	36	37	19	16	11
Ce	42	80	42	94	84	36	25	11
Th	15	10	5	14	15	10	26	25

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Sample no.	98RL016AV	98RL140	98RL145	98RL172	98RL173	98RB008	98RB014	98RL073
Mineralogy						garnet	garnet-	staurolite-
Lithology	average	siltite-argillite	siltite-argillite	siltite-argillite	siltite	schist	schist	schist
Color		dark gray	gray	gray	green			
30' x 60' quad.		St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.		Plummer	West Dennis	Tensed	Sanders	Merry Cr.	Clarkia	Fernwood
Unit	Ywu	Ywu	Ywu	Ywu	Ywu	Ysw	Ysw	Ysw
Lat.		47.34121	47.06964	47.12508	47.06711	47.00540	47.02090	47.09577
Long.		-116.92940	-116.73595	-116.90314	-116.78454	-116.21802	-116.27823	-116.43070
				Unnormalized results (weight %)				
SiO_2	66.14	71.99	67.61	68.13	67.86	75.57	65.60	65.65
Al_2O_3	19.61	17.02	16.47	18.03	17.04	11.05	19.45	21.77
TiO_2	0.63	0.654	0.721	0.657	0.670	0.507	0.765	0.767
FeO*	2.25	2.68	4.81	3.29	4.65	5.38	4.67	3.19
MnO	0.01	0.000	0.032	0.023	0.064	0.070	0.047	0.136
CaO	0.22	0.01	0.31	0.11	0.29	1.45	0.12	0.23
MgO	2.10	0.54	2.25	1.65	1.69	1.95	1.83	0.96
K_2O	6.73	5.01	5.22	5.45	4.46	2.05	4.46	4.90
Na_2O	0.32	0.19	1.18	0.15	1.28	0.55	0.77	0.88
P_2O_5	0.09	0.078	0.118	0.033	0.121	0.068	0.121	0.144
Total	98.09	98.17	98.72	97.52	98.12	98.64	97.84	98.63
				Normalized results (weight %)				
SiO_2	67.43	73.33	68.49	69.86	69.16	76.61	67.05	66.57
Al_2O_3	19.99	17.34	16.68	18.49	17.37	11.20	19.88	22.07
TiO_2	0.646	0.666	0.730	0.674	0.683	0.514	0.782	0.778
FeO*	2.30	2.73	4.87	3.37	4.74	5.45	4.78	3.23
MnO	0.006	0.000	0.032	0.024	0.065	0.071	0.048	0.138
CaO	0.22	0.01	0.31	0.11	0.30	1.47	0.12	0.23
MgO	2.14	0.55	2.28	1.69	1.72	1.98	1.87	0.97
K_2O	6.86	5.10	5.29	5.59	4.55	2.08	4.56	4.97
Na_2O	0.32	0.19	1.20	0.15	1.30	0.56	0.79	0.89
P_2O_5	0.093	0.079	0.120	0.034	0.123	0.069	0.124	0.146
				Trace elements (ppm)				
Ni	8	7	20	17	26	41	9	5
Cr	64	50	70	64	66	44	68	71
Sc	24	19	23	23	15	11	24	29
V	101	77	101	91	82	63	98	110
Ba	757	694	1061	439	1022	247	769	1095
Rb	206	205	175	247	169	139	160	123
Sr	10	29	47	42	49	81	41	126
Zr	226	244	351	220	277	274	202	257
Y	34	48	26	34	35	40	47	45
Nb	15.1	16.2	19.3	16.3	16.7	18.5	18.9	15.5
Ga	27	20	22	24	24	15	26	27
Cu	6	9	18	15	87	12	3	8
Zn	0	8	83	113	76	129	67	99
Pb	1	1	15	3	17	13	8	16
La	14	82	16	24	24	42	45	36
Ce	18	118	51	23	47	47	67	47
Th	26	17	24	9	22	20	8	19

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.			**61**	**62**		**63**	**64**	**65**
Sample no.	98RL041	98RL042	98RL104	98RL141	98RL043	98RL086	98RL083	98RL147
Mineralogy								
Lithology	quartzite	argillite	siltite-argillite	argillite	quartzite	quartzite	siltite	siltite
Color		red	green	purple			gray-green	green
30' x 60' quad.	Wallace	Wallace	St. Maries	St. Maries	Wallace	St. Maries	St. Maries	St. Maries
7.5' quad.	Wallace	Wallace	Calder	Plummer	Wallace	Benewah	Emida	West Dennis
Unit	Ysp1q	Ysp1a	Ysp1a	Ysp1a	Ysp4	Ysp4	Yl	Yl
Lat.	47.44056	47.43500	47.34256	47.31312	47.43277	47.26386	47.15000	47.07973
Long.	-115.995833	-115.99584	-116.14695	-116.94001	-115.99611	-116.64112	-116.61267	-116.65841
				Unnormalized results (weight %)				
SiO_2	85.87	59.57	73.43	63.96	95.20	88.37	73.43	68.77
Al_2O_3	6.79	19.68	13.06	17.98	2.35	4.70	14.06	15.67
TiO_2	0.193	0.778	0.511	0.804	0.050	0.665	0.615	0.831
FeO*	1.04	6.49	3.34	5.70	0.36	3.43	3.61	3.55
MnO	0.031	0.005	0.003	0.001	0.000	0.002	0.002	0.006
CaO	0.52	0.09	0.22	0.07	0.00	0.00	0.01	0.15
MgO	0.62	2.57	2.76	1.93	0.15	0.13	1.74	2.07
K_2O	2.18	7.92	4.51	6.99	1.46	2.01	4.55	5.66
Na_2O	1.68	0.58	0.60	0.11	0.05	0.05	0.13	1.95
P_2O_5	0.058	0.098	0.185	0.054	0.011	0.016	0.021	0.066
Total	98.98	97.78	98.62	97.59	99.63	99.37	98.17	98.73
				Normalized results (weight %)				
SiO_2	86.76	60.92	74.46	65.54	95.55	88.93	74.80	69.66
Al_2O_3	6.86	20.13	13.24	18.42	2.36	4.73	14.32	15.87
TiO_2	0.195	0.796	0.518	0.824	0.050	0.669	0.626	0.842
FeO*	1.05	6.64	3.39	5.84	0.36	3.45	3.68	3.60
MnO	0.031	0.005	0.003	0.001	0.000	0.002	0.002	0.006
CaO	0.53	0.09	0.22	0.07	0.00	0.00	0.01	0.15
MgO	0.63	2.63	2.80	1.98	0.15	0.13	1.77	2.10
K_2O	2.20	†8.10	4.57	†7.16	1.47	2.02	4.63	5.73
Na_2O	1.70	0.59	0.61	0.11	0.05	0.05	0.13	1.98
P_2O_5	0.059	0.100	0.188	0.055	0.011	0.016	0.021	0.067
				Trace elements (ppm)				
Ni	3	22	31	14	5	4	18	20
Cr	13	73	48	95	1	47	57	88
Sc	8	18	13	24	0	7	15	17
V	23	110	64	104	10	53	76	108
Ba	848	453	496	517	179	221	1074	810
Rb	65	278	161	255	31	51	206	181
Sr	69	22	21	18	12	12	31	47
Zr	139	218	231	340	88	717	405	208
Y	12	56	37	60	8	21	30	20
Nb	4.7	16.6	11.6	19.6	4.5	14.4	14.1	23.7
Ga	5	28	14	26	3	3	19	23
Cu	0	0	11	5	0	0	0	0
Zn	5	53	30	13	0	0	1	2
Pb	5	12	4	5	6	7	1	2
La	20	49	48	76	3	11	52	14
Ce	17	99	84	144	12	39	74	31
Th	18	20	14	11	4	15	12	15

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 2. XRF analyses of metasedimentary rocks from the St. Maries and Wallace quadrangles (continued).

Map no.	**66**	**67**
Sample no.	98RL148	98TF852
Mineralogy		
Lithology	siltite	siltite-argillite
Color	gray-green	gray-green
30' x 60' quad.	St. Maries	St. Maries
7.5' quad.	West Dennis	West Dennis
Unit	Yl	Yl
Lat.	47.06975	47.06842
Long.	-116.65761	-116.66347
Unnormalized results (weight %)		
SiO_2	65.20	68.45
Al_2O_3	18.95	14.32
TiO_2	0.890	0.701
FeO*	3.19	4.19
MnO	0.005	0.008
CaO	0.17	0.25
MgO	1.60	3.66
K_2O	7.32	5.11
Na_2O	1.38	1.66
P_2O_5	0.125	0.147
Total	98.83	98.49
Normalized results (weight %)		
SiO_2	65.98	69.50
Al_2O_3	19.18	14.54
TiO_2	0.901	0.712
FeO*	3.22	4.25
MnO	0.005	0.008
CaO	0.17	0.25
MgO	1.62	3.72
K_2O	†7.41	5.19
Na_2O	1.40	1.69
P_2O_5	0.126	0.149
Trace elements (ppm)		
Ni	11	27
Cr	90	69
Sc	16	16
V	121	80
Ba	1506	960
Rb	190	187
Sr	41	37
Zr	547	426
Y	33	34
Nb	20.6	13.8
Ga	31	23
Cu	0	3
Zn	0	11
Pb	7	0
La	59	51
Ce	98	102
Th	13	7

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 3. ICP analyses of metasedimentary rocks in the St. Maries and Wallace quadrangles. See Table 2 for rock descriptions and locations.

Map no.	**18**	**22**	**25**	**28**	**34**	**35**	**39**	**40**	**45**
Sample no.	98RL014	98RL032	98RB003	98TF817	98RL023	98RL030	98RL024	98RL028	98RL051
Unit	Ypl	Yp	Ys	Ys	Yb	Yb	Yr	Ysr	Ywm
					Trace elements (ppm)				
La	40.93	57.66	47.28	52.44	60.32	47.48	9.37	101.52	25.14
Ce	72.43	107.18	89.06	101.88	73.45	92.93	20.82	179.05	48.85
Pr	7.99	12.21	10.00	11.89	13.89	10.51	2.54	20.24	5.39
Nd	30.69	46.89	38.40	47.63	54.64	40.77	11.17	76.04	21.01
Sm	6.68	10.19	8.28	10.83	12.57	8.87	2.76	13.70	4.36
Eu	1.28	1.91	1.35	1.73	2.63	1.76	0.58	2.29	0.93
Gd	5.67	8.69	7.05	9.85	11.18	7.30	2.49	8.88	3.96
Tb	1.00	1.48	1.19	1.68	2.00	1.17	0.40	1.41	0.73
Dy	5.93	8.78	7.04	9.92	11.98	6.78	2.21	7.67	4.81
Ho	1.20	1.75	1.40	2.02	2.33	1.37	0.37	1.49	1.01
Er	3.40	5.00	3.88	5.71	6.00	4.00	0.89	4.14	2.95
Tm	0.53	0.75	0.59	0.88	0.86	0.64	0.13	0.63	0.45
Yb	3.57	4.74	3.70	5.54	5.01	4.21	0.77	4.15	2.80
Lu	0.60	0.76	0.59	0.89	0.74	0.68	0.11	0.67	0.44
Ba	941	648	849	1212	647	611	213	818	639
Th	18.49	20.23	19.00	16.41	11.38	14.85	2.43	17.20	10.60
Nb	19.36	15.75	15.42	17.56	14.68	15.03	1.36	14.97	12.35
Y	32.52	50.47	38.00	56.55	62.94	38.11	8.50	41.12	30.44
Hf	6.90	6.09	6.54	6.66	5.75	8.14	1.13	7.10	5.23
Ta	1.53	1.25	1.22	1.22	1.04	1.12	0.12	1.12	0.90
U	3.35	3.52	3.77	3.60	2.79	3.11	0.65	2.98	2.45
Pb	20.28	51.93	18.24	13.16	10.57	5.34	4.24	5.10	6.45
Rb	184.9	228.9	196.2	211.2	208.9	246.3	50.1	227.7	154.9
Cs	9.21	13.08	11.88	12.85	11.63	11.71	1.36	18.46	9.25
Sr	128	53	64	66	52	27	6	24	40
Sc	20.0	21.1	13.7	17.1	13.6	13.9	1.1	14.5	13.1

Table 3. ICP analyses of metasedimentary rocks in the St. Maries and Wallace quadrangles (continued).

Map no.	**48**	**54**	**60**				**65**	**65**	**65**
Sample no.	98RL006	98RL140	98RL073	98RL041	98RL042	98RL043	98RL147	98RL147R	98RL147AV
Unit	Ywu1	Ywu	Ysw	Ysp1q	Ysp1a	Ysp4	Yl	duplicate	average
				Trace elements (ppm)					
La	38.37	89.63	30.35	10.27	53.40	7.06	15.93	16.21	16.07
Ce	71.86	125.11	54.86	22.06	101.56	12.32	29.46	29.94	29.70
Pr	7.91	20.47	7.53	2.76	11.37	1.65	3.47	3.52	3.49
Nd	30.03	81.19	28.79	11.17	43.81	6.73	13.52	13.69	13.61
Sm	6.15	19.09	6.48	2.64	9.26	1.52	2.80	2.96	2.88
Eu	1.14	3.43	1.55	0.66	1.98	0.36	0.68	0.73	0.70
Gd	5.27	13.05	5.60	2.40	8.13	1.34	2.90	2.97	2.93
Tb	0.93	1.96	1.05	0.40	1.46	0.22	0.53	0.54	0.53
Dy	5.86	10.15	7.09	2.35	9.14	1.28	3.41	3.40	3.40
Ho	1.23	1.85	1.58	0.48	1.91	0.25	0.73	0.73	0.73
Er	3.49	4.99	4.71	1.32	5.29	0.66	2.20	2.16	2.18
Tm	0.53	0.73	0.72	0.21	0.76	0.09	0.36	0.36	0.36
Yb	3.45	4.58	4.76	1.31	4.68	0.57	2.37	2.38	2.38
Lu	0.56	0.72	0.76	0.21	0.73	0.09	0.41	0.41	0.41
Ba	577	698	1072	906	457	167	791	802	796
Th	15.79	15.46	16.78	4.24	14.45	1.74	10.38	9.99	10.19
Nb	12.91	15.27	14.11	4.50	16.24	1.23	19.45	19.73	19.59
Y	34.76	51.97	45.03	14.48	54.52	7.22	20.93	21.14	21.04
Hf	8.28	6.91	7.06	3.49	6.26	1.86	5.58	5.46	5.52
Ta	1.04	1.15	1.15	0.33	1.21	0.12	1.46	1.44	1.45
U	3.05	3.14	4.93	1.18	3.62	0.57	2.15	2.11	2.13
Pb	2.44	3.10	16.44	6.15	11.55	3.35	2.81	2.84	2.82
Rb	141.1	200.7	124.2	63.3	263.4	27.5	168.5	171.5	170.0
Cs	8.95	12.33	5.33	4.74	23.14	1.29	3.05	3.11	3.08
Sr	31	30	144	80	22	12	52	53	52
Sc	10.4	18.9	25.5	3.4	22.1	0.7	15.7	16.2	16.0

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle.

Map no.	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**
Sample no.	98K040607	98K073002	98K080404	98K080409	98K033004	98K033006	98K073001	98K080302
Lithology	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt
Form	flow	flow	flow	flow	flow	flow	flow	flow
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	St. Maries	Benewah Lk.	Chatcolet	Harrison	Harrison	Harrison	Benewah Lk.	Worley
Unit	Ted	Ted	Ted	Ted	Tgn2	Tgn2	Tgn2	Tgn2
Lat.	47.26956	47.36242	47.34542	47.40123	47.44931	47.46148	47.36033	47.48878
Long.	-116.59677	-116.62993	-116.77245	-116.78249	-116.77684	-116.76701	-116.63459	-116.91565
				Unnormalized results (weight %)				
SiO_2	51.22	50.87	51.02	50.76	53.71	53.60	53.75	53.51
Al_2O_3	15.16	15.44	15.49	15.22	13.93	13.68	13.81	13.90
TiO_2	1.308	1.295	1.284	1.271	1.907	1.875	1.863	1.868
FeO*	10.07	10.25	10.16	10.76	10.91	11.17	11.69	11.43
MnO	0.202	0.196	0.194	0.199	0.199	0.206	0.212	0.206
CaO	10.18	10.34	10.35	10.33	8.45	8.41	8.43	8.53
MgO	6.46	6.61	6.66	6.67	3.89	4.42	4.79	4.75
K_2O	0.62	0.68	0.74	0.65	1.28	1.30	1.35	1.28
Na_2O	3.06	2.94	2.97	2.93	2.78	2.90	2.91	2.92
P_2O_5	0.301	0.300	0.299	0.300	0.410	0.383	0.381	0.390
Total	98.58	98.92	99.17	99.09	97.47	97.94	99.19	98.78
				Normalized results (weight %)				
SiO_2	51.96	51.42	51.45	51.23	55.11	54.73	54.19	54.17
Al_2O_3	15.38	15.61	15.62	15.36	14.29	13.97	13.92	14.07
TiO_2	1.327	1.309	1.295	1.283	1.957	1.914	1.878	1.891
FeO*	10.21	10.36	10.24	10.86	11.19	11.40	11.79	11.57
MnO	0.205	0.198	0.196	0.201	0.204	0.210	0.214	0.209
CaO	10.33	10.45	10.44	10.42	8.67	8.59	8.50	8.64
MgO	6.55	6.68	6.72	6.73	3.99	4.51	4.83	4.81
K_2O	0.63	0.69	0.75	0.66	1.31	1.33	1.36	1.30
Na_2O	3.10	2.97	3.00	2.96	2.85	2.96	2.93	2.96
P_2O_5	0.305	0.303	0.302	0.303	0.421	0.391	0.384	0.395
				Trace elements (ppm)				
Ni	48	45	48	45	3	8	5	2
Cr	172	191	181	180	44	45	49	50
Sc	35	39	44	42	35	36	37	35
V	312	318	311	309	277	298	289	290
Ba	301	306	290	287	526	505	487	490
Rb	8	7	7	8	29	30	30	29
Sr	366	378	378	378	314	307	307	305
Zr	106	106	105	106	164	160	158	158
Y	28	29	28	27	36	36	36	36
Nb	8.1	7.6	7.5	7.4	14.1	13.0	11.5	11.9
Ga	16	18	20	23	22	21	22	22
Cu	79	82	79	82	23	24	22	24
Zn	96	94	96	97	119	121	122	116
Pb	2	4	1	2	10	40	6	8
La	0	11	8	15	10	17	25	22
Ce	35	33	30	28	48	47	45	54
Th	4	3	2	4	2	5	5	6

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle (continued).

Map no.	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**
Sample no.	98K080405	98K080408	98K033007	98K033104	MM509	BRETC	JP-5	98K033001
Lithology	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt
Form	flow	flow	flow	flow	flow	flow	flow	flow
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	Chatcolet	Harrison	Harrison	Black Lake	Mission Mtn.	Merry Cr.	Worley	Harrison
Unit	Tgn2	Tgn2	Tgr2	Tgr2	Ton	Tpr	Tpr	Tpr
Lat.	47.34896	47.40282	47.47366	47.48660	47.00983	47.01210	47.44233	47.44272
Long.	-116.76979	-116.77846	-116.76631	-116.72059	-116.90369	-116.20715	-116.89682	-116.75081
				Unnormalized results (weight %)				
SiO_2	53.81	53.84	53.51	53.56	48.00	48.81	49.48	50.42
Al_2O_3	14.17	14.38	13.51	13.41	15.92	13.26	12.66	12.77
TiO_2	1.892	1.936	2.134	2.167	3.569	3.172	3.680	3.634
FeO*	10.68	10.75	11.91	12.23	11.83	13.57	13.99	13.75
MnO	0.201	0.191	0.195	0.196	0.184	0.221	0.250	0.233
CaO	8.60	8.69	7.55	7.55	7.42	9.09	8.51	8.56
MgO	4.66	4.64	3.58	3.73	4.79	5.22	4.43	4.02
K_2O	1.29	1.11	1.79	1.65	1.77	1.16	1.24	1.41
Na_2O	2.98	3.09	2.94	3.03	3.99	2.67	2.83	2.80
P_2O_5	0.388	0.380	0.371	0.369	0.786	0.753	0.780	0.796
Total	98.67	99.01	97.49	97.89	98.26	97.93	97.85	98.39
				Normalized results (weight %)				
SiO_2	54.54	54.38	54.89	54.71	48.85	49.84	50.57	51.24
Al_2O_3	14.36	14.52	13.86	13.70	16.20	13.54	12.94	12.98
TiO_2	1.918	1.955	2.189	2.214	†3.63	†3.24	†3.76	†3.69
FeO*	10.82	10.86	12.22	12.49	12.04	13.86	14.30	13.97
MnO	0.204	0.193	0.200	0.200	0.187	0.226	0.260	0.237
CaO	8.72	8.78	7.74	7.71	7.55	9.28	8.70	8.70
MgO	4.72	4.69	3.67	3.81	4.87	5.33	4.53	4.09
K_2O	1.31	1.12	1.84	1.69	1.80	1.18	1.27	1.43
Na_2O	3.02	3.12	3.02	3.10	4.06	2.73	2.89	2.85
P_2O_5	0.393	0.384	0.381	0.377	†0.80	†0.77	†0.79	†0.81
				Trace elements (ppm)				
Ni	2	3	10	13	3	33	2	6
Cr	49	53	27	30	9	108	26	23
Sc	33	34	33	31	19	39	34	36
V	284	295	407	413	255	378	440	439
Ba	511	532	646	622	466	433	631	561
Rb	30	21	42	43	22	26	31	35
Sr	324	326	325	325	528	284	282	293
Zr	162	161	169	168	315	179	203	213
Y	35	37	35	34	35	46	49	51
Nb	12.9	12.3	14.8	13.7	53.5	17.3	17.3	20.3
Ga	24	22	21	22	27	22	20	23
Cu	26	22	31	41	5	31	11	15
Zn	122	125	130	125	137	141	151	170
Pb	6	7	10	31	1	3	4	4
La	14	16	11	25	33	25	37	28
Ce	66	48	34	33	79	59	70	47
Th	7	5	7	6	5	5	6	4

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle (continued).

Map no.	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**
Sample no.	98K033003	98K033010	98K033111	98K033112	98K033114	98K040101	98K040202	98K040204
Lithology	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt
Form	flow	flow	flow	flow	flow	flow	flow	flow
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.	Harrison	Harrison	Black Lake	Black Lake	Black Lake	St. Joe	Calder	St. Joe
Unit	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr
Lat.	47.44542	47.47644	47.40192	47.40082	47.40060	47.30117	47.27888	47.29435
Long.	-116.76111	-116.83940	-116.72758	-116.71320	-116.67388	-116.27396	-116.163055	-116.25178
				Unnormalized results (weight %)				
SiO_2	48.48	49.36	49.36	49.58	49.24	49.65	49.43	49.67
Al_2O_3	12.30	12.63	12.36	12.38	12.58	12.59	12.59	12.74
TiO_2	3.561	3.621	3.501	3.617	3.635	3.626	3.599	3.651
FeO*	14.61	14.51	14.56	14.52	14.66	14.19	14.43	14.26
MnO	0.242	0.239	0.244	0.242	0.236	0.249	0.246	0.250
CaO	8.40	8.52	8.24	8.42	8.56	8.41	8.49	8.54
MgO	4.34	4.21	4.20	4.23	4.01	4.33	4.31	4.48
K_2O	1.28	1.28	1.37	1.23	1.22	1.23	1.22	1.30
Na_2O	2.64	2.64	2.63	2.69	2.56	2.78	2.52	2.62
P_2O_5	0.767	0.768	0.766	0.780	0.776	0.768	0.775	0.779
Total	96.62	97.78	97.23	97.69	97.48	97.82	97.61	98.29
				Normalized results (weight %)				
SiO_2	50.18	50.48	50.77	50.75	50.51	50.75	50.64	50.53
Al_2O_3	12.73	12.92	12.71	12.67	12.91	12.87	12.90	12.96
TiO_2	†3.69	†3.70	†3.60	†3.70	†3.73	†3.71	†3.69	†3.71
FeO*	†15.12	†14.84	†14.97	†14.86	†15.04	14.51	†14.78	14.51
MnO	0.250	0.244	0.251	0.248	0.242	0.255	0.252	0.254
CaO	8.69	8.71	8.47	8.62	8.78	8.60	8.70	8.69
MgO	4.49	4.31	4.32	4.33	4.11	4.43	4.42	4.56
K_2O	1.32	1.31	1.41	1.26	1.25	1.26	1.25	1.32
Na_2O	2.73	2.70	2.70	2.75	2.63	2.84	2.58	2.67
P_2O_5	†0.79	†0.79	†0.79	†0.80	†0.80	†0.79	†0.79	†0.79
				Trace elements (ppm)				
Ni	1	4	0	5	3	1	2	2
Cr	29	27	22	26	28	26	29	28
Sc	36	35	34	33	35	33	37	35
V	437	445	419	443	450	453	439	447
Ba	527	526	543	504	506	514	496	499
Rb	31	31	36	33	30	31	30	33
Sr	283	290	283	287	291	281	288	284
Zr	207	209	216	211	212	203	207	202
Y	51	50	49	51	51	48	49	48
Nb	19.4	18.9	19.8	19.9	19.1	18.4	19.5	19.8
Ga	23	25	24	26	24	23	24	24
Cu	24	13	5	15	15	11	16	14
Zn	150	152	154	158	153	152	155	158
Pb	†103	24	4	9	3	11	9	8
La	11	34	24	37	18	30	23	19
Ce	62	60	90	76	73	67	62	62
Th	4	6	5	7	6	7	6	7

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle (continued).

Map no.	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**98**
Sample no.	98K040205	98K040205F	98K040206	98K040603	98K040605	98K040606	98K040613	98K040613R
Lithology	basalt	basalt	basalt	basalt	basalt	basalt	basalt	duplicate
Form	flow	flow	flow	slump?	slump?	slump?	flow	
30' x 60' quad.	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	
7.5' quad.	Calder	Calder	St. Joe	St. Maries	St. Maries	St. Maries	St. Maries	
Unit	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr
Lat.	47.29519	47.29519	47.29482	47.29005	47.27715	47.27568	47.27505	47.27505
Long.	-116.24433	-116.24433	-116.25214	-116.55678	-116.57972	-116.57466	-116.50865	-116.50865
				Unnormalized results (weight %)				
SiO_2	48.97	49.01	50.15	48.67	49.94	49.25	49.30	49.33
Al_2O_3	12.48	12.48	12.75	12.64	12.95	12.61	12.59	12.58
TiO_2	3.606	3.610	3.472	3.771	3.588	3.602	3.626	3.625
FeO*	14.48	15.53	14.14	14.44	13.63	14.28	14.09	14.16
MnO	0.241	0.235	0.246	0.241	0.242	0.250	0.232	0.232
CaO	8.49	8.51	8.25	8.71	8.56	8.53	8.60	8.57
MgO	4.30	4.26	4.38	4.07	4.23	4.44	4.27	4.23
K_2O	1.22	1.15	1.19	1.32	1.23	1.20	1.12	1.11
Na_2O	2.46	2.62	2.60	2.51	2.71	2.72	2.64	2.68
P_2O_5	0.774	0.778	0.728	0.786	0.773	0.764	0.761	0.762
Total	97.02	98.18	97.91	97.16	97.85	97.65	97.23	97.28
				Normalized results (weight %)				
SiO_2	50.47	49.92	51.22	50.09	51.04	50.44	50.71	50.71
Al_2O_3	12.86	12.71	13.02	13.01	13.23	12.91	12.95	12.93
TiO_2	†3.72	†3.68	†3.55	†3.88	†3.67	†3.69	†3.73	†3.73
FeO*	†14.92	†15.82	14.44	†14.86	13.93	14.62	14.49	14.56
MnO	0.248	0.239	0.251	0.248	0.247	0.256	0.239	0.238
CaO	8.75	8.67	8.43	8.96	8.75	8.74	8.85	8.81
MgO	4.43	4.34	4.47	4.19	4.32	4.55	4.39	4.35
K_2O	1.26	1.17	1.22	1.36	1.26	1.23	1.15	1.14
Na_2O	2.54	2.67	2.66	2.58	2.77	2.79	2.72	2.75
P_2O_5	†0.80	†0.79	†0.74	†0.81	†0.79	†0.78	†0.78	†0.78
				Trace elements (ppm)				
Ni	3	0	6	3	7	5	5	6
Cr	25	36	32	29	23	32	37	32
Sc	36	35	32	38	36	39	37	33
V	447	443	431	†456	453	441	†457	447
Ba	490	500	504	521	544	533	515	511
Rb	33	28	34	30	31	28	25	24
Sr	290	296	276	292	293	282	283	281
Zr	208	212	205	212	206	204	204	204
Y	50	51	47	52	48	49	48	49
Nb	20.4	18.9	19.3	19.3	19.4	18.5	18.4	19.6
Ga	25	24	24	25	23	22	22	23
Cu	28	13	21	10	11	12	17	13
Zn	155	150	149	153	155	150	160	152
Pb	5	5	8	4	8	3	2	5
La	33	14	26	25	26	21	19	16
Ce	69	72	61	79	68	60	71	71
Th	7	8	7	6	8	9	8	8

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle (continued).

Map no.		**99**	**100**	**101**	**102**	**103**	**104**	**105**
Sample no.	98K040613AV	98K073003	98K080301	98K080401	98K080402	98K080407	98K080410	98K080504
Lithology	average	basalt	basalt	basalt	basalt	basalt	basalt	basalt
Form		flow	flow	flow	flow	slump?	flow	flow
30' x 60' quad.		St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries	St. Maries
7.5' quad.		Benewah Lk.	Worley	Chatcolet	Chatcolet	Harrison	Harrison	Calder
Unit		Tpr	Tpr	Tpr	Tpr	Tpr	Tpr	Tpr
Lat.		47.36431	47.49403	47.34281	47.34278	47.40405	47.39500	47.291309
Long.		-116.62734	-116.93060	-116.79260	-116.77839	-116.77364	-116.78194	-116.236891
				Unnormalized results (weight %)				
SiO_2	49.32	49.91	49.84	49.67	49.64	49.64	49.65	50.27
Al_2O_3	12.59	12.92	12.79	12.68	12.67	12.77	12.61	12.80
TiO_2	3.626	3.707	3.707	3.670	3.576	3.676	3.563	3.681
FeO*	14.13	13.69	14.07	14.15	15.01	14.26	15.20	13.84
MnO	0.232	0.228	0.236	0.254	0.248	0.242	0.235	0.215
CaO	8.59	8.77	8.60	8.50	8.41	8.56	8.31	8.67
MgO	4.25	4.32	4.34	4.58	4.71	4.58	4.46	4.12
K_2O	1.12	1.29	1.42	1.29	1.19	1.36	1.22	1.30
Na_2O	2.66	2.59	2.66	2.73	2.76	2.68	2.79	2.66
P_2O_5	0.762	0.770	0.803	0.789	0.735	0.772	0.755	0.791
Total	97.25	98.20	98.46	98.32	98.95	98.54	98.79	98.35
				Normalized results (weight %)				
SiO_2	50.71	50.83	50.62	50.52	50.17	50.38	50.26	51.11
Al_2O_3	12.94	13.16	12.99	12.90	12.80	12.96	12.76	13.01
TiO_2	3.73	†3.78	†3.76	†3.73	†3.61	†3.73	†3.61	†3.74
FeO*	14.52	13.94	14.29	14.39	†15.17	14.47	†15.39	14.08
MnO	0.239	0.232	0.240	0.258	0.251	0.246	0.238	0.219
CaO	8.83	8.93	8.73	8.65	8.50	8.69	8.41	8.82
MgO	4.37	4.40	4.41	4.66	4.76	4.65	4.51	4.19
K_2O	1.15	1.31	1.44	1.31	1.20	1.38	1.23	1.32
Na_2O	2.74	2.64	2.70	2.78	2.79	2.72	2.82	2.70
P_2O_5	0.78	†0.78	†0.82	†0.80	†0.74	†0.78	†0.76	†0.80
				Trace elements (ppm)				
Ni	6	5	3	4	4	4	0	8
Cr	35	41	34	32	37	31	42	32
Sc	35	35	34	42	38	39	30	36
V	452	454	†457	†455	437	452	425	449
Ba	513	491	529	520	481	498	492	511
Rb	25	26	32	30	27	30	30	32
Sr	282	291	288	280	277	287	279	300
Zr	204	206	213	208	199	206	206	212
Y	49	50	51	48	47	50	50	50
Nb	19	17.5	19.3	19.0	17.4	18.5	17.9	17.6
Ga	23	24	24	22	24	25	22	26
Cu	15	13	11	16	15	17	16	11
Zn	156	165	157	148	150	154	150	161
Pb	4	5	5	5	4	5	2	5
La	18	23	24	38	18	29	31	30
Ce	71	71	68	70	59	67	54	61
Th	8	8	8	5	8	7	8	6

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.

Table 4. XRF analyses of basaltic rocks from the St. Maries quadrangle (continued).

Map no.	**106**	**107**
Sample no.	STJ1C	98K033103
Lithology	basalt	basalt
Form	flow	flow
30' x 60' quad.	St. Maries	St. Maries
7.5' quad.	St. Joe	Black Lake
Unit	Tpr	Tpr?
Lat.	47.29435	47.48597
Long.	-116.25178	-116.70872
Unnormalized results (weight %)		
SiO_2	49.42	47.96
Al_2O_3	12.57	10.22
TiO_2	3.623	3.874
FeO*	15.26	16.57
MnO	0.246	0.276
CaO	8.48	8.13
MgO	4.55	6.15
K_2O	1.30	1.19
Na_2O	2.64	2.22
P_2O_5	0.761	0.734
Total	98.85	97.32
Normalized results (weight %)		
SiO_2	50.00	49.28
Al_2O_3	12.72	10.50
TiO_2	†3.67	†3.98
FeO*	†15.43	†17.03
MnO	0.249	†0.28
CaO	8.58	8.35
MgO	4.60	6.32
K_2O	1.32	1.22
Na_2O	2.67	2.28
P_2O_5	†0.77	†0.75
Trace elements (ppm)		
Ni	5	16
Cr	35	45
Sc	36	37
V	†456	†473
Ba	484	471
Rb	33	29
Sr	286	231
Zr	204	199
Y	49	48
Nb	18.2	19.4
Ga	20	19
Cu	11	15
Zn	154	166
Pb	7	5
La	24	22
Ce	44	78
Th	8	5

Major elements normalized on a volatile-free basis; FeO* is total Fe expressed as FeO.
"R" at end of sample number denotes a duplicate bead made from the same rock powder.
"†" denotes values > 120% of highest standard in lab.