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To Accompany Map MF-1192-C

MINERAL RESOURCE POTENTIAL OF THE SALMO-PRIEST WILDERNESS STUDY AREA PEND OREILLE COUNTY, WASHINGTON, AND BOUNDARY COUNTY, IDAHO

SUMMARY REPORT

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U. S. Geological Survey and the U. S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studied. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Salmo-Priest Wilderness study area (RARE E6-981, A1-981), Kaniksu National Forest, Boundary County, Idaho, and Colville National Forest, Pend Oreille County, Washington. The area is being considered for inclusion in the wilderness system.

SUMMARY

The geologic and geochemical evaluation has pointed out no evidence to suggest a significant exploration target exists in the study area, with the possible exception of the areas of anomalous gold values.

The mineral resource survey indicates that the area has low potential for metallic and energy minerals, fossil fuels, and geothermal resources. Nonmetallic potential, notably shale, is abundant, but adequate supplies are adjacent to the Lehigh cement company plant in Metaline Falls, Washington.

Introduction

The Salmo-Priest Wilderness study area is about 62 mi^2 (160 km^2) and lies 85 mi (135 km) north of Spokane, Wash., in the rugged mountains east of Metaline Falls, Wash. The area is bounded by the United States-Canadian border on the north (fig. 1).

To appraise the mineral resource potential of the Salmo-Priest study area, geologic mapping and geochemical stream-sediment sampling of the area were done by the U. S. Geological Survey in 1978 (Miller, 1982). The U. S. Bureau of Mines searched for all known mining claims within the study area and took rock samples for prospects or mine workings in 1976 and 1978. These studies were supplemented by aeromagnetic, airborne gamma-ray spectrometry, and reconnaissance gravity surveys by the U. S. Geological Survey (Pitkin and Duval, 1980).

Geology

Rocks in the study area range in age from Proterozoic to Cenozoic. They include (ascending order) the Belt Supergroup (Proterozoic Y), Windermere Group (Proterozoic Z and Proterozoic Z?), Gypsy Quartzite (Cambrian), Maitlen Phyllite (Cambrian), tonalite and tronhjemite (Mesozoic), and glacial and alluvial deposits (Quaternary).

Argillite, siltite, and quartzite of the Proterozoic Y Belt Supergroup crop out in the southeast corner of the study area. These rocks, here designated undivided Belt Supergroup, most closely resemble the Wallace Formation of the Belt Supergroup. Much of this part of the section, however, also resembles the Burke, St. Regis, and parts of the Prichard Formations of the Belt Supergroup. The rocks consist of phylittic or schistose laminated argillite and siltite that locally have iron-oxide stained outcrop surfaces and contain pyrite and pyrrhotite.

Rocks that propably are part of the Wallace Formation overlie the undivided Belt unit. The lower part of the Wallace Formation consists of carbonate rocks, dolomite, and limy dolomite interbedded with lesser amount of phyllitic argillite. It forms a sinuous belt that underlies part of the east edge of the study area. The upper part is made up chiefly of dark-gray argillite with sparse interbeds of carbonate rocks. None of the Belt Supergroup is known to contain significant mineralization in or nearby the study area, except for the lead-silver deposit at the Continental Mine 2.4 mi (4 km) east of the study area.

The Windermere Group consists of (ascending order) the Shedroof Conglomerate, Leola Volcanics, Monk Formation, and Three Sisters Formation of Walker (1934). The Shedroof Conglomerate of Proterozoic Z age crops out in a northeast-striking northwest-dipping homoclinal section in the eastern part of the study area. The Shedroof unconformably overlies the Wallace Formation of the Belt Supergroup and gradationally underlies the Leola Volcanics. No mineral deposits or indications of significant mineralization are in or associated with the Shedroof Conglomerate within the study area. The Shedroof, like the Three Sisters Formation of Walker (1934), however, is a Precambrian conglomerate and, as such, cannot be ruled out as a possible host to low-grade large-tonnage gold deposits.

