UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Preliminary geologic map of the Smith Peak area, Bonner and Boundary Counties, Idaho

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 auspices of the Regional Framework Studies Program and the Branch of Western Regional Geology. All the maps are 15' blocks photographically mosaiced from published 7.5' topographic quadrangles. The preliminary geologic map 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 that interested parties do not have to wait until completion of the entire 2^{o} sheet. In addition, a greater amount of information can be presented on a more detailed base of the preliminary maps, than will appear on the final 2^{o} compilation.

The preliminary maps are more detailed and accurate than reconnaissance maps, but because they are the outgrowth of 2^{o} scale mapping and limited by the haste necessary to cover so large an area in a reasonable length of time, they are not the quality of U. S. Geological Survey 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. In northeastern corner, includes glacial lake beds deposited in Kootenai River valley

Qls LANDSLIDE DEPOSITS (Quaternary)--Mixed fragmental debris from rapid movement slides, and large, essentially unbrecciated blocks that have moved only slightly.

COMPLEX OF SELKIRK CREST

The igneous complex of Selkirk Crest is a large mass of predominantly muscovite-biotite granitic rocks in the Selkirk Mountains between the Priest River valley and the Purcell trench. All of the two-mica bodies making up the complex are closely related to one another in age, composition, and origin. They 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. Most of the rocks making up the complex are probably of anatectic origin, but some units may represent pre-existing bodies that were relatively unaffected by the anatexis. Although older, these pre-existing rocks are included with the complex, as they were incorporated in the mass as discrete bodies of rock and emplaced with the complex.

The composition of the complex as a whole varies between relatively wide limits, although the extremes of these limits can be found within almost all of the individual constituent bodies (see degree of variation within individual units on modal diagrams). The rock units differ from one another primarily in texture, and to a lesser degree in composition, but in any particular unit, dikes, pods, or small bodies of almost all other units occur as small intrusions or inclusions. Almost all contacts, both internal to and between major map units making up the complex, are gradational over wide intervals.

All dated rocks within the complex have yielded concordant or near concordant potassium-argon ages between 44 m.y. and 54 m.y. on coexisting mica pairs (Miller and Engels, 1975), but these numbers may represent cooling or uplift ages. Some elements of the complex may be Cretaceous two-mica rocks that were caught up during emplacement of the mass. The "mixed rock" units, TKsl, TKsb, and TKsrr, contain numerous screens and pendants of Belt Supergroup rocks. Because both isotopic and relative ages of the major constituent two-mica bodies, and the possibly older incorporated units that make up the complex are so poorly understood, the individual units are described as they occur, roughly from west to east.

Although most of the two-mica granitic rocks that make up the Selkirk complex are considered to be of anatectic origin, the modifying terms, two-mica and muscovite-biotite are used with no genetic connotations.

TKscc GRANODIORITE OF CARIBOU CREEK (Tertiary and (or) Cretaceous)-- Composition ranges from tonalite to monzogranite, but most is granodiorite (see modal diagram). All rocks contain biotite and almost all contain muscovite; average muscovite:biotite ratio is 1:3. Color index averages 6, but ranges from 4 to 10. Quartz is generally gray to purple-gray; amount varies within relatively narrow limits, but potassium feldspar content has extreme variations ranging from about 3 percent to almost 40 percent. Typical rock is medium-to-coarse-grained, non-porphyritic, and shows no primary directional fabric. Common textural variations include medium- to fine- grain equigranular two mica rock, and sparsely porphyritic rock with groundmass similar to that found in the typical Caribou Creek granodiorite. The sparsely porhyritic type is found along the west fork of Smith Creek, and the equigranular type about 1.5 km south of West Fork Lake. Grain size of micas is noticeably smaller than average grain size of rock; distinguishes this unit from some others. All contacts gradational over distances ranging from a few hundred meters to more than 1 km. Caribou Creek body extends 8 km west of map area, almost to Upper Priest Lake, where body is in contact with granodiorite of Trapper Creek (Miller, 1982). Unit underlies about 75 km^2, mostly west of map area.

