U.S. DEPARTMENT OF THE INTERIOR

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Preliminary geologic map of the Wigwams area, Bonner and Boundary County, Idaho

By

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INTRODUCTION

This map is part of a 1:48,000-scale preliminary geologic map series covering the Sandpoint $1^{o}x2^{o}$ quadrangle. The maps of this series are being Open-Filed in order to make geologic information available as the project progresses so that interested parties do not have to wait for completion of the entire $1^{o}x2^{o}$ sheet. In addition, a greater amount of information is presented at the 1:48,000-scale of the preliminary maps than will appear on the final compilation. The bases for all maps in the series are 15-minute blocks formed by photographic mosaics of published 7.5' topographic quadrangles.

The preliminary maps are more detailed and accurate than reconnaissance maps, but because they are the outgrowth of 2-degree-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 of similar scale released in more formal publication series such as GQ or MI maps. The map information is relatively detailed in some areas but almost reconnaissance in others, so all maps in this series should be considered preliminary and subject to refinement.

DESCRIPTION OF MAP UNITS

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

PRIEST RIVER COMPLEX

On several earlier maps of this series (Miller, 1982a; 1982b; 1982c; and 1983), the Priest River complex was referred to as the igneous complex of Selkirk Crest. At about the time those maps were prepared and since then, these rocks were designated the Priest River complex by others in a number of publications (e.g., Reynolds and others, 1981; Rehrig and Reynolds, 1981; Rhodes and Hyndman, 1984; and Rehrig and others, 1987); that name is adopted here for conformity.

The Priest River complex is a large mass of predominately muscovite-biotite granitoid rocks and lesser amounts of metasedimentary and metaigneous rocks. The east part of the complex lies between the Purcell trench and the east arm of the Newport fault. The central part extends under the spoon-shaped Newport fault and the western part continues for as much as 20 km west of the western arm of the fault (see index map). All of the two-mica granitoid bodies making up the complex are closely related to one another in age, composition, and origin. They are probably not distinct, sequentially emplaced plutons, but rather an igneous complex that appears to be a single composite intrusive mass. Textural and mineralogical features that distinguish individual two-mica bodies of the complex probably result from localized physical conditions, and compositional inhomogeneities that developed as, or were present when, the complex was emplaced. The protolith of the metasedimentary part of the complex was Middle Protoerozoic Belt Supergroup rocks.

Most of the granitoid rocks making up the complex are probably of anatectic origin, but a few specific units appear to represent pre-existing plutonic bodies that were relatively unaffected by the anatexis. These older rocks include pre-Belt(?) orthogneiss, Proterozoic mafic sills in the lower Belt, and pre-Cretaceous(?) Mesozoic granitoid plutons. Although older and forming discrete bodies with distinctly different compositional and textural characteristics, these pre-existing plutonic rocks are included with the complex, because they are wholly contained within it, and attained their present configuration and position, relative to units surrounding them, when the complex was emplaced.

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, mineralogic characteristics and, to a lesser degree, in bulk 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 (between different lithologies within a heterogeneous unit) and between major map units making up the complex, are gradational over intervals ranging from tens of m to over one km.

All dated rocks within the complex east of the Newport fault have yielded concordant or nearly concordant potassium-argon ages between 44 m.y. and 54 m.y. on coexisting mica pairs (Miller and Engels, 1975), but these numbers probably represent cooling or uplift ages. In the western part of the complex, potassium-argon apparent ages are progressively older westward, and in the westernmost part yield concordant 100 m.y. ages on coexisting mica pairs. Archibald and others (1984) offer convincing evidence that most of the two-mica rocks of the complex are probably Cretaceous. However, a well dated Tertiary hornblende-biotite pluton intrudes the southern part of the complex near Newport, Washington, so the possibility that some of the two-mica bodies were also generated at that time cannot be totally dismissed. Partly because the isotopic and relative ages of both the constituent two-mica bodies and the older(?) incorporated granitic units are not fully resolved, and partly because relative age relationships between the two-mica bodies are ambiguous, the individual units are assigned equivalent ages and are described as they sequentially occur, roughly from west to east.

Although most of the two-mica granitic rocks that make up the Priest River complex are considered to be of anatectic origin, the modifying terms, two-mica and muscovite-biotite are used without genetic connotation.