The Leola Volcanics of Proterozoic Z age is made up almost entirely of greenstone derived from basalt flows and tuffaceous and volcaniclastic rocks. The formation appears to grade downward into the Shedroof Conglomerate. No mineral deposits or indications of significant mineralization in or associated with the Leola Volcanics have been found within study area.

The Monk Formation of Proterozoic Z age is a heterogeneous unit that consists chiefly of argillite, but contains substantial amounts of dolomite, conglomerate, and quartzite. The Monk rests in apparent unconformity on the Leola Volcanics and appears to grade upward conformably into the Three Sisters Formation of Walker (1934). Other than a small talc prospect in metamorphosed dolomite about 0.6 mi (1 km) outside the proposed wilderness area, no mineral deposits have been identified in the Monk Formation.

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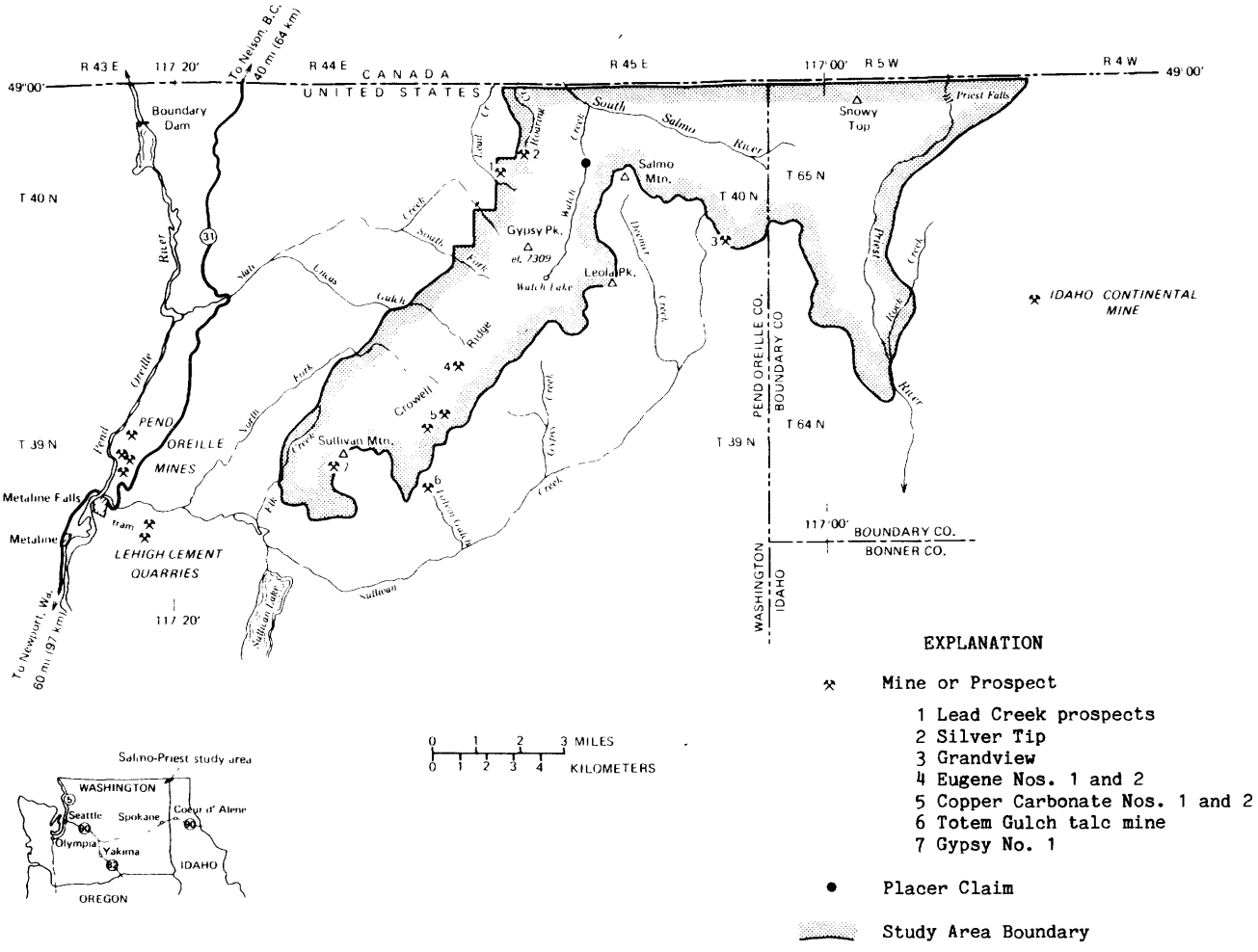

