UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE CONTINENTAL MOUNTAIN AREA

by

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INTRODUCTION

This map is part of a 1:48,000 scale preliminary geologic map series covering the Sandpoint 2^{o} quadrangle. The series is a by-product of the Sandpoint 2^{o} project, conducted under the regional framework studies program and the Branch of Western Regional Geology. All the maps are 15' blocks that have been photographically mosaiced from existing 7.5' topographic quadrangles. The series is designed to fill out areas within the Sandpoint 2^{o} quadrangle not covered by geologic mapping at a scale of 1:62,500 or larger. Maps of this series make geologic information available as the project progresses so interested parties do not have to wait the necessarily long time needed to complete the entire 2^{o} sheet. In addition, these maps present more information than will appear on the final 2^{o} compilation, and they are better suited for field use.

The maps are more detailed and accurate than reconnaissance maps, but because they are the outgrowths of 2^{o} scale mapping and subject to the inherent haste necessary to cover so large an area in a reasonable length of time, they are not the quality of finished U.S.G.S. maps at 1:62,500 scale released in more formal publication series. The coverage is relatively detailed in some areas but almost reconnaissance in others. The maps should therefore be considered preliminary and subject to refinement.

DESCRIPTION OF MAP UNITS

Qag GLACIAL AND ALLUVIAL MATERIAL (Quaternary)--Includes drift from both alpine and continental glaciations, and all alluvial material in modern drainages.

Tt QUARTZ MONZONITE OF TRAPPER PEAK (Tertiary(?))--Monzonite to quartz monzonite; conspicuous dearth of quartz in rock. Underlies about 0.5 km^2 around Trapper Peak. Unusual in variety of mafic minerals; contains olivine, hypersthene, augite, hornblende, and biotite. Plagioclase is andesine, and potassium feldspar is orthoclase. Accessory minerals include apatite, zircon, and abundant opaque minerals. Medium- to fine-grained. Texture is seriate to slightly porphyritic, with 5 to 10 mm phenocrysts of augite. Fine-grained chilled margins around entire pluton. Numerous dikes up to 5 m thick and at distances as great as 200 m from pluton are chilled and fine-grained. No directional structures in rock, but pluton intrudes highly deformed Prichard Formation of Proterozic Belt Supergroup. Metamorphic effects of Tertiary and(or) Cretaceous Selkirk Crest igneous complex are pronounced in Prichard Formation but absent in quartz monzonite of Trapper Peak. Trapper Peak pluton clearly post-dates all dynamic and thermal effects of Selkirk Crest igneous complex.

ROCKS OF SELKIRK CREST IGNEOUS COMPLEX

The Selkirk Crest igneous complex is a large mass of predominantly muscovite-biotite granitic rocks in the Selkirk Mountains between

the Upper Priest River valley and the Purcell Trench which lies 25 km east of the map. Virtually all of the bodies making up the complex are two-mica rocks, and they are closely related in age, composition, and origin. These bodies (i.e., map units) are not individual plutons per se, in that they were probably not emplaced as distinct plutonic entities. Rather, the entire complex appears to be a single intrusive mass and the textural and mineralogical features that distinguish individual bodies comprising the mass resulted from localized physical conditions and compositional inhomogeneities that developed as, or were present when, the complex was emplaced. Relative movement between individual bodies making up the complex could have been large or small during emplacement, regardless of how far the complex traveled through the crust as a unit.The composition of the complex as a whole varies between relatively wide limits, although these limiting compositions can be found within almost all of the individual constituent bodies. The degree of variation within individual bodies is evident from the ternary modal diagrams. Modal diagrams were not made for some map units because they are too heterogeneous on all scales to take representative samples objectively. The individual bodies making up the complex differ from one another primarily in texture, and to a lesser degree in composition, but in any particular map unit, dikes, pods, or small bodies of almost all other units in the complex can be found. Contacts, both internal to and between map units making up the complex, are gradational over intervals ranging from a cm to more than a km wide.Along many of the contacts this gradation is an

alternating series of irregular dike-form masses made up of the rock types of the two bodies in contact. In most cases, the major lithology of one body can be found in any of the other bodies, either as small intrusions or inclusions. No single textural and (or) compositional characteristic distinguishes one body from another; rather, a set of characteristics, one or more of which may be common to other bodies in the complex, distinguish one map unit from another.The Selkirk Crest igneous complex extends well beyond the map area. To the south some elements of the mass extend almost to the Pend Oreille River where relations are complicated by older rocks and several hornblende-biotite plutons that are not part of the complex. South of the Pend Oreille River, similar two-mica rocks extend to the northern edge of the Columbia River Group basalts south of Spokane. At the latitude of the study area the west side of the complex is bounded by the Newport fault along the edge of Priest Lake, and the east side, east of the map area, by a probable fault in the Purcell Trench. The northwest end appears to be an unfaulted, but highly complicated intrusive contact.All rocks sampled within the complex for potassium-argon dating have yielded concordant ages on coexisting mica pairs that range between 44 m.y. and 54 m.y. (Miller and Engels, 1975). These apparent ages may or may not represent emplacement ages. In addition to numerous inclusions, screens, and pendants of Belt Supergroup rocks, some elements appear to be Cretaceous, Triassic(?), and Precambrian granitic rocks that were caught up and incorporated as units in the two-mica magma. The 44 m.y. to 54 m.y. potassium-argon apparent ages

may represent cooling or uplift ages; actual emplacement of the complex may have occurred several million years earlier. Because of uncertainties in both absolute and relative ages, the units making up the complex are described in approximate order of their occurrence from west to east.

