MINERAL RESOURCE POTENTIAL OF THE BLUE JOINT WILDERNESS STUDY AREA, RAVALLI COUNTY, MONTANA, AND THE BLUE JOINT ROADLESS AREA, LEMHI COUNTY, IDAHO

By

Karen Lund and Warren M. Rehn, U.S. Geological Survey
and
John R. Benham, U.S. Bureau of Mines

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964), the Joint Conference Report on Senate Bill 4, 88th Congress, and related acts, 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 studies. 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 Blue Joint Wilderness Study Area in the Bitterroot National Forest, Ravalli County, Montana, and the Blue Joint Roadless Area in the Salmon National Forest, Lemhi County, Idaho. The Blue Joint Wilderness Study Area, Montana, was classified as a further planning area (01941) during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979. The Blue Joint Roadless Area (04941), Idaho, was included in the River of No Return Wilderness by Public Law 96-312 (July 23, 1980).

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

Blue Joint Wilderness Study Area, Montana.—A moderate to high potential for the occurrence of epithermal precious-metal vein deposits exists in areas of hydrothermal alteration and fossil hot springs activity in the Eocene volcanic rocks. A high potential also exists for copper, silver, cobalt, and barite sediment-hosted resources that occur in the Proterozoic quartz schist of the southeastern part of the study area.

A moderate potential exists for molybdenum resources resulting from a molybdenum stockwork system. Barite resources at the Woods Creek Barite No. 1 claim could not be estimated.

Blue Joint Roadless Area, Idaho.—A moderate potential for gold, silver, molybdenum, and uranium resources is present in granites at two localities.

INTRODUCTION

The Blue Joint area is in the southern Bitterroot Mountains 90 mi south of Missoula, Mont., and comprises the Blue Joint Wilderness Study Area, 96 sq mi in size, in Ravalli County, Mont., and the contiguous Blue Joint Roadless Area, 31 sq mi in size, in Lemhi County, Idaho (fig. 1).

Both areas were evaluated by the U.S. Geological Survey, but only the Blue Joint Wilderness Study Area, in Montana, was studied by the U.S. Bureau of Mines. Therefore, only mines and prospects in the wilderness study area are described.

The geology of the Blue Joint area is described in a companion report (Lund and others, 1983); the geochemistry is described in Rehn and others (in press); and the geophysical results are described in Kleinkopf and others (in press). Mines and prospects in the Blue Joint Wilderness Study Area have been described by Benham (1981).

GEOLOGY

The Blue Joint area is underlain by the Painted Rocks pluton (Eocene), which intrudes the southeastern part of the Bitterroot lobe of the Idaho batholith (Cretaceous) and its metasedimentary and metaigneous roof rocks. Proterozoic Y metasedimentary roof rocks (map unit Yq) are pure to feldspathic quartzite, phyllite, and quartz schist. Bedded copper sulfides, bedded barite, and banded iron-formation occur within the quartz schist. These rocks are tentatively correlated with the Big Creek and Yellowjacket Formations of adjacent east-central Idaho. Metaigneous complexes (unit Ygn) intrude some of the Proterozoic Y metasedimentary rocks. Amphibolite crops out along the Montana-Idaho border north of Blue Joint mountain; granodiorite gneiss crops out in the Deer Creek Point area; and granite augen gneiss and amphibolite crop out in the middle part of Woods Creek. Gray, foliated, porphyritic to nonporphyritic, medium-grained biotite granite-granodiorite (unit Kg) is the common rock type of the main phase of the Idaho batholith, which intrudes the metasedimentary (unit Yq) and metaigneous (unit Ygn) rocks of its roof north of the Nez Perce Fork of the Bitterroot River. Tertiary volcanic and volcaniclastic rocks (unit Tv) include rhyolite-rhyodacite and andesite. Volcaniclastic rocks include conglomerates containing volcanic and quartzite cobbles, and tuffaceous lake beds. Most of the volcanic rocks have been hydrothermally altered to some extent, and hot-springs deposits are present locally. The Eocene Painted Rocks pluton (unit Tg) is predominantly granite containing slightly younger, crosscutting dikes of rhyolite porphyry, granite porphyry, and andesite.