Figure 1.--Location of Salmo-Priest Wilderness study area, Pend Oreille County, Washington, and Boundary County, Idaho.

The Three Sisters Formation of Walker (1934) is probably Proterozoic Z in age. In the study area, it is made up of conglomerate, conglomeratic quartzite (grit), quartzite and argillite. Although no known mineralization is in or associated with this formation in the study area, the unit is a Precambrian conglomerate, a rock type that is host to low-grade large-tonnage gold deposits in other parts of the world.

The Gypsy Quartzite of Early Cambrian age unconformably overlies the Windermere Group and gradationally underlies the Maitlen Phyllite. The Gypsy forms a relatively undeformed belt through the western part of the study area. The rock is predominantly medium- to fine-grained quartzite containing lesser amounts of conglomeratic quartzite and phyllitic argillite. No known mineral deposits or mineralization are associated with the Gypsy Quartzite in the study area.

The Maitlen Phyllite of Early Cambrian age consists of interbedded phyllite, quartzite, argillitic carbonate rocks, and carbonate rocks. No known mineral deposits or mineralization occurs in the lower part of the Maitlen Phyllite within the study area, although barren quartz veins and veinlets are common throughout the formation. West of the study area, near Metaline Falls, are numerous mines and prospect pits in the uppermost carbonate-bearing part of the Maitlen Phyllite and in the lower part of the overlying Metaline Limestone. These deposits appear to be associated with the carbonate-rich part of the Maitlen, which does not occur within the study area.

The tonalite of the Continental Mountain pluton of Mesozoic age forms two lobes joined along the west margins; part of the northern lobe underlies the northeast corner of the study area. The pluton is made up primarily of medium- to coarse-grained biotite tonalite. This pluton may be the source of mineralization at the Continental mine, about 2.5 mi (4 km) southeast of the study area; the mine was a producer of lead and silver. Host rocks for the ore deposit, the lower part of the Wallace Formation, may or may not occur in the study area, however, and no mineralization associated with the tonalite is known within the study area.

A small mass of trondhjemite, a leucotonalite, of Mesozoic age is exposed just outside the northeast boundary of the study area. No known mineral deposits or mineralization are associated with the trondhjemite.

Quaternary glacial and alluvial material mantles some areas and occurs in most modern stream channels.

Structure

The major geologic structure within the study area appears to be a west-dipping homocline broken by three high-angle faults. The apparent simplicity of this structure is unusual in that it appears to be an island of relatively undeformed terrain in a region of extreme structural complexity. West of the study area are the highly faulted and folded rocks of the Metaline district, and to the south are numerous high-angle faults. East of the study area the geologic structure is incompletely known, and one or more undetected major faults may exist in and around the Upper Priest River valley.

The largest fault recognized in the study area passes along the south and west sides of Salmo Mountain, northward into the South Salmo River valley, and then into British Columbia. Although the fault plane is not exposed, the trace of the fault appears to be relatively unaffected by topography and probably is nearly vertical.