TKscc GRANODIORITE OF TRAPPER CREEK (Tertiary and (or) Cretaceous)-- Muscovite-biotite granodiorite. Essentially non-porphyritic, but locally contains sparse, poorly formed phenocrysts up to 2 cm. Potassium feldspar is microcline; irregular distribution in rock with respect to both amount and grain size. Occurs as discrete crystals with some crystal forms developed, but most commonly as anhedral, locally poikilitic or poikiloblastic, intergranular fillings between other minerals. Average plagioclase composition about an_{30}. Biotite is only mafic mineral; color index ranges from 6 to 12, averages about 9. Biotite:muscovite ratio varies widely, averages about 10:1; higher than for most rocks in Selkirk complex. Zircon, apatite, and epidote commonly with cores of allanite, in all rocks. Texture ranges from hypidiomorphic-granular to seriate, grain size from medium-grained to fine-grained. Pegmatite and alaskite dikes common, but not as abundant as in many Selkirk complex units. Contact with Caribou Creek unit and mixed granitic and metamorphic rocks of Lookout Mountain is unclear owing to poor exposures and numerous dikes near contact. Entire west end of body cut off by Newport fault. Rock has affinities to the granodiorite of Reeder Creek which occurs in 15' map area to south, and could be offset northeast end of that

pluton. If so, Trapper Creek body not part of Selkirk complex, but is intruded by complex.

TKscc GRANDIORITE OF CARIBOU CREEK (Tertiary and (or) Cretaceous)--Composition ranges from tonalite to monzogranite, but most is granodiorite (see ternary diagram on map sheet). All rocks contain biotite and almost all contain muscovite; average muscovite:biotite ratio is 1:3. Color index is 6 but ranges from 4 to 10. Typical rock is medium-to-coarse-grained and, non-porphyritic. Shows no primary directional fabric. Common textural variations are sparsely porphyritic rock with groundmass similar to that found in the typical Caribou Creek rock, and medium- to fine-grained two-mica rock. Grain size of micas is noticeably smaller than average grain size of rock, which distinguishes this unit from some others, especially from adjacent monzogranite of Klootch Mountain. Phenocrysts in sparsely porphyritic rock commonly poikilitic or poikiloblastic; obvious only on stained slabs. Quartz generally gray to purple-gray; amount varies within relatively narrow limits, but potassium feldspar has extreme variations ranging from about 3 percent to almost 40 percent. Appearance of low potassium-feldspar rocks not appreciably different from those with abundant potassium feldspar. Some of variation may be related to apparent metamorphism of rock in northwest part of body, because greatest variations occur in that area. All contacts gradational over distances ranging from a few hundred meters to more than 1 km. Rocks indistinguishable from granodirotie of Caribou Creek occur

as dikes, pods, and isolated small bodies in mixed granitic and metamorphic rocks of Lookout Mountain which surround Caribou Creek body, and in fact, make up about 10 to 20 percent of mixed unit. Caribou Creek body extends 3 km east of map area. Part of west end cut off by Newport fault and part is in contact with granodiorite of Trapper Creek. Body underlies about 75 km^2.

TKslc MAFIC GRANODIORITE OF LUCKY CREEK (Tertiary and (or) Cretaceous)--Tonalite to monzogranite; average composition, granodiorite (see modal diagrams). Distinguished by relatively high mafic mineral content; color index ranges from 5 to 20, averages 13. Biotite and minor opaque minerals are only mafic minerals. Potassium feldspar is orthoclase with patches of microcline. Distribution of potassium feldspar is non-uniform; some areas in which grains are concentrated and areas with almost no potassium feldspar. Size of potasium feldspar-concentration domains varies from cubic cm to cubic m. Plagioclase composition ranges from an_{24} to an_{32}. Small amounts of muscovite in most rocks. Rock is medium- to coarse-grained; has poorly developed foliation at some places, and locally has segregated mineral layers. Zone about 300 m wide in eastern part of unit is leucocratic two-mica monzogranite and has nearly double amount of radioactivity [1/] (170 cps) as rest of unit (about 90 cps).

[1/] All radioactivity measurements made with Geometrics model GR-101A scintillometer. Readings from this instrument were consistently about 15 percent lower than readings from several other scintillometers with which it was compared in the field. All of the other scintillometers had larger sodium iodide crystals, however.

TKsl MIXED GRANITIC AND METAMORPHIC ROCKS OF LOOKOUT MOUNTAIN (Tertiary and (or) Cretaceous, and Precambrian)--Highly heterogeneous unit made up of several two-mica rock types that intrude, and are intimately mixed with, metamorphic rocks probably derived from Belt Supergroup and possibly from pre-Belt Supergroup rocks. Metamorphic rocks are chiefly plagioclase-muscovite-biotite-quartz schist, amphibolite, and minor gneissic monzogranite. Schist and amphibolite probably derived from Prichard Formation and mafic sills in Prichard Formation respectively; gneissic rock may be pre- or post-Belt Supergroup. Intrusive rocks include representative types from Caribou Creek and Klootch Mountain bodies, in addition to numerous dikes and irregularly shaped bodies of alaskite, pegmatite, and fine-grained equigranular rock. Mineral composition of these latter rock types extremely variable over small distances in an apparently nonsystematic manner even though rocks of a given type appear identical in hand specimen. Principal variation is in feldspar ratios that result in petrologic range from syneogranite to tonalite even in the most leucrocratic types. All rock types mixed on all scales; at some places, most lithologies occuring in unit may be found in a single outcrop, at other places, single rock type may underlie 1 km^2 or more. Distribution of metamorphic rock versus granitic rock systematic in general. Metamorphic rock progressively more abundant near contact with Prichard Formation and gneiss unit; occurs locally as irregularly shaped elongate masses up to 1 km in length, but only as thin seams and schilieren in most of unit. Southeast of dash-dot line near Trapper Peak, about 1/2 included

metamorphic rock in unit is calc-silicate rock, and may be derived from Wallace Formation of Belt Supergroup. As a whole, unit appears to be mixture of late-stage granitic materials from surrounding units mixed with metamorphic rock of varying amount.