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 of concentrated crystals and some of almost no potassium feldspar. Size of individual feldspar-concentration domains varies from cubic centimeters to cubic meters. Plagioclase composition ranges from an_{24} to an_{32}. Trace amounts of muscovite in most rocks, but could be secondary. Medium- to coarse-grained. Has poorly developed foliation at some places, and locally has segregated mineral bands. Zone of leucocratic two-mica monzogranite about 300 m wide in Continental Mountain map area to west (Miller, 1982) has almost double amount of radioactivity (170 cps[1/]) as rest of unit (about 90 cps). Unit extends 10 km to southwest where it is cut off by Newport Fault.

1/ Counts per second. 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.

TKssl GRANODIORITE OF SEARCH LAKE (Tertiary and (or) Cretaceous)--Muscovite-biotite granodiorite (see modal diagram). Biotite only mafic mineral. Average color index 11. Muscovite: biotite ratio variable, but averages about 1:8. 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 enhedral with some rims of epidote. Zircon and opaque minerals are ubiquitous, but dearth of apatite is conspicuous. Some anhedral embayed sphene crystals probably remnants undigested during anatexis. Texture is hypidiomorphic-granular to seriate; most of rock is medium-grained. Locally, expecially along northeast edge, rock is slightly foilate. Contains relatively few dikes compared to other units in area. Compositionally similar to, and could be related to granodiorite of Trapper Creek which crops out 8 km west of map area. However, lack of foliation and included dike rock suggests granodiorite may be younger than surrounding granitic rocks; if so, is probably not related to granodiorite of Trapper Creek. Intrudes Prichard Formation of Belt Supergroup. Extends 9 km to southwest and underlies about 28 km^2.

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. Named for Lookout Mountain, 10 km southwest of Smith Peak (west of map area). Metamorphic rocks are chiefly plagioclase-muscovite-biotite-quartz schist, amphibolite, and minor gneissic monzogranite. Schist and amphibolite probably derived from Prichard Formation of Proterozoic Y Belt Supergroup and mafic sills in Prichard Formation respectively; gneissic rock may pre- or post-date Belt Supergroup. Intrusive rocks include representative types from Caribou Creek, Shorty Peak, and Klootch Mountain bodies, in addition to numerous dikes and irregular shaped bodies of alaskite, pegmatite, and fine-grained equigranular rock. Compositions of these latter rock types are extremely variable over small distances. Composition varies principally in feldspar ratio resulting in petrologic range from syenogranite to tonalite (trondhjemitic). All rock types mixed on all scales; at some places most lithologies found in unit may be found in a single outcrop, at other places single rock type may underlie 1 km^2 or more. Metamorphic rock progressively more abundant northwest of Cutoff Lake; on Red Top and northwest of Hidden Lake metamorphic rock occurs as irregular shaped elongate masses up to 1 km in length. South from Cutoff Lake, metamorphic rock occurs only as thin seams and schlieren making up less than 1 percent of unit. As a whole, unit appears to be mixture of late stage granitic materials from surrounding units mixed with metamorphic rock in varying amounts.

TKsk MONZOGRANITE OF KLOOTCH MOUNTAIN (Tertiary and (or) Cretaceous)--Porphyritic two-mica monzogranite and granodiorite; average composition is monzogranite (see modal 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 long potassium feldspar phenocrysts and by micas of about the same size as other groundmass minerals; in eastern part of body, however, poikilitic muscovite occurs as grains 1 to 1.5 cm across. Most rock has no primary preferentially oriented fabric, but a subtle non-penetrative foliation and lineation is present at many places. Radioactivity of this unit generally 20 to 50 percent higher than most two-mica units of Selkirk complex (see map). Several localized highs to 250 cps recorded. Klootch Mountain body more uniform in appearance than most of Selkirk complex; contains other two-mica lithologies but proportion is relatively low compared to diversity within other units of the complex. Extends at least 5.5 km west of map area.

TKsp MONZOGRANITE OF SHORTY PEAK (Tertiary and (or) Cretaceous)--Medium-grained monzogranite and granodiorite; average composition monzogranite (see modal diagram). Characterized by small equant potassium feldspar phenocrysts that average 1 to 2 cm in size. Both phenocrysts and groundmass potassium feldspar are microperthitic orthoclase with patches of microcline. Contains muscovite and biotite; ratio averages 2:5. Both micas occur as thin 1 to 2 mm flakes disseminated through the groundmass; size of micas smaller than other groundmass minerals. Appearance of rock is variable owing to differences in grain size, concentration of phenocrysts, and local development of both primary and secondary foliation. Most rock non-foliated, except for eastern part. Foliation in eastern part due chiefly to protoclastic or cataclastic flowage of deformed quartz grains around other minerals, with subsequent recrystallization of quartz; probably related to late stage movements (relatively high level) during emplacement of the igneous complex of Selkirk Crest. Shorty Peak two-mica rock underlies about 55 km^2 in map area and extends north of U.S.-Canadian border. All contacts are gradational.

TKsb MIXED TWO-MICA ROCKS OF BALL CREEK (Tertiary and (or) Cretaceous)--Monzogranite to tonalite; average composition granodiorite. Color index averages about 7. Muscovite:biotite ratio varies more widely than in most units, from about 1:10 to about 1:1. Large variation in texture and grain size as well as in composition. Medium-to coarse-grained, but locally fine-grained. Texture ranges from seriate to even grained; small discontinuous areas of sparse, small, poorly formed phenocrysts. Alaskite and pegmatite dikes and pods common. Contact between Ball Creek and bounding units is gradational over wide zone. In north half of area, unit resembles Klootch Mountain rock, but is more heterogeneous with respect to texture and composition. Locally prophyritic in northernmost part with well formed 3 cm long phenocrysts, but

concentration of phenocrysts even in porphyritic areas is irregular.

TKsrr MIXED GRANITIC ROCKS OF RUSSELL RIDGE (Tertiary and (or) Cretaceous)--Highly heterogeneous mixture of two-mica granitic rocks, and locally, metamorphic rocks. Granitic varieties include tonalite of Snow Peak, leucocratic even-grained monzogranite, alaskite, and pegmatite. Composition and texture highly variable over short distances. Extensive areas of abundant pods and disaggregated mafic schist bands in slightly, but irregularly, foliate leucocratic monzogranite and pegmatite. Almost all granitic rocks contain abundant muscovite. Biotite is only mafic mineral. Potassium feldspar is abundant, but concentration varies greatly from place to place; all is microcline. Plagioclase averages an_{40} in mafic-bearing rocks and an_{18} in leucocratic rocks. Metamorphic rocks include schist, gneiss, mafic schist, and hybrid rocks that show complete gradation from metamorphic to granitic-looking rocks. Schist probably derived from Proterozoic Y Prichard Formation, mafic schist from meta diabase sills in Prichard, and gneiss from the porphyroblastic granitic gneiss unit. Hybrid-looking rocks probably represent late stages of anatectic conversion of protolith to two-mica granitic rocks. Russel Ridge body extends unknown distance to northeast and southeast. This unit in map area is small apophysis west of Snow Peak body, main mass lies east of Snow Peak body in map area to east.

TKssp TONALITE OF SNOW PEAK (Tertiary and (or) Cretaceous)--Tonalite to granodiorite; average composition tonalite. Biotite is chief mafic mineral; occurs as thin flakes much smaller than other major minerals in rock. Pale green epidote with allanite core is ubiquitous throughout unit and makes up as much as 1 percent of rock. Color index averages 14; ranges from 11 to 17, high for most units of igneous complex of Selkirk Crest. Potassium feldspar is microperthitic orthoclase. Almost all potassium feldspar is in small, sparse, irregularly distributed phenocrysts and only locally in fine-grained intergranular crystals. Plagioclase averages an_{40}, but appears to be slightly more sodic in eastern part of unit. Pale lavender-gray quartz contrasts with white feldspars. Almost no muscovite in rock, except along east edge where small amounts occur near gradational contact with mixed granitic rocks of Russell Ridge. Texture is medium-grained seriate; sparsely and irregularly porphyritic. Contains moderate amount of light gray fine-grained dikes; number, size, and textural and compositional variety increase eastward toward mixed granitic rocks of Russell Ridge. Unit forms north-south trending belt just east of map area, but extent is unknown.

(End description of igneous complex of Selkirk Crest)

Rm MONZONITE OF LONG CANYON (Triassic?) - Leucocratic pyroxene-hornblende monzonite to quartz monzonite (note difference in compositional range of quartz monzonite between IUGS-Streckeisen classification and traditional U.S. usage of term). Extremely

heterogeneous with respect to composition, texture, and included material. Hornblende is ferrohastingsite. Pyroxene is hedenbergite and occurs entirely as cores in hornblende. Color index is about 8. Potassium feldspar mostly microcline, but some untwinned crystals could be orthoclase. Plagioclase conspicuously unzoned; has composition range from an_{24} to an_{30}. Apatite, allanite, and especially sphene are abundant throughout. Fine- to coarse- grained; typically medium-grained, but seriate and slightly porphyritic. Quartz is fine grained, interstitial, and averages less than 3 percent of rock. Most rock has strong foliation and (or) lineation. Directional fabric common locally, associated with strongly developed cataclasis in rock, but cataclasis may be superimposed on primary fabric. Contains abundant included material and irregular dikes, some associated with monzonite, some younger; found in all parts of the body, and commonly make up more than 20 percent of the rock. Inclusions are elongate and oriented; derived mostly from older porphyroblastic gneiss and Prichard Formation. Pluton includes abundant pegmatitic and alaskitic dikes and segregations associated with monzonite, in addition to younger dikes associated with Selkirk Crest igneous complex. Monzonite forms elongate tapering mass that appears to dip eastward; underlies about 15 km^2. Elongate shape may have been completely or in part attained during emplacement of Selkirk complex. Intrudes porphyroblastic gneiss. Tentative age assignment based on lithologic similarity to Triassic monzonitic intrusive bodies in western United States (Miller, 1977), and total chemical and mineralogical dissimilarity with Tertiary and Cretaceous granitic rocks in the region. Radioactivity slightly above average for most granitic rocks in region, but contains numerous localized areas of high radioactivity with readings up to 710 cps.

BELT SUPERGROUP (Proterozoic Y)

Yp PRICHARD FORMATION

Highly deformed sillimanite grade schist and hornfels; derived from argillite, siltite, and quartzite. Contains numerous zones of amphibolite and garnet amphibolite, presumably derived from diabase sills commonly found in Prichard Formation. Primary sedimentary structures only locally preserved. No internal stratigraphy preserved due to deformation. Contains 1 to 4 zones of leucocratic highly cataclasized granitic rock, presumably anatectic1y derived from Prichard Formation or pre-Belt Supergroup rocks. Anastomosing granitic zone(s) range in thickness from 300 m to less than 1 m. Prichard contains abundant pyrite and(or) pyrrhotite and has iron oxide-stained surfaces. Contact relations with prophyroblastic gneiss ambiguous owing to deformation; gneiss could intrude Prichard or Prichard could be depositional on gneiss. Anomalously coarse-grained pebble-bearing arkosic quartzite near contact with gneiss suggests depositional unconformity.

gn PORPHYROBLASTIC GRANITIC GNEISS (Precambrian(?))--Highly cataclastic, but totally recrystallized, biotite-potassium feldspar-quartz-plagioclase-gneiss. Probably metamorphosed plutonic rock; composition averages granodiorite (see modal diagram) 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. Porphyroblasts are microcline and microperthite with patches of microcline, and average about 4.5 cm, some as large as 10 cm. Plagioclase composition averages an_{22}. Muscovite occurs only as a secondary mineral. Contains abundant sphene, zircon, allanite, and apatite. Color index of groundmass about 20 on east edge of unit; decreases progressively to about 10 on west edge. Most porphyroblasts show some effects of cataclasis. Much of biotite in small flakes, in part disaggregated from larger crystals by cataclasis. Quartz and plagioclase from 0.05 cm to 1 cm all cataclasized; grain size largely a function of degree of cataclasis. All products of cataclasis are recrystallized, however. Groundmass and porphyroblasts show lineation and (or) foliation to some degree throughout unit; degree of fabric development variable on local scale, however. Age unknown, but may be pre-Belt Supergroup on basis of possible depositional contact of Prichard on gneiss near mouth of Boundary Creek.

STRUCTURE

The Smith Peak map area includes the north-central part of a "metamorphic core complex." Although informally termed the Priest River crystalline/metamorphic complex by Rehrig and others (1982), the informal name, igneous complex of Selkirk Crest is preferred for several reasons. Chiefly, the complex is unlike most of the so-called metamorphic core complexes of western North America (Coney, 1980), in that it consists almost entirely of granitic rather than metamorphic rocks. Secondly, the name Priest River crystalline/ metamorphic complex conflicts with an earlier named metamorphic unit, the Priest River Group (Daly, 1912). In addition, although the complex flanks the Priest River valley, it does not underlie it, whereas the Selkirk Crest wilderness area is located near the center of the complex.

The complex itself is made up of over a dozen units, most of which are two-mica granitic rocks. These units, although distinguishable, are all very similar to one another, and appear to have been emplaced as a single mass rather than sequentially as a series of individual plutons over a period of time. Essentially simultaneous emplacement is suggested by wide gradational zones between units and by orientation of large and small scale structural elements that conform more closely to the form of the mass as a whole than to the shape of individual constituent units. In addition, small intruive bodies and (or) inclusions of almost any unit can be found in almost any other unit. Most of the complex is considered to be of anatectic origin. Textural and mineralogical features that distinguish individual units are probably the result of both compositional inhomogeneties originally present in the protolith, and from a wide range in physical conditions that developed in different parts of the complex as it was emplaced.

Individual units are irregular in form, but most are elongate roughly north-south. Primary foliation and orientation of flattened inclusions are generally, but not everywhere, parallel to contacts between units. Exceptions to this parallelism are most common in the interior parts of the complex where foliation is poorly developed, inclusions less abundant, and measurable directional fabric more randomly oriented. Cataclasis and secondary

penetrative structures are best developed near the margins of the complex. Along the northeast margin, minor fold axes and mineral lineations are oriented both parallel and normal to the general northwest strike of the complex, suggesting multiple stage deformation. It is not known if this 12 km long segment of the margin of the complex within the map area is representative of the eastern margin in general, however.

The eastern side of the monzonite of Long Canyon appears to be a fault along part of its length. The contact is relatively straight along this segment suggesting the dip of the fault is relatively steep or vertical. Relative motion appears to be down on the east, but total displacement is probably not great.

The only major fault in the area is an inferred structure concealed beneath the Quaternary deposits along the margin of the Kootenai River valley. At the latitude of the map area, the Kootenai River Valley is coincident with the Purcell Trench, a major structural and geomorphic feature that extends from the U.S.-Canadian boundary, south for a distance of about 190 km. The trench is recognizable for about 280 km north of the boundary, but may not be structurally controlled for at least part of that distance (Rice, 1941). Cataclasis in the Prichard Formation increases progressively outward in the range towards the margin of the trench. Mylonitic rocks are found in and along the foothills of the mountains several places south of the map area. If this bounding fault and associated mylonite is similar to those bounding other "metamorphic core complexes", it is east dipping with relatively upward motion on the west or footwall (Coney, 1980). No chlorite breccia is associated with the exposed mylonitic rocks in the map area, but it could be concealed beneath the valley fill.

About 10 km west of the map area, the west side of the Selkirk complex is terminated by the Newport fault, a similar, but west dipping fault that is locally exposed along the east side of the Priest River valley. Chlorite breccia is extensively developed along this fault, especially in the southern part. Both of these faults, but especially the one in the Purcell Trench, appear to be nearly coincident with the original border of the complex along part of their lengths.

Although only one fault is shown on the map, others might be found with closer spaced traverses and if better exposure existed in areas covered by extensive glacial-alluvial material or heavy forest cover. Considerable movement, distributed across zones between individual units, probably occurred during emplacement of the complex, but these zones do not constitute faults.

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