A northeast-trending fault that separates the Monk Formation and Three Sisters Formation of Walker (1934), and a small fault in the southwest corner of the study area, offset the Maitlen Phyllite-Gypsy Quartzite contact about 3,900 ft. (1,200 m) in an apparent right-lateral direction.

The rocks below the Shedroof Conglomerate in the eastern part of the study area may be cut by one or more faults of large displacement. The Newport fault zone (Miller, 1974; Miller and Engles, 1975) may project into the Upper Priest River valley from Upper Priest Lake, although no evidence of the fault has been found north of the upper lake.

The more massive, competent units, such as the Gypsy Quartzite and the Three Sisters Formation of Walker (1934), show very little internal deformation such as minor folds, cleavage or shearing. This is in sharp contrast to the other formations, especially the Maitlen Phyllite, which nearly everywhere shows internal deformation. Argillite in the Monk Formation is so highly cleaved that it crops out rarely, and almost all tuffaceous rock or fine-grained flow rock in the Leola Volcanics is highly phyllitic and sheared. The Shedroof Conglomerate has irregular slip planes pervasively developed throughout the rock, along which stretched clasts have been reoriented at moderate angles to bedding planes.

Results of Geochemical Sampling

The collection and analysis of geochemical stream-sediment and heavy-mineral-concentrate samples permit the area of a stream drainage above a given sample locality to be tested for mineralization. Sample localities were chosen along streams and tributaries at selected intervals to maximize areal coverage (see map). All samples are composites of several samples collected from several sites along a small area of a stream; composite samples were taken to reduce the variance in sample results due to stream sorting or channel configuration.

A total of 41 samples were taken from in or near the study area. At 36 sample sites, both stream-sediment and heavy-mineral-concentrate samples were collected.

Both stream-sediment samples and heavy-mineral concentrates were analyzed by a semiquantitative spectrographic method for the following 31 elements: iron, magnesium, calcium, titanium, manganese, silver, arsenic, gold, boron, barium, beryllium, bismuth, cadmium, cobalt, chromium, copper, lanthanum, molybdenum, niobium, nickel, lead, antimony, scandium, tin, strontium, vanadium, tungsten, yttrium, zinc, zirconium, and thorium. In addition the samples were analyzed by atomic-absorption analysis for gold, zinc, and tungsten.

Samples contained what were judged to be anomalous concentrations of gold, silver, zinc, copper, arsenic, and beryllium in some of the stream sediment or heavy-mineral concentrates (tables 1, 2). Sample numbers not present in table 2 indicate sites where concentrate samples could not be collected.

Anomalous concentrations of gold were found in seven samples; the highest value was in sample 42 (6 ppm). Sample values, in order of decreasing abundance, were: sample 24, 0.5 ppm; sample 20, 0.4 ppm; sample 12, 0.2 ppm; and samples 2, 6, and 16, 0.1 ppm. The detection limit for gold in the stream-sediment samples is 0.05 ppm, and any value above this amount is considered anomalous. Four of the seven samples were pan concentrates. Gold anomalies did not appear in both sample types at any given sample site.

Gold was found in some samples that drained all formations in the study area, except the Wallace and Shedroof Formations. Proportionately, the largest number of anomalies are associated with the Three Sisters Formation of Walker (1934), followed by the Maitlen Phyllite. The source of gold may have been from numerous unconcentrated thin quartz veinlets, especially common in the Three Sisters and the Gypsy, or possibly from localized mineralization along major faults in the study area. The absence of gold in streams adjacent to those yielding anomalies suggests that these anomalies are small and localized.

Table 1.--Semiquantitative spectrographic analyses of stream sediment samples.

(All values in parts per million. Lower limits of determination are given in parentheses at head of each column. Dash, not detected at lower limit indicated; asterisk, detected below lower limit indicated.)