TKsk MONZOGRANITE OF KLOOTCH MOUNTAIN (Tertiary and (or) Cretaceous)--Porphyritic two-mica monzogranite and granodiorite; average composition is monzogranite (see ternary diagram). Named for Klootch Mountain 3.5 km southwest of the map area. Potassium feldspar is microperthitic orthoclase with patches of microcline in some crystals. Size and concentration of phenocrysts vary only within fairly narrow limits except in southern and eastern parts where they are sparse or absent. Plagioclase composition averages an_{25} to an_{30}. Medium- to coarse-grained; color index averages about 6. Rock distinguished from other two-mica bodies by relatively abundant 2.5-to 4-cm potassium feldspar phenocrysts and by micas of about the same size as other groundmass minerals. With few exceptions, micas in all other two-mica bodies have notably smaller grain size than other minerals in rock. Potassium feldspar is microperthitic orthoclase with patches of microline in some crystals. Size and concentration of phenocrysts vary within fairly narrow limits except in southern and eastern parts where they are sparse or absent. Plagioclase composition averages an_{25} to an_{30}. Rock locally contains poikilitic muscovite 1 to 1.5 cm across. Most rock has no primary preferential orientation of mineral grains, but subtle nonpenetrative foliation and lineation present at many places south of map area. Radioactivity of this

unit generally 20 to 50 percent higher than most two-mica units of Selkirk Crest complex. Several localized highs to 250 cps recorded southeast of map area. Klootch Mountain body more uniform in appearance than most two-mica units; contains other two-mica lithologies but proportion is relatively low compared to amount of "foreign" lithologies in other two-mica units. Klootch Mountain rock type is common in other units, especially Lookout Mountain unit, and occurs at lest 18 km south and 13 km east of area.

TKssl GRANODIORITE OF SEARCH LAKE (Tertiary and (or) Cretaceous)--Muscovite-biotite granodiorite. Biotite only mafic mineral. Average color index 11. Biotite:muscovite ratio variable, but averages about 8:1. Most potassium feldspar is microcline, but some untwinned crystals could be orthoclase; many contain abundant included plagioclase crystals. Average plagioclase composition an_{35}. Abundant allanite, commonly euhedral with some rims of epidote. Zircon and opaque minerals are ubiquitous, but dearth of apatite is conspicuous. Some anhedral embayed sphene crystals probably unmelted remnants of anatexis. Texture is hypidomorphic-granular to seriate; most of rock is medium-grained. Locally, especially along northeast edge, rock is slightly foliate. Contains relatively few dikes compared to other units in area. Similar to, and could be related to, granodiorite of Trapper Creek. Intrudes Prichard Formation of Belt Supergroup. Lack of foliation and dikes suggests granodiorite may be younger than surrounding granitic rocks; if so, is not related to granodiorite

of Trapper Creek.

TKsml MAFIC GRANODIORITE OF MARSH LAKE (Tertiary and (or) Cretaceous)--Medium- to fine-grained biotite granodiorite to tonalite; average composition is plagioclase-rich granodiorite. Biotite is only mafic mineral except for minor amounts of opaque minerals. Average color index about 15; high for rocks of Selkirk Crest complex. Trace of muscovite in some rocks, but could be secondary. Potassium feldspar is microcline; concentration highly variable over short distances. Average plagioclase composition an_{30}; crystals relatively unzoned. Euhedral allanite crystals with epidote overgrowths in all rocks. Zircon, opaque mineral(s), apatite, and locally, anhedral embayed sphene make up accessory mineral suite. Much of rock has subtle to pronounced foliation and (or) lineation. Foliation formed by trains of biotite crystals mixed with fine-grained granoblastic felsic minerals. Much of rock probably represents intermediate-to late-stage anatectic melting of Belt Supergroup and included mafic sills; latter probably contributed most Fe and Mg for biotite.

TKsgg GARNET-BEARING GRANODIORITE OF PEAK 5925 (Tertiary and (or) Cretaceous)--Medium-grained muscovite-biotite granodiorite and tonalite. Contains sparse pale tan xenoblastic garnets. Biotite:muscovite ratio averages about 5:1. Contains abundant epidote-clinozoisite, but unlike most nearby inrusive rocks, allanite almost absent. Potassium feldspar is microcline; occurs interstitially to all others minerals. Average plagioclase

composition is an_{25}, slightly more sodic than most Selkirk Crest complex rocks. Accessory minerals include zircon, apatite and embayed anhedral sphene. There is conspicuous absence of all opaque minerals. Has well developed foliation near margins of body; texture is seriate. Appears to have been metamorphosed. Intrudes Prichard Formation; could be part of Selkirk Crest complex or could pre-date complex. Has some affinities to tonalite of Continental Mountain.