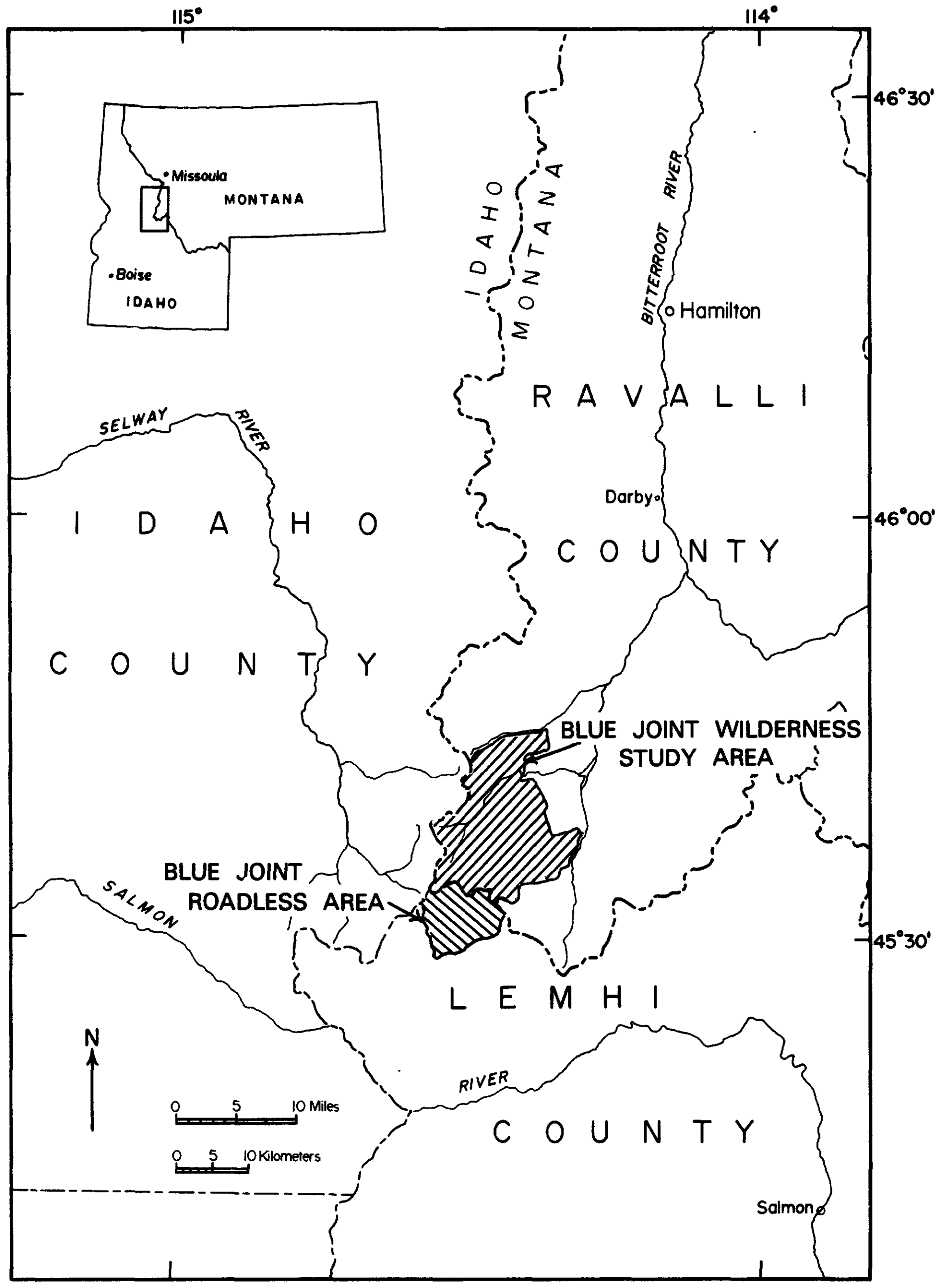

Figure 1.--Index map showing the location of the Blue Joint Wilderness Study Area (01941) and Roadless Area (04941).

Pink granite is present north of Blue Joint Creek and may be genetically related to the overlying volcanic rocks. Gray granite occurs south of Blue Joint Creek. Recent alluvium and older glacial moraine and minor glacial-lacustrine deposits (unit Q) are along the major streams within the area.