Map No.	Ag (0.5)	Pb (10)	Zn (200)	Cu (5)	As (200)	Be (1)	B (10)
1	-	20	*	30	-	1	100
2	-	20	*	30	-	1	100
3	-	20	*	20	-	1	100
4	-	30	*	20	-	1	100
5	-	30	*	20	-	2	50
6	-	50	*	50	-	1	150
11	-	30	-	15	-	1	70
12	-	20	-	20	-	1.5	100
13	-	30	*	50	-	2	100
16	-	20	*	70	-	1	100
17	-	15	-	100	-	1	50
18	-	20	*	70	-	1	100
19	-	30	*	50	-	1.5	100
20	-	20	*	20	-	1	100
21	-	30	*	30	-	1.5	100
22	-	20	*	20	1	1	70
23	-	30	*	30	-	1.5	100
24	-	30	*	20	-	1.5	100
25	-	30	*	50	-	2	150
26	-	30	-	100	-	1	50
27	-	20	*	20	-	1	50
27a	-	20	*	20	-	1	100
29	-	20	*	50	-	1	50
30	-	20	-	50	-	1	50
31	-	20	*	100	-	1	30
32	-	20	*	50	-	1	50
33	-	10	*	10	-	1	50
34	1	20	-	10	-	1	50
35	-	30		20	-	1	100
36	-	30	*	50	-	1	50
37	-	20	*	20	-	1.5	50
38	0.5	20	*	15	-	1	100
41	-	20	*	15	-	1	100
42	-	10	-	10	-	1	100
43	-	20	*	70	-	1	100
44	-	20	-	20	-	1.5	100
45	-	20	-	20	-	1.5	100
46	-	20	-	20	-	1	100
47	-	20	-	50	-	1	100
50	-	20	-	50	-	1	100
51	-	20	-	50	-	1	100

Table 2.--Semiquantitative spectrographic analyses of heavy-mineral concentrates of stream sediment.

(All values in parts per million. Lower limits of determination are given in parentheses at head of each column. Dash, not detected at lower limit indicated; asterisk, detected below lower limit indicated.)

Map No.	Ag (0.5)	Pb (10)	Zn (200)	Cu (5)	As (200)	Be (1)	B (10)
1	-	100	*	300	-	1	100
2	-	100	*	300	-	2	100
3	-	100	2000	200	-	1	150
4	-	100	500	70	-	1.5	100
6	-	100	300	300	200	1.5	200
11	-	50	-	50	-	*	70
12	-	150	-	300	-	*	300
13	-	200	-	300	-	*	100
16	*	50	*	300	-	*	100
17	-	20	*	200	-	*	50
18	-	50	*	300	-	*	150
19	-	100	*	300	-	1	150
20	-	150	-	200	-	*	150
21	-	150	700	300	-	1.5	150
22	-	200	700	300	-	5	300
23	-	200	700	300	-	2	150
24	-	150	700	200	-	2	100
25	-	150	-	300	-	1	200
27	-	50	-	100	-	*	300
27a	-	200	*	150	-	1	200
29	-	30	*	100	-	-	200
30	-	20	*	100	-	-	50
31	*	20	*	200	-	-	20
32	-	30	-	150	-	*	70
33	-	50	-	100	-	-	300
36	1	100	*	300	-	*	300
37	-	50	*	70	-	1	200
41	-	100	*	200	-	*	300
42	-	70	*	150	-	1	300
43	*	70	*	300	-	1	150
44	-	50	*	70	-	*	200
45	-	100	*	70	-	*	150
46	-	70	*	70	-	1	150
47	-	50	-	100	-	*	200
50	-	70	-	150	-	-	100
51	-	70	*	300	-	-	100

Two of the three silver anomalies (samples 34, 36) were from the South Salmo River. The third sample (38) may be influenced by the proximity of lead-zinc-silver mineralization in the Metaline Limestone.

Six samples contained high zinc values. As expected, the highest values were found closest to the mineralized Metaline Limestone, near the west boundary of the study area. The highest value (2,000 ppm) is in sample 3, from a stream that drains an area mostly outside the study area.

Four anomalous copper values were found in stream-sediment samples that drain the Leola Volcanics. Though anomalous for the region, these values fall well within the range 70-300 ppm Cu that is normal background for volcanic rocks of this type. For pan-concentrate samples, 300 ppm Cu is not considered anomolous.

Arsenic values occur in two of the gold-bearing pan-concentrate samples (6 and 12). These values may indicate localized mineralization along the northeast-trending fault that separates the Maitlen Phyllite from the Three Sisters Formation. Arsenic is commonly associated with gold and is also a trace element used in finding gold anomalies.

Beryllium is marginally anomalous in several samples, especially those that contain higher than normal zinc values. The beryllium concentrations, like zinc, are probably related to proximity of the Metaline Limestone which occurs west of the study area.

Airborne Geophysical Surveys

An aerial radiometric and magnetic survey of the Salmo-Priest Wilderness study area (RARE E6-981 and A1-981) was made by the U. S. Geological Survey during October 1978 (Pitkin and Duval, 1980). The airborne geophysical data define previously mapped geologic units within the study area. The radiometric data show radioelement distributions for bedrock and surficial units. These distributions appear to be within reasonable limits for the rock types involved, and there is no immediate evidence for any anomalous concentrations of radioactive elements within the study area.

The magnetic data (Pitkin and Duval, 1980) provide information on structural attitudes and define areas underlain by bedrock with differing magnetic properties. The residual-magnetic map of the study area reflects the distribution of previously mapped lithologic units and substantiates mapped faults, but no anomalous area with abnormal concentrations of magnetic material were noted.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mineral resource potential of the study area appears to be low, even though the area is adjacent to the large deposits near Metaline Falls that produced substantial amounts of zinc, lead, and silver. The mineralization in the Metaline district is restricted primarily to one formation, the Metaline Limestone, which does not occur within the study area. Results from geochemical stream-sediment sampling suggest, however, that the outer fringe of mineralization related to the Metaline district does approach the west edge of the study area. The Continental mine, about 2.4 mi (4 km) east of the study area, produced several million pounds of lead containing high silver values from veins in the Wallace Formation. The lower part of the Wallace Formation may be present as part of the undivided Belt Supergroup in the southeast corner of the study area, but no mineralization was found there.

All the other formations appear to have low mineral resource potential both within and outside the study area. A few zones, however, within individual formations are candidates as hosts for mineralization. These zones include parts of the carbonate and argillite in the Monk Formation, and the basal carbonate rocks in the lower part of the Maitlen Phyllite. No mineralization, however, was found in any of these zones within the study area.

The trondhjemite just east of the study area is a two-mica pluton but is not of the type with which uranium mineralization is associated. Ground scintillometer surveys within this body and within the tonalite of Continental Mountain consistently yielded readings below the background levels for plutons in the region. All other formations were checked with a ground scintillometer, but no anomalies were detected.

Economic Appraisal

Part of the study area is in the Metaline mining district. Between 1906 and 1977, this district produced 2,155 million pounds (964 million kg) of zinc, 420 million pounds (190 million kg) of lead and minor amounts of gold, silver, and copper. The Lehigh cement plant has a production capacity of 225,000 tons (204,000 t) of cement per year.

One placer and about 20 lode claims have been located within the study area. Seven main claims are located on figure 1. Except for prospecting, the study area has no known mining history. Only minor amounts of copper minerals, in small quartz veins, were found on two claims. The latest activity was in 1971.

The country rocks are thick sequences of shale or phyllite interbedded with quartzite, conglomerate, greenstone, and some limestone. Although shale is abundant, it seems to have no economic value; adequate resources are within tramming distance of the Lehigh cement plant. No lead or zinc deposits, such as those found in limestone host rocks near Metaline Falls, Wash., are known in the study area. A small talc occurrence, just beyond the south boundary in Totem Gulch, appears to be only of marginal interest.

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