Ktc MONZOGRANITE OF TANGO CREEK (Cretaceous)--Porphyritic muscovite-biotite monzogranite. Medium-and coarse-grained, with potassium feldspar phenocrysts to about 10 cm, average length about 5 cm. Perthitic, microcline twinning in phenocrysts is patchy; potassium feldspar in both phenocrysts and groundmass. Phenocrysts contain abundant small plagioclase crystals oriented concentrically with outer crystal form; contrasts with randomly oriented plagioclase in potassium feldspar of Boulder Mountain pluton. Concentration of phenocrysts varies considerably over short distances. Rock contains average of 0.7 percent muscovite, crystals consistently smaller than other minerals in rock, especially biotite. Size difference between muscovite and biotite contrasts with relatively equal mica sizes in Selkirk Crest complex rocks. Color index averages 7. Plagioclase averages an_{20}. Quartz typically in round crystals or crystal aggregates averaging 1 cm across. Accesory minerals include zircon, apatite, allanite, opaque mineral(s) and a small amount of sphene. Texture is porphyritic with hypidomorphic-granular groundmass; no

foliation or lineation, but phenocrysts aligned locally. Pluton has crude textural zonation; relatively finer grained seriate core roughly concentric with coarse-grained outer margin of body, but elongate in east-northeast direction. Textural zonation is irregular and two types not internally uniform. Textural contrast subtle enough that attempts to map it have been unsuccessful; both types highly porphyritic. Pluton underlies about 80 km^2 south of map area; east end cut off by Newport fault. Intrudes Proterozoic Y Prichard Formation; nowhere forms intrusive contact with any other unit. Potassium-argon apparent age of biotite from sample collected in sec. 31, T. 62 N., R. 4 W., 5.5 km south of map area is 87.2 m.y.; this is minimum age due to either slow cooling or Tertiary thermal disturbance, presumably by Selkirk Crest igneous complex. Radioactivity of Tango Creek pluton much higher (average 200 cps) than most granitic rocks in region (average 90 cps); some areas over 300 cps.

Kbm GRANDIORITE OF BOULDER MOUNTAIN (Cretaceous)--Medium- to fine-grained biotite granodiorite; contains minor muscovite. Pluton underlies about 8 km^2 in map area, about 7 km^2 west of map area, and 5 km^2 south of map area. Average color index is 13; biotite is only mafic mineral. Plagioclase composition between an_{30} and an_{35}. Potassium feldspar is microcline; generally finer grained than other minerals, locally poikilitic(?); has abundant included plagioclase similar to granodiorite of Reeder Creek in 15' map area to south. Quartz forms 1 cm phenocrysts near margins of pluton; same size as other minerals in most of body. Biotite is subhedral to anhedral, varies greatly in grain size. Accessory

minerals are zircon, apatite, and epidote; conspicuous dearth of opaque minerals. Texture is seriate in most of body. At many places around margin of pluton, rock shows chilled textures. Numerous large quartz bodies and anomalous amounts of molybdenum are present in southern part of pluton, possibly other parts. Castor and others (1980) report a core of fine-grained to microcrystalline porphyry and extensive rock alteration near center of pluton. Rock intrudes Proterozoic Y Prichard Formation and possibly other formations of Belt Supergroup up to Striped Peak Formation. Probably Cretaceous on basis of mode of occurrence and compositional and textural similarities with nearby plutons of known Cretaceous age. Rock may be separate pluton derived from same magma type as granodiorite of Reeder Creek.

Kgp MONZOGRANITE OF GRANITE PASS (Cretaceous)--Leucocratic muscovite monzogranite and biotite-muscovite monzogranite. Medium- to coarse-grained; non-porphyritic; contains no discernible directional fabric. Average color index 0 to 3; averages about 6 percent muscovite. Underlies about 17 km^2 west of map area. Relatively uniform lithologically, but appears compositionally zoned in that biotite occurs consistently, though sparsely, within outermost 0.5 km of pluton, but only locally within interior of body. Biotite commonly intergrown with muscovite in single crystals. Potassium feldspar is microcline, and plagioclase is albite (an_3 average). Unit forms distinct pluton with well defined contacts in contrast to heterogeneous intrusive masses of Selkirk complex. In study area intrudes Prichard, Burke, and Wallace Formations and southwest of map area, possibly Revett and

St. Regis Formations, all of Proterozoic Y Belt Supergroup. Muscovite from southwest part of pluton, about 5 km west of map area, yields potassium-argon apparent age of 95.4 m.y. (Miller and Engels, 1975), represents minimum age, owing to slight thermal resetting, presumably from intrusions of Selkirk Crest complex. Radioactivity of Granite Pass pluton much higher (average about 220 cps) than most granitic rocks in region (average about 90 cps); contains some areas over 300 cps.

Kr GRANODIORITE OF RUBY CREEK (Cretaceous)--Coarse-grained, porphyritic bitotie granodiorite. No hornblende observed. Average color index about 20. Potassium feldspar is mostly microcline with some micorperthitic orthoclase. Most potassium feldspar occurs as phenocrysts, almost none in groundmass. Composition of plagioclase ranges from about an_{30} to an_{45}; average is about an_{38}. Large sphene crystals abundant. Epidote as overgrowths on allanite and as anhedral crystals. Accessories include apatite, sphene, ilmenite, magnetite(?), and zircon. Porphyritic with hypidiomorphic granular groundmass. No oriented fabric in pluton. Appears to be intruded by leucocratic dikes of Selkirk igneous complex. Inclusions of rock resembling Ruby Creek pluton in Selkirk complex as much as 10 km to northeast. West edge cut off by Newport fault. Underlies about 9 km^2. Sample collected near center sec. 35, T. 64 N., R. 5 W. yields biotite apparent age of 66.7 m.y. (Miller and Engles, 1975), but is in area affected by thermal resetting presumably by granitic rocks of Selkirk Crest complex.