Folded and thrust-faulted Proterozoic Y metasedimentary (unit Yq) and metaigneous rocks are cut by predominantly north-northeast-trending normal faults which were associated with uplift of the Idaho batholith and intrusion of the Painted Rocks pluton. Tertiary volcanic rocks were preserved in downdropped fault blocks. These faults formed the north-northeast fracture system along which the Eocene dikes were intruded.

GEOCHEMISTRY

A geochemical study was made of the Blue Joint Wilderness Study Area and Roadless Area (Rehn and others, in press). Stream-sediment samples were taken from 165 locations, and each sample was divided into three fractions for analysis: a fine fraction (-170 mesh), and magnetic and nonmagnetic heavy-mineral fractions. Rock samples were collected from 157 locations in a 1.2-mi grid pattern and from 520 additional locations. Stream-sediment and rock samples were analyzed using a semiquantitative six-step emission spectrographic method for 31 elements (Rehn and others, in press). In addition, selected rock samples were analyzed by other chemical methods and by X-ray fluorescence for smaller numbers of elements. Water was also collected from 99 of the stream-sediment sample sites and analyzed for uranium, thorium, and alkalinity.

Statistical examination of the geochemical analyses indicated high geochemical abundance and variation in rocks in the study area, particularly for the incompatible elements beryllium, molybdenum, niobium, and tin. An attempt was made to choose categories of high and anomalously high values consistent with both statistical parameters and natural population gaps for those elements having sufficient numbers of uncensored values. For most elements, the background limit was chosen at or near one standard deviation above the geometric mean, and the limit for anomalously high values was chosen at two standard deviations above the mean, or at an obvious population gap. Element values between these two limits are considered "high." Values chosen as anomalously high for some elements are: silver in stream sediments (fine fraction), 0.5 ppm; silver in rocks, 0.35 ppm; gold in stream sediments (panned concentrates), 0.2 ppm; gold in rocks, 10 ppm; bismuth in stream sediments (nonmagnetic fraction), 20 ppm; bismuth in rocks, 10 ppm; copper in stream sediments (fine fraction), 50 ppm (background limit, 15 ppm); molybdenum in stream sediments (nonmagnetic fraction), 30 ppm (background limit, 15 ppm); molybdenum in rocks, 15 ppm (background limit, 7 ppm); tungsten in stream sediments (nonmagnetic fraction), 100 ppm; tungsten in rocks, 10 ppm; zinc in stream sediments (fine fraction), 200 ppm; and zinc in rocks, 100 ppm.

Areas were identified within the Blue Joint area which have prominent multielement anomalies in one or more sample media. These areas of anomalous values are of two types. One type consists of areas in which the geochemical variation can be ascribed to processes of differentiation which formed the granite of the Painted Rocks pluton, such as the large area around Razorback Mountain. High values for elements in these enriched areas of the pluton are not likely to be associated with mineralization. The rocks in the other type of area are altered, and anomalous values for such elements as silver, gold, bismuth, tungsten, and zinc indicate that the geochemical variation in these areas may be due to epithermal gold and silver mineralization. Areas of this type are at Bare Cone, Steep Hill, and the middle fork of Reynolds Creek.

GEOPHYSICS

The aeromagnetic and gravity studies of the Blue Joint Wilderness Study Area and Roadless Area (Kleinkopf and others, in press) outline the general geologic features of the area and give some information about possible mineralized rock. Near Bare Cone (area 1, fig. 2), closely spaced magnetic contours may indicate an extensive altered zone in the Eocene granite beneath the quartzite roof rocks. At Steep Hill (area 3, fig. 2), the magnetic values give no indication of altered or mineralized rock, but the anomalously low gravity value suggests altered rock. The altered zone in the middle fork of Reynolds Creek (area 4, fig. 2) has a corresponding flattened magnetic gradient and one-station gravity anomaly. No possible areas of concealed altered or mineralized rock were identified by the gravity and magnetic surveys.

MINING CLAIMS AND DISTRICTS

Forty mining claims have been located in the Blue Joint Wilderness Study Area; of these, 15 were lode, 23 were 160-acre placer, and 2 were 20-acre placer. Only one claim, the Woods Creek Barite No. 1, is active. There are no patented claims or mineral or energy leases. Mining activity in the Blue Joint area began in 1898 when a group of 10 prospectors located seven 160-acre placer claims in the Blue Joint placer. Since 1898 and intermittently to 1934, 15 more 160-acre placer claims were located in the Blue Joint placer. Examination of these claims revealed only a few prospect trenches and pits. Little, if any, ore appears to have been produced. Other workings and prospects inside the wilderness study area are claims in the Chicago, Last Chance, and Gold Bar placers. Nearby mining districts east and south of the Blue Joint area include the Overwich, Hughes Creek, Alta, and Mineral Point (Sahinen, 1957).

Examination of the Castle Rock, Rocky Point, Thunderhead, and Woods Creek Barite No. 1 lode claims revealed only a few prospect pits and trenches, and no evidence of production. The only minerals of interest consist of minor fluorite at the Thunderhead claim on Bare Cone and barite at the Woods Creek Barite No. 1 claim.

DEFINITION OF MINERAL RESOURCE POTENTIAL

A low mineral resource potential designation is given to areas having amounts of certain elements in samples that are between the background and anomalous limits. However, they have few or no geological characteristics generally associated with deposits containing those elements.

A moderate resource potential designation is given to areas having amounts of certain elements in samples that are anomalously high. These areas also have many, but not all, of the geological characteristics generally associated with deposits containing these elements. No mining for these elements has been done, but some exploration may have been done.

A high mineral resource potential designation is given to areas having amounts of certain elements in samples that are anomalously high, but these areas also have most of the geological characteristics generally associated with deposits containing these elements and show evidence of mining.

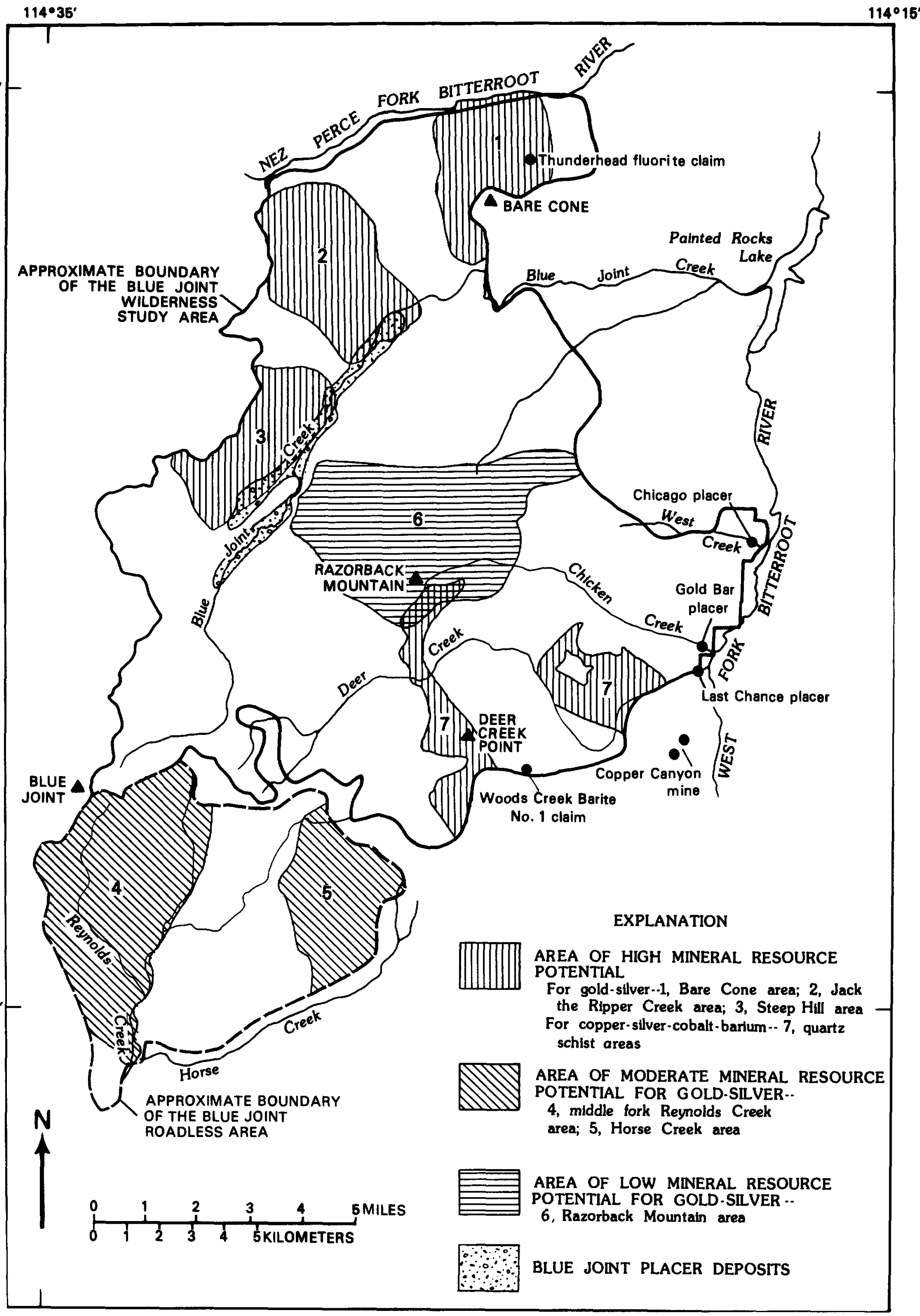

Figure 2.--Areas of high, moderate, and low resource potential for gold-silver and copper-cobalt-silver-barite, Blue Joint Wilderness Study Area and Roadless Area.