TKpk 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 at the west edge of the map area. Potassium feldspar is microperthitic orthoclase containing patches of microcline in some crystals. Concentration of 2.5 to 4 cm-long 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 is medium to coarse grained; color index averages about 6. Distinguished from other two-mica bodies by relatively abundant potassium feldspar phenocrysts and by micas that are about the same size as other groundmass minerals; in eastern part of body, poikilitic muscovite occurs as grains 1 to 1.5 cm long. Rock has no primary oriented fabric, except for a randomly occurring, subtle, non-penetrative planar and linear alignment of some minerals. Along western margin, rock has pronounced foliation and lineation associated with Eocene emplacement of complex and development of Newport fault. Klootch Mountain body is more uniform in appearance than most of Priest River complex; body 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 and 22 km north of map area. Appears to be gradational eastward into both the mixed two-mica rocks of Ball Creek and mixed granitic rocks of Camels Prairie. Radioactivity of this unit is generally 20 to 50 percent higher than most two-mica units of Priest River complex (see map). Several localized highs to 250 cps (counts per second)1/ recorded in map area to north.

TKpcb MAFIC GRANODIORITE OF CAVANAUGH BAY (Tertiary and (or) Cretaceous)--In Wigwams map area, occurs only at western edge; in adjacent map area, extends southwestward for 11 km to Newport fault zone. Following description applies to entire body, not just the part in Wigwams map area. Most rock in unit is biotite granodiorite; average color index about 14. Noticeably more mafic than average for overall complex. Contains only trace amounts of muscovite except at a few places. Porphyritic; potassium feldspar phenocrysts range from 1.5 to 4 cm, average about 2 cm. Concentration of phenocrysts highly variable from a few per m^2 of outcrop to several hundred per m^2. Heterogeneous with respect to composition, texture, and mineralogy, but not as much so as most units in Priest River complex. Grain size ranges from fine to coarse, but part of variability due to deformation of minerals during and after emplacement. More than half of this unit in map area to west falls within a highly sheared zone adjacent to Newport fault. Near fault, large potassium feldspar (orthoclase) and plagioclase (average an_{30}) crystals are cataclastically rounded with extensive development of fine-grained quartz and feldspar trains. Almost all rock in western part of unit is foliated and lineated. Lineation consists of aligned elongate clusters of biotite grains and disaggregated quartz grains. Tectonic segregation of most biotite into elongate and flattened clusters defines poorly

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1/ All radioactivity measurements made with Geometrics model GR-101A scintollometer. 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.

developed foliation, which conforms to margin of complex, but not necessarily to margins of body. In eastern part of mass, most biotite is not restricted to plane of foliation. Fine-grained, equigranular, gray dikes and coarse pegmatite dikes common throughout unit. Dikes show cataclasis, particularly in western part of unit, but in places cross-cut main cataclastic foliation.

TKpc MIXED GRANITIC ROCKS OF CAMELS PRAIRIE (Tertiary and (or) Cretaceous)--Mixed leucocratic two-mica granitoid rocks with numerous dikes and metamorphic rocks. Basically same assemblage of granitic rocks as in TKpm, but Camels Prairie unit consistently contains less than 10 percent metamorphic rocks. Large proportion of metamorphic rocks are amphibolite and gneiss; only minor schist. Proportion of metamorphic rocks progressively increases toward TKpm unit and progressively decreases northeastward. Most abundant granitic rock in unit appears to be even-grained two-mica monzogranite, but dikes, pods, and irregular-shaped masses of pegmatite and alaskite are extremely abundant throughout. In much of unit, both color index and texture are highly variable over distance of a few meters but in some parts (e.g., southwest of Dodge Peak) are relatively uniform. Color index ranges from about 1 to 15; average estimated to be in lower third of that range. Equigranular and seriate are most common textures, but irregularly deformed primary foliation discontinuously developed in much of body. Paucity of attitudes is function of not only sparse foliation development, but widely spaced traverses.

TKpm MIXED GRANITIC AND METAMORPHIC ROCKS (Tertiary and (or) Cretaceous)--Chiefly leucocratic two-mica granitic rocks, schist, amphibolite, and minor gneiss. Granitic rocks range in composition from tonalite to alkalic monzogranite; color index generally between 5 and 10, even in tonalite. Most rocks contain muscovite and biotite, some only biotite. Allanite ubiquitous, garnet locally common, sphene absent. Plagioclase averages sodic andesine, even in tonalite; potassium feldspar is perthitic orthoclase, microcline locally. Granitic part of unit is extremely heterogeneous; made up of large and small irregular-shaped bodies and dikes that grade by texture and(or) composition into one another. Most common granitic type is even-grained two-mica monzogranite, but extensive areas underlain by dikes and non-tabular bodies of pegmatite and alaskite. Much rock in this unit, most of which lies to west of map area along Newport fault, has an irregularly developed foliation and lineation, probably related to deformation associated with Newport fault.

Metamorphic rocks, chiefly sillimanite-muscovite-biotite-plagioclase-quartz schist, make up about 25 to 45 percent of unit. Andulusite abundant at some places. Amphibolite interlayered with metasedimentary rocks; both are commonly garnet-bearing. Metamorphic rocks occur mainly as screens and irregular bodies from a few ten to a few thousand meters in length. Shape and orientation of bodies are irregular, but generally elongate parallel to foliation in metamorphic rock, especially in western part of unit. On outcrop scale, distribution of small metamorphic pods in granitic rocks is extremely variable but some are found almost everywhere in unit. Pegmatite and alaskite dikes cut nearly all metamorphic masses, regardless of size. Most metamorphic rocks probably derived from Middle Proterozoic Prichard Formation.

TKpb 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 from about 1:10 to about 1:1, a greater range than in most units of Priest River complex. Large variation in texture and grain size as well as in composition. Most rock is medium to coarse grained, but irregular-shaped fine-grained pods and masses from centimeters- to tens of meters-long occur throughout the unit. Texture ranges from seriate to even grained. Isolated areas have sparse, small, poorly-formed potassium feldspar phenocrysts; most of unit is non-porphyritic, except in northernmost part, which has well-formed 3-cm-long phenocrysts. Even there, however, distribution of phenocrysts is irregular. In north half of area, unit resembles Klootch Mountain rock, but is more heterogeneous with respect to texture and composition. Alaskite and pegmatite dikes and pods common, especially in central and southern part of unit. Contact between Ball Creek unit and bounding units is gradational over a zone, averaging 300 m wide. Contacts south of Roman Nose, and west, south, and east of Dodge Peak are particularly uncertain because gradational zone is widest there.

TKpsp TONALITE OF SNOW PEAK (Tertiary and (or) Cretaceous)--Biotite tonalite to biotite granodiorite; average composition tonalite. Biotite occurs as thin flakes much smaller than other major minerals in rock. Pale green epidote with allanite cores is ubiquitous throughout unit and makes up as much as 1 percent of rock. Color index averages 14; ranges from 11 to 17, higher than most units of Priest River complex. Potassium feldspar is microperthitic orthoclase. Almost all potassium feldspar forms small, sparse, irregularly distributed phenocrysts and at only a few places forms fine-grained groundmass 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 in easternmost part of unit in map area to east. Texture is medium-grained seriate; sparsely and irregularly porphyritic. Contains scattered, light-gray, fine-grained dikes; number, size, and textural and compositional variety increase eastward. Unit forms north-south-trending belt just east of map area, but extent is unknown.

hc GRANODIORITE OF HUNT CREEK (Cretaceous? or Proterozoic?)--Medium- to coarse-grained biotite granodiorite. Highly porphyritic; potassium feldspar phenocrysts range in size from 2 to 10 cm, average about 4 cm. Potassium feldspar is orthoclase with minor microcline in some crystals; proportion of microcline increases westward. Potassium feldspar is pale pink and occurs chiefly as phenocrysts; very little in groundmass. Color index averages about 8; biotite and opaque minerals are only mafic minerals. Small amount of muscovite interlayered with opaque minerals is probably secondary. Abundant allanite and zircon, but no sphene. Rock has poorly developed foliation and(or) lineation commonly marked by alignment of phenocrysts or by smeared out trains of comminuted quartz crystals. Orientation of foliation irregular on outcrop scale. Varying degrees of intergranular cataclasis throughout unit, but increasing southwestward. Composition and texture of Hunt Creek body is much more uniform than other units of Priest River complex, even though abundant pegmatite and two-mica dike rocks are present in it, especially around margins. Unit extends nine km to Newport fault in map area to west. Forms thin, discontinuous band around part of Klootch Mountain mass. Unit is thought to be either an older granitic rock or a polymetamorphosed extension of porphyroblastic granitic gneiss unit (gn), caught up in two-mica rocks of Priest River complex and smeared out as a screen between Klootch Mountain unit on west and various two-mica units on east. Even though Hunt Creek rock more closely resembles several Cretaceous plutons of hornblende-biotite suite of Miller and Engels (1975), than it does Precambrian(?) porphyroblastic granitic gneiss, proximity and alignment with latter unit suggest Hunt Creek body could be related to it. Radioactivity of Hunt Creek rock and associated rocks within unit is higher than any other in Priest River complex. Response averages 150 cps, and in a few areas is as high as 350 to 400 cps.

gn PORPHYROBLASTIC GRANITIC GNEISS (Proterozoic?)--Biotite-potassium feldspar-quartz-plagioclase-orthogneiss. Average composition of orthogneiss is granodiorite (see modal diagram) but composition of protolith may have been different. Composition variable over a few meters due to variation in porphyroblast concentration. Almost all potassium feldspar is in porphyroblasts; rock with few porphyroblasts is 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. Rock contains abundant sphene, zircon, allanite, and apatite. Color index of groundmass averages about 14, but where extensively exposed in map area to north, averages about 20 in east part of unit, decreasing progressively to about 10 on west edge. Most porphyroblasts show some tectonic rounding. Much biotite occurs as small flakes resulting from disaggregation of larger crystals. Quartz and plagioclase from 0.05 cm to 1 cm are broken and rehealed, their grain size largely a function of degree of breakage. Groundmass and porphyroblasts show lineation and(or) foliation throughout unit; degree of development ranges from intense to barely perceptible. Only southernmost end of gneiss exposed in map area; unit extends 28 km northward to Canadian border. Non-contiguous Hunt Creek unit (hc) may be southern extension. Age unknown, but may predate Belt Supergroup on basis of similarity to a gneiss 37 km south of map area dated at 1576 m.y. by U-Pb on zircon (Evans and Fischer, 1986).

STRUCTURE

The Wigwams map area includes the central part of the Priest River complex (Reynolds and others, 1981) that lies between the Priest River valley and Purcell trench. That part of the complex within the map area is subdivided into eight units, most of which are two-mica granitic rocks. One, and probably two, of these units, although defined as part of the complex, are almost certainly older than the two-mica granitic units that compose the bulk of the complex. North and west of the map area, the complex has been subdivided into 13 additional units; about 1/3 of the eastern part of the complex lies south of the map area and is unmapped.

The lithologic units making up the complex, although distinguishable from one another, are all similar. They appear to have been generated and emplaced as a single mass, during a single event, rather than sequentially as a series of individual plutons. Essentially simultaneous emplacement is suggested not only by lithologic similarity of units, but 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 shapes of the individual constituent units. In addition, almost any particular unit contains small intrusive bodies and(or) inclusions of both contiguous and non-contiguous units.

Individual units are irregular in form, but most are elongate roughly north-south. Primary foliation and orientation of flattened inclusions are generally parallel to the outer form of the complex, but in places are parallel to the outer form of individual 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 istotropic. Ductile and brittle cataclasis and secondary penetrative structures are best developed near the margin of the complex east of the map area and near the Newport fault to the west. Along a 12 km segment of the northeast margin of the complex in the map area to the north, minor fold axes and mineral lineations are oriented both parallel to normal to the general northwest strike of the complex, suggesting polyphase deformation. It is not known, however, if that segment of the margin is representative of the eastern margin in general.

Three north-northwest-striking faults are exposed at only a few localities and their strike, extent, and the amount of movement along them is poorly constrained. The easternmost fault is exposed on the ridge about 2 km northwest of Roman Nose. There, it forms a chloritized breccia zone about 1 m wide that strikes about N30W and dips 40° west. It appears to offset gently-dipping contacts of several two-mica bodies between the ridge where it is structural and geomorphic feature that extends south from the United States-Canada boundary about 190 km, and north from the boundary about 280 km. It may not be structurally controlled for at least part of that distance north of the boundary (Rice, 1941). At the latitude of the Wigwams map area, fabric development in rocks of the complex increases progressively eastward toward the trench. Mylonitic rocks are found discontinuously in and along the foothills of the mountains at several places north and southeast of the map area. Although there are no known exposures of the inferred fault within the United States part of the Purcell trench, this fault has been interpreted as a detachment fault bounding the Priest River complex (Reynolds and others, 1981; Miller, 1983; Rhodes and Hyndman, 1984; Rehrig and others, 1987).

About 10 km west of the map area, the Priest River complex is structurally overlain by the hanging wall of the discontinuously exposed west-dipping eastern limb of the U-shaped Newport fault. The complex is presumably continuous beneath the fault, as it is exposed west of the Pend Oreille River valley, west of the east-dipping western limb of the Newport fault. The Newport fault, therefore, appears to bound a shallow flap of supracrustal rocks above the asymmetric Priest River complex (Harms, 1982). The Priest River complex then, extends from an inferred detachment fault in the Purcell trench to about 10 km west of the Pend Oreille River valley where it intrudes Paleozoic and Proterozoic rocks. Eocene potassium-argon cooling ages on the east side of the complex and Cretaceous concordant potassium-argon ages from similar rocks on the west side (Miller and Engels, 1975) are interpreted to indicate that the east side represents deeper Cretaceous crustal levels relative to the west side, and date the uplift attendant to movement on the detachment faults as Eocene.

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