Kc TONALITE OF CONTINENTAL MOUNTAIN (Cretaceous)--Primarily medium-to coarse-grained biotite tonalite. Trace amounts of hornblende; has and average color index of 17. Epidote ubiquitous and abundant; many crystals have cores of allanite. Sphene abundant, although not obvious in hand specimen. Average plagioclase composition about an_{25-30}, in thin section plagioclase is water clear, almost totally free of sericitic alteration common in most plutonic feldspar. Numerous euhedral and subhedral crystals of clinozoisite and muscovite, probably products of low grade metamorphism, present in plagioclase and show strong preferred orientation in either two or three planes. These included crystals not concentric with outer crystal forms of plagioclase, but may be parallel to plagioclase crystal symmetry elements. Potassium feldspar is microcline and, like plagioclase, is water clear with no sericitic alteration. All potassium feldspar is anhedral, occupying interstices between other crystals. Most of the rock is hypidiomorphic-granualar, although poorly developed lineation and foliation are present. Most biotite, even though subhedral, appears to be interstitial to felsic minerals. Continental Mountain pluton forms two lobes joined along their western margins. Has very narrow contact metamorphic aureole; almost no megascopic recrystallization in host rock more than 100 m from pluton. Biotite from sample collected 1 km south of study area yielded K-Ar apparent age of 104 m.y. (Miller and Engels, 1975). Sample locality lies near margin of large area in which potassium-argon ages have been reset to varying degrees, age therefore considered minimum.

Kct TRONDHJEMITE (LEUCOTONALITE) (Cretaceous)--Forms small 1 to 2 km^2 mass on east side of Continental Mountain pluton. Has similarities with tonalite of Continental Mountain although relation not clear. Trondhjemite is either intruded by tonalite or is offshoot or variant of main tonalite pluton in which composition and texture have been altered by assimilation of country rock. Rock is coarse-grained muscovite-biotite trondhjemite with an average color index of 9. Plagioclase averages about an_{30} and occurs in relatively unzoned euhedral to subhedral crystals that enclose clinozoisite and muscovite. Potassium feldspar is microcline and makes up less than 1 percent of rock. All feldspars clear of sericitic alteration, probably indicating rock mildly metamorphosed. Muscovite ranges from less than 1 percent to about 3 percent of rock. Trondhjemite has hypidiomorphic granular texture; micas exhibit same interstitial relation to feldspars as biotite does in tonalite of Continental Mountain. Rock has virtually no directional fabric and contains very few inclusions. Biotite and muscovite from sample at the north end of body yields potassium-argon apparent ages of 98 m.y. and 93 m.y., respectively (Miller and Engles, 1975). These are minimum ages, as dated rock is closer to reset area than sample of tonalite of Continental Mountain mentioned above.

Khs GRANITIC ROCK OF HUGHES RIDGE-SOUTH (Cretaceous(?))--Highly altered granitic rock; feldspars too altered to establish rock name. Plagioclase sericitized, but some recognizable; average composition an_{40}. Potassium feldspar, if present, was completely sericitized. Biotite only mafic mineral recognized, but about 95

percent chloritized. Some white mica could be primary muscovite. Allanite with and without epidote overgrowths common. Minor opaque minerals, apatite, and zircon. No sphene seen. Texture is hypidiomorphic-granular; slightly to highly foliated and (or) lineated locally. Cut by thin quartz-tourmaline veins around margins. Cretaceous(?) age assignment made on basis of similarity to nearby Cretaceous plutons.

Khn GRANITIC ROCK OF HUGHES RIDGE-NORTH (Cretaceous(?))--highly sheared and altered granitic rock; feldspars too altered to establish rock name. Original texture destroyed by shearing and subsequent recrystallization. Lineated and foliated. Abundant secondary muscovite and biotite. All feldspars except some untwinned plagioclase sericitized. Rock recrystallized after sericitization to form muscovite and clinozoisite in feldspars. Rock contains abundant epidote, some allanite, and minor sphene and garnet. Cretaceous(?) age assignment based on proximity of only Cretaceous plutons.

WINDERMERE SUPERGROUP (Proterozoic Z)

Zs SHEDROOF CONGLOMERATE--Up to 3250 m thick in a northeast striking, northwest dipping homoclinal section. Unconformably overlies Wallace Formation of Belt Supergroup; gradationally underlies Leola Volcanics, latter not exposed in map area. Owing to possible repetition of part of unit by numerous close-spaced slip surfaces, actual thickness could be as little as two-thirds apparent thickness. Lower third to half of formation is boulder and pebble conglomerate with sparse interbeds of

conglomeratic feldspathic quartzite. This part of formation characteristically tan to rusty yellow-brown, and contains considerable carbonate minerals in the groundmass. Clast size ranges from over a meter to less than a centimeter; most grondmass material is sand size. Quartzite, tan dolomite, and argillite are most abundant clast types, some granitic clasts present. Sorting poor, and degree of roundness fair to good. Most clasts flattened and elongated, and show preferred orientation parallel to a pervasive slip cleavage everywhere developed in rock. All rocks examined in thin section show recrystallization even where sedimentary structures preserved. Upper part of formation is made up of conglomerate beds with green chlorite- and (or) epidote-bearing matrix. Green beds progressively more abundant higher in formation and probably reflect increasing admixture of pyroclastic material, which marks inception of volcanism that dominated during Leola time. In upper 200 m, thin basalt flows, phyllitic quartzite, and metagraywacke beds, probably tuffaceous, are abundant. Other than color, abundance of volcanic material, and large proportion of quartzite and metagraywacke beds, upper part of formation similar to lower part. Aalto (1971) considers all or most conglomerate in Shedroof to be of glacial marine origin. Evidence within map area for glacial origin is not conclusive.

BELT SUPERGROUP (Proterozoic Y)

Ywa_2 WALLACE FORMATION, UPPER ARGILLITE--Black to gray, phyllitic to schistose argillite. Most rock is highly phyllitic. One or more well developed slip cleavages most places, especially in Hughes ridge area. Pencil slate common where two intersecting cleavages developed. Were not destroyed, bedding ranges from thinly laminated light and dark gray layers to silty argillite that shows no bedding features. Cross lamination, channel-and-fill and graded beds present in laminated part of section. Tan to gray dolomite and limy dolomite beds to 2m thick sparsely scattered through section; normally separated by more than 100m of carbonate-free argillite. Near base, 15 to 20m of vitreous medium-grained quartzite containing sparse clasts of quartzite up to 2 cm across. Grades bed-by-bed upward through narrow transition to argillite. Thickness of unit is about 1425 m as calculated from outcrop width; figure is estimate only owing to probable unmapped structures and effect of slip cleavage. Unit is unconformably overlain by Shedroof Conglomerate.

Ywc_2 WALLACE FORMATION, UPPER CARBONATE--Gray and tan dolomite and limy dolomite, argillite and siltite; minor limestone. Thin-to thick-bedded, platy-to blocky-weathering. On Hughes Ridge, about 1/4 of unit is white fine-grained dolomitic marble; weathers into 3 to 10 cm slabs that show fine internal layering. Algal structure present but not abundant. About 1/3 of unit is interlayered argillite and siltite. Much of

carbonate is argillaceous and (or) arenaceous. Unit forms conspicuous rusty red soil. Forms poor exposure most places, but locally is well exposed. Apparent thickness calculated from outcrop width is about 490 m. Top of unit is base of quartzite of upper argillite unit (Ywa_2); bottom is base of lowest thick carbonate bed.

Ywa_1 WALLACE FORMATION, LOWER ARGILLITE--Light to dark gray laminated argillite and siltite; most is highly phyllitic. In isolated outcrops indistinguishable from upper argillite unit. Internal stratigraphy poorly understood, but most common lithology is laminated to thinly bedded argillite with no carbonate beds. About 150 m of section on mountain just west of Continental Mine is largely thin bedded, unlaminated, slightly hornfelsed argillitic siltite. Intensely deformed locally by multiple slip cleavages, especially on Hughes Ridge. Thickness unknown due to internal deformation and faulting; apparent homoclinal section east side Upper Priest River valley may be cut by normal fault(s).

Ywc_1 WALLACE FORMATION, LOWER CARBONATE--Tan and white dolomite and limy dolomite interlayered with quartzite, siltite, and argillite. Carbonate occurs as separate beds and as mineral grains in quartzite and siltite. Carbonate minerals leached out of rock over large areas. Appears to be about 335 m thick as calculated from outcrop width, but consistant placement of lower contact questionable owing to large gradational interval

and similarity of unit to underlying unit. Contains graded beds, deformed mud cracks, soft sediment slumpage features, and irregular bed thickness. Where sedimentary structures not destroyed by cleavage, identical to lower Wallace of Miller and Clark (1975). Mapped with Ywa_1 and Ywcs on south part of Hughes Ridge because of intense deformation and extremely poor exposure there. Best preservation and exposures just west of Continental Mine. Commonly hornfelsed within 2 or 3 km of most plutons except Continental Mountain pluton. Carbonate beds make up about half of unit; interlayered clastic beds other half.

Ywcs WALLACE FORMATION, CALC-SILICATE UNIT--Interlayered white fine-grained quartzite, brown and white siltite, and pale green calc-silicate rock. Almost all bedding features destroyed by slip cleavage prior to metamorphism. Plagioclase, actinolitic tremolite, and minor garnet are most common calc-silicate minerals. Reddish brown layers and seams apparently were argillite beds; metamorphosed to quartz, plagioclase, and phlogopitic biotite. S_2 which formed by intense development of slip cleavage and was subsequently thermally metamorphosed remains as white, pale green, and red-brown layering in hornfels. All primary sedimentary features destroyed. Calc-silicate layers sparse in some areas, possibly due to pre-metamorphism leaching of carbonate minerals. This unit could represent quartzitic transition zone from upper part of Ravalli Group to carbonate-rich lower Wallace Formation. Thickness

unknown owing to destruction and re-orientation of bedding by slip cleavage.

Yr RAVALLI GROUP UNDIVIDED--Interlayered siltite, quartzite, and argillite. Intensely folded and cleaved by axial plane slip cleavage prior to thermal metamorphism. Northern belt on east side of Continental Mountain pluton predominantly white to pale gray siltite and quartzite. Argillite zones occur chiefly as bedding plane partings, and layers up to 2 m thick; separated by much greater thicknesses of siltite and quartzite. No bedding preserved in argillite; all phyllitic or schistose. Quartzite and siltite in layers from a few cm to several m in thickness. Thicker layers may be primary beds not destroyed by slip cleavage; thinner layers are S_2. Quartzite and siltite exposed in fold axes at south end Hughes Ridge are pale gray and vitreous. Unit contains fair amount of structurally intermixed phyllite and schist derived from argillite. In north belt, upper part generally quartzitic and lower part siltitic; may correspond roughly to Revett and Burke Formations, respectively. Thickness unknown due to cleavage and folding.

Yb BURKE FORMATION--Siltite, quartzite, and minor argillite, probably part of Burke Formation, but identification not positive. Hornfelsed by Granite Pass pluton. Siltite and quartzite beds pale gray to pale tan, range from few cm to few m in thickness; generally, the coarser the grain size, the thicker the bed.

Argillite pale to dark gray, thin-bedded to laminated; contains secondary sericite, chlorite and biotite. Only lower 400 m, as calculated from outcrop width, are exposed. Some siltite beds contain thin carbonate-bearing zones. Graded bedding and cross-lamination locally preserved. Formation gradational downward into Prichard Formation through increase in laminated argillite and thick quartzite beds. Top not exposed in area.

Yp PRICHARD FORMATION--Argillite, quartzite, and siltite. Relatively unmetamorphosed west of Upper Priest Lake except within about 200 m of Granite Pass or Tango Creek plutons. High greenschist to low amphibolite metamorphism in belts south and east of Continental Mountain pluton. Within 1/2 to 2 km of Selkirk Crest complex, highly deformed and metamorphosed; sillimanite and andalusite common in much of this zone. Primary sedimentary structures preserved only locally in latter two areas, well preserved west of Upper Priest Lake. Upper 150 to 300 m dark and light gray laminated argillite interbedded with thick fine-grained quartzite beds. Grades downward into about 750 m of dark and light gray laminated argillite similar to than in uppermost part of formation, but with almost no quartzite interbeds. Thick argillite zone grades downward into interbedded siltite, argillite and quartzite. Siltite and quartzite form 10 cm to 2 m thick zones that show poor to well developed internal bedding. Most weathers lighter than fresh rock. Argillite chiefly medium to dark gray, forms layers from less than 1 cm to 10 m thick; moderately well to very well

developed laminations within layers. Most rock, especially argillite and siltite, contains abundant pyrite and (or) pyrrhotite and has rust colored iron-stained surfaces. About 1500 m exposed in study area, but accurate estimate not possible due to folding in eastern part. About 5180 m reported by Miller (1974) in Newport 1 quadrangle 50 km to southwest.

Yd METADIABASE SILLS--diabase sills of tholeiite composition. Range from 2 m to at least 500 m in thickness; intrude Prichard Formation only. Thicker sills differentiated to slight degree; have pegmatitic segregations commonly localized about 3/4 of distance from bottom to top of sill. Plagioclase (an_{30} average), hornblende, minor quartz, epidote, microcline, and opaque minerals make up most of sills. Bishop (1973) reports 1320 m.y. rubidium-strontium isochron age for sill 53 km to east. Uranium-lead age on zircon from same sill is 1430 m.y. (Elston and Bressler, 1980).

gn PORPHYROBLASTIC GNEISS (Precambrian(?))--Highly cataclastic, but totally recrystallized, biotite-potassium feldspar-quartz-plagioclase-gneiss. Porphyroblasts of microcline and microperthitic orthoclase, the latter including patches of microcline, average about 4.5 cm, some up to 10 cm. Plagioclase composition averages an_{22}. Muscovite occurs only as secondary mineral. Contains abundant sphene, zircon, allanite, and apatite. Probably metaplutonic rock; average composition granodiorite, but protolith could have been

different. Composition highly variable on local scale due to variation in porphyroblast concentration. Almost all potassium feldspar is in porphyroblasts; rocks with few porphyroblasts are near tonalite composition. Most porphyroblasts show some effects of milling. Much of biotite in small flakes, in part disaggregated from larger crystals by cataclasis. Quartz and plagioclase from 0.04 cm to 1 cm, all cataclasized; grain size largely a function of degree of cataclasis. All products of cataclasis are recrystallized. Color index of groundmass varies between about 10 and 20, even on local scale. Groundmass and porphyroblasts show lineation and (or) foliation to some degree throughout unit; however, degree of fabric development variable on local scale. Mixed with abundant dike and sill material of Selkirk Crest complex; contacts gradational over wide interval, and placement necessarily somewhat subjective. Age unknown, but may be pre-Belt Supergroup on basis of possible depositional contact of Prichard on gneiss near mouth of Boundary Creek, 14 km east of map area.

STRUCTURE

The Newport fault separates two fundamentally different terranes; the Selkirk Crest igneous complex and its associated high rank metamorphic rocks on the east, and barely metamorphosed Belt Supergroup rocks intruded by relatively high-level plutons on the west. This contrast in style and degree of metamorphism appears to be consistent from the north end of Upper Priest Lake, southward for the entire strike length of the fault, about 200 km. South of the map area, where the fault is locally exposed, it appears to dip west at a low to moderate angle, but no dips have been directly measured. About 45 km south of the map area, where there is relatively good control on the surface trace of the fault across irregular topography, a dip of 30 degrees to the west was calculated for three separate localities. Northward from where the dip was calculated, the fault appears to steepen.

The N. 40 W., strike of the fault near Upper Priest Lake bends to a roughly south strike just south of the map area; the fault maintains this orientation with only small divergences to just north of the Pend Oreille River, 60 km to the south. The hill at the north end of Upper Priest Lake is the northernmost point at which the fault is well located and the metamorphic contrast across the fault exists.

Northward from Upper Priest Lake, the character of the Newport fault becomes progressively different from that of the southern part. Neither the metamorphic contrast across the fault nor a well defined zone of brittle cataclasis that characterize the southern part of the fault is apparent. Though concealed, the fault is fairly well located to about 4 km south of the Continental Mountain pluton by juxtaposition of Belt Supergroup units; the Wallace Formation on the west side strikes directly into the Prichard

Formation on the east side. Even though it is not exposed, the fault must curve eastward out of the Upper Priest River valley 4 km south of the Continental Mountain pluton, because north of that point distinctive subdivisions of the Wallace Formation cross the valley. Three km northest of where the fault exits the valley, a high angle fault trending N. 45 W., relatively up on the southwest side, offsets the apparent northward projection of the Newport fault and exposes a higher structural, but lower stratigraphic level. The Newport fault apparently continues northeastward, but the labeled segment that passes south of Trapper Peak and up the valley of Grass Creek may or may not be the main trace.

The fault zone labeled as Newport fault(?) on the map is well exposed on the ridge south of Trapper Peak. Although the rocks there are highly deformed in a zone 100 to 200 m wide, the deformation clearly ended before metamorphism associated with emplacement of the Selkirk Crest complex was complete. All products of cataclasis are recrystallized and no indication of the brittle response characteristic of rocks cut by the fault south of Upper Priest Lake is apparent. Either the Newport fault(?) in the Trapper Peak area is a different fault and is older than both the Newport fault to the south and the Selkirk complex, or it represents a relatively deeper part of the Newport fault. The latter interpretation is preferred because it seems unlikely that a regional structure having the size and extent of the Newport fault would die out over so short a distance. The progressively diminishing metamorphic contrast across the fault north of Upper Priest Lake, therefore, probably represents exposure of progressively deeper erosional levels. Even though the northern segment of the fault is the same as, and developed contemporaneously with, the rest of the Newport fault, thermal metamorphism associated with the Selkirk Crest complex outlasted movement on the fault at these deeper levels.

Rocks in the northwestern third of the quadrangle are dynamothermally metamorphosed and contrast markedly with both the Selkirk Crest complex east of the Newport fault and the relatively pristine (low greenschist static metamorphism) Belt Supergroup rocks west of the fault. These dynamothermally metamorphosed rocks include all Belt Supergroup and Windermere Group rocks west of the Upper Priest River, and most of those flanking the Continental Mountain pluton. The metamorphism appears to pre-date that associated with emplacement and subsequent uplift of the Selkirk Crest complex. The same dynamothermal-static metamorphic contrast exists 90 km southwest of the map area across the southern Colville Valley, where Belt Supergroup rocks occur on the east side of the valley and the Deer Trail Group on the west side (Miller and Clark, 1975). The Deer Trail Group and overlying Windermere Group are dynamothermally metamorphosed, and have a consistent northeast strike. This northeast strike is notably different from, and appears to truncate, a generally north striking unmetamorphosed Belt Supergroup section that is not overlain by the Windermere. The two sections are separated by the Jumpoff Joe fault which is different from, but may be related to the Newport fault. Both sections across the Colville Valley are unconformably overlain by the same Lower Cambrian quartzite formation.

In the Continental Mountain area, neither the contrast in structural trends nor the break between dynamothermal and static metamorphic conditions is clear. The Granite Pass pluton separates essentially unmetamorphosed Prichard Formation on the southeast from highly folded, cleaved, and folitated rocks of the Ravialli Group(?) and Wallace Formation on the northwest. In the Prichard Formation on Plowboy Mountain, almost none of the argillitic rocks are phyllitic and even fine structures such as cross-lamination are preserved. However, in the Ravalli(?) and Wallace rocks north of the pluton,

only locally is bedding recognizable, and almost all argillitic rocks are highly phyllitic or schistose.

East of the Upper Priest River the boundary between metamorphic styles is either gradational or masked by metamorphism and structures related to emplacement of the Selkirk Crest complex. The Prichard Formation on the east side of Grass Creek is thermally metamorphosed and locally shows tight folds that appear to be related to, and increase in frequency towards the Selkirk Crest mass. Even so, at distances less than 1 cm from the Selkirk Crest rocks, sedimentary structures are locally preserved even though apparent thermal metamorphic effects extend 3 km from the Selkirk Crest mass. Immediately west of Grass Creek and the Newport fault(?), no sedimentary structures are preserved, including bedding, except at a few isolated localities. For at least 1 km west of the inferred trace of the fault, all of the rock consists of homogeneous-looking phyllite or schist. At the northern end of the quadrangle, between Blue Joe and Grass Creeks, the phyllite and schist appear to grade westward into Prichard Formation in which sedimentary structures are preserved. West of the mouth of Blue Joe Creek, development of cleavage and schistosity increase progressively again, westward to the fault that crosses Blue Joe Creek. The Ravalli Group(?) and Wallace Formation west of this fault are highly cleaved, tightly folded, and highly phyllitic. This style of deformation continues westward to the edge of the quadrangle and is developed in the Shedroof Conglomerate also. Although the development of cleavage and schistosity lessens a few km west of the fault that crosses Blue Joe Creek, in general, it is a primary characteristic of this entire belt of rocks and contrasts markedly with metamorphic structures in the same formations south of the Granite Pass pluton and east of the Newport fault(?).

At least three northwest striking high angle faults of apparently

different ages have been mapped; others with small displacements may have gone unidentified. The two faults north and south of the Cretaceous Granite Pass pluton do not cut that body, but the fault south of the Continental Mountain pluton is younger, because it cuts the Tertiary and (or) Cretaceous Selkirk Crest complex. This fault offsets steeply dipping contacts of the Wallace Formation only about 1.5 km in an apparent right lateral sense. However, the same fault offsets the trace of the Newport fault several km in the same apparent sense, suggesting that the dip of the Newport fault here is much more shallow than to the south.

The dash-dot contact shown within the mixed rocks of Lookout Mountain unit is the boundary between rock with mica schist inclusions on the west and rock with both calc-silicate and mica-schist inclusions on the east. The only substantial amount of carbonate rock in the Belt Supergroup in this region is in the Wallace and Striped Peak Formations; all nearby Prichard sections are devoid of carbonate rock. The dash-dot contact presumably delineates a pre-or syn-Selkirk Crest complex fault even though no fault as such now exists.

Internal structures such as foliation and lineation in the Selkirk Crest complex rocks are extremely subtle except around the margins and locally within specific units. Preferred orientation of these structures decreases gradually inward from the margins, but can be observed locally within the interior part where included material is abundant.

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