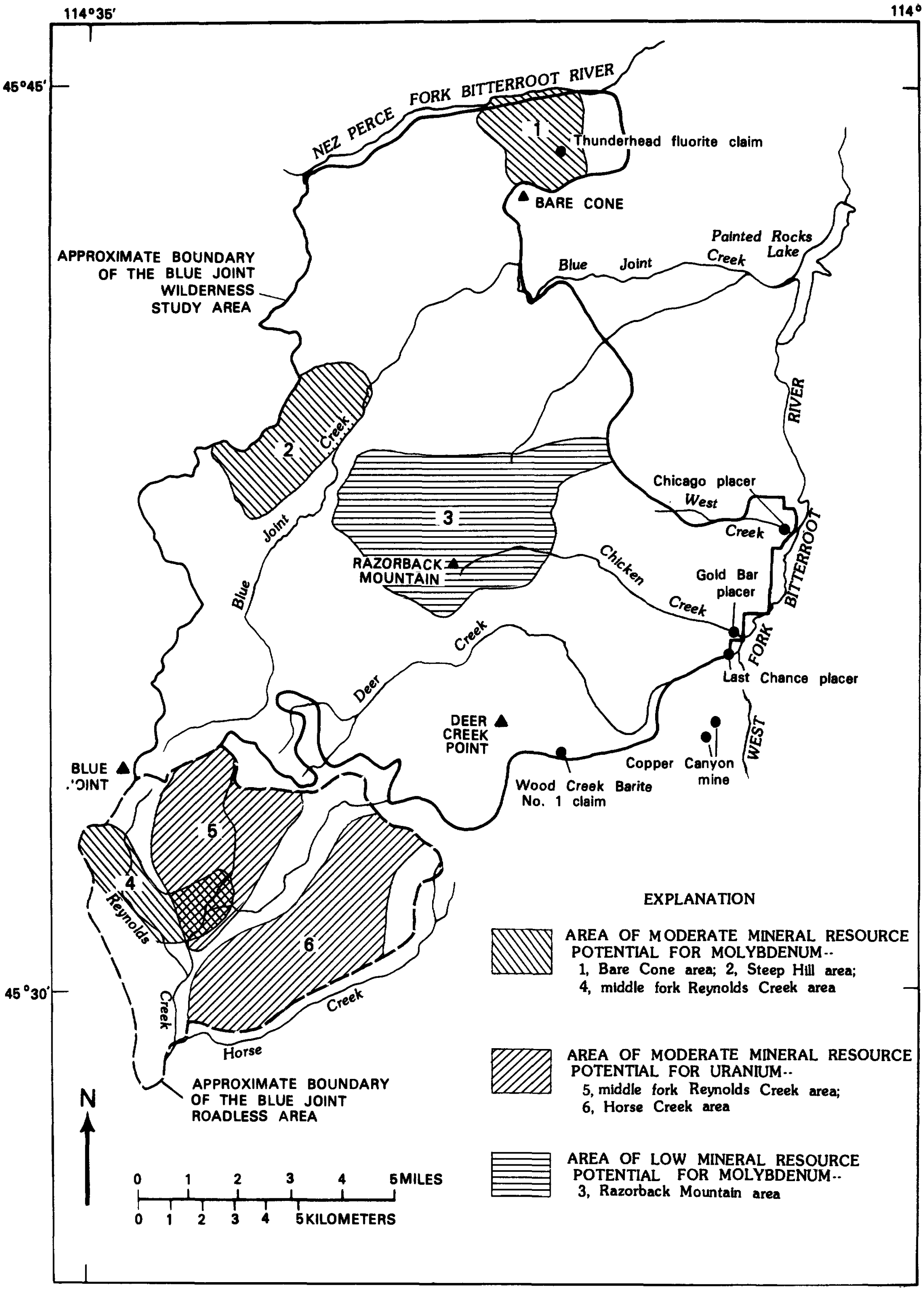

Figure 3.--Areas of moderate resource potential for molybdenum and uranium, Blue Joint Wilderness Study Area and Roadless Area.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Blue Joint Wilderness Study Area

Gold and silver

Anomalously high gold and silver values were found in samples from four areas within the Blue Joint Wilderness Study Area. Based on a comparison of geological and geochemical features common to known gold-silver deposits, three areas, around Steep Hill, Bare Cone, and Jack the Ripper Creek, are assigned high mineral resource potential. The fourth area, around Razorback Mountain, is geochemically anomalous but comparatively less favorable. In all three of the high-potential areas, quartz veins and hydrothermal-alteration minerals are present. Sinter deposits are particularly evident in Jack the Ripper Creek drainage (area 2, fig. 2). Zones of brecciation and pyrite-sericite alteration are in the Bare Cone area (area 1, figs. 2 and 3) and at Steep Hill (area 3, fig. 2). The Steep Hill and Jack the Ripper Creek areas are underlain by Eocene rhyolitic to dacitic flows and tuffs. The Bare Cone area is underlain by pink granite of the Painted Rocks pluton. In a prospect (Thunderhead claim) in the Bare Cone area, fluorite veins are exposed in a rhyolite dike. Gold, silver, molybdenum, tungsten, zinc, mercury, uranium, arsenic, bismuth, and fluorine values are anomalously high in these areas and form a favorable association of elements for the occurrence of mineral resources. The geochemistry and geology of these areas are similar to areas which contain epithermal gold-silver vein deposits (Kamilli and Ohmoto, 1977; Clifton and others, 1980), and similar to areas which contain such deposits related to hot-spring activity (Ward and others, 1981).

The area around Razorback Mountain (area 6, map A) has low mineral resource potential. Geological and geochemical studies indicate that the anomalously high values for gold and silver were the result of weak magmatic concentrations of some elements at the roof zone of the Painted Rocks pluton. The typical fractured, altered rock and quartz veins associated with a possible gold-silver deposit were not found in this area.

Although no precious-metal lode prospects have been located in the wilderness study area, placer claims are present at Blue Joint Creek (Blue Joint placer) and near the mouths of Deer, Chicken, and West Creeks (Last Chance, Gold Bar, and Chicago placers). The fine flakes of gold recovered from these placers were thought to have come from residual Tertiary gravels from an exotic source (Sahinen, 1957). However, the present study indicates that the gold found in the placers possibly came from mineralized zones in the volcanic rocks and granites.

Molybdenum (figure 3)

High molybdenum values were found in samples from three areas within the Blue Joint Wilderness Study Area, at Bare Cone (area 1), Steep Hill (area 2), and Razorback Mountain (area 3). The element assemblage at Bare Cone is silver, molybdenum, zinc, beryllium, and arsenic. On the basis of anomalously high values for these elements, plus fluorite veins (Thunderhead claim) and pyrite-sericite alteration of the granitic host rock, this area has moderate potential for a Climax-type molybdenum stockwork deposit.

Many more high molybdenum values were found in rock samples from the Steep Hill area. On the basis of the altered-rock zone and quartz veins here, and the anomalously high values for molybdenum, tungsten, silver, mercury, gold, lead, uranium, arsenic, and lithium, this area has a moderate potential for a molybdenum stockwork deposit; however, fluorine values are low, and the locality does not have all the geological characteristics of a Climax-type deposit (Westra and Keith, 1981). Complexing of molybdenum by fluorine, however, may not be the concentrating process (Candela and Holland, 1981); low-fluorine molybdenum porphyry deposits, such as the Little Falls deposit in Idaho (Rostad, 1967), are known.

The Razorback Mountain area (area 3) has low potential for molybdenum despite anomalously high values in some samples. Geological and geochemical evidence suggest that these anomalous values were from weak magmatic concentrations near the roof zone of the Painted Rocks pluton.

Copper, silver, cobalt, and barite (figure 2)

Anomalously high amounts of copper, silver, cobalt, and barium were found in outcrop samples from two areas of Proterozoic Y quartz schist (unit Yq, area 7) in the southeastern part of the wilderness study area. Regional correlations indicate that the quartz schist may be part of the Proterozoic Y Yellowjacket Formation (Berg, 1977; Lopez, 1981; Lund and others, 1983), which contains the cobalt-copper-silver deposit at Blackbird, Idaho (Bennett, 1977). The rocks of the Copper Canyon mine north of Woods Creek and 1.5 mi east of the wilderness study area are characterized by stratiform and remobilized chalcopyrite and bornite (Sahinen, 1957; Berg, 1977; Rehn and others, in press); bedded iron-formation is also present (Kelley, 1967). Bedded tourmaline quartzite and tourmaline breccia are in the quartz schist between Chicken and Deer Creeks. Bedded barite (of drilling-mud quality) occurs at the southern edge of the wilderness study area (Woods Creek Barite No. 1 claim).

The geochemical study of the wilderness study area was not detailed enough to locate areas of mineral resource potential within the quartz schist. However, considerable geochemical and geological evidence indicates that the schist has a high potential for massive sulfide deposits of the type that occur in sedimentary rocks (Morganti, 1981). The copper deposits at the Copper Canyon mine are probably of this type; also the possible correlation of the quartz schist with the Yellowjacket Formation indicates a potential for cobalt resources as well.

Blue Joint Roadless Area

Gold and silver (figure 2)

Anomalous gold and silver values in samples from the middle fork of Reynolds Creek (area 4) are associated with anomalously high zinc and tungsten values and hydrothermal minerals in the granite (unit Tg); parts of area 4 also coincide with areas of anomalous amounts of molybdenum, tin, and uranium (fig. 3, areas 4 and 5). Although area 4 has moderate potential for precious-metal deposits, it has fewer favorable geologic indicators than do areas of moderate potential in the Blue Joint Wilderness Study Area. The high gold-silver values are most likely associated with the molybdenum, tin, and uranium assemblage in area 4.

The Horse Creek area (area 5) has moderate potential based primarily on anomalous values of gold and uranium in stream-sediment samples.

Molybdenum (figure 3)

High values for molybdenum and associated tin, tungsten, uranium, and fluorine in the pyrite-sericite-carbonate altered zone in the middle fork of Reynolds Creek (area 4; Rehn and others, in press) are indicators of moderate potential for a Climax-type stockwork molybdenum system. There is a higher potential for a stockwork molybdenum system here than in areas of molybdenum occurrence in the Blue Joint Wilderness Study Area. No younger, mineralizing intrusive body has been recognized in these areas.

Uranium (figure 3)

High values for uranium were found in samples from throughout the Painted Rocks pluton and particularly in rocks of the Blue Joint Roadless Area. Anomalously high uranium values were found in stream-sediment and water samples from tributaries of the middle fork of Reynolds Creek (area 5) and the north side of Horse Creek (area 6). Samples from these areas also have high base- and precious-metal values; therefore, areas 5 and 6 are considered to have moderate potential for uranium deposits.

REFERENCES CITED

Benham, J. R., 1981, Mines and prospects in the Blue Joint Wilderness Study Area, Ravalli County, Montana: U.S. Bureau of Mines Open-File Report MLA 21-81, 16 p.; available from U.S. Bureau of Mines, Western Field Operations Center, Spokane, Wash. 99202.

Bennett, E. H., 1977, Reconnaissance geology and geochemistry of the Blackbird Mountain-Panther Creek region, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 167, 108 p.

Berg, R. B., 1977, Reconnaissance geology of southernmost Ravalli County, Montana: Montana Bureau of Mines and Geology Memoir 44, 39 p.

Candela, P. A., and Holland, H. D., 1981, The effect of fluorine on the partitioning of molybdenum between a magma and a hydrothermal fluid: Geological Society of America Abstracts with Programs, v. 13, no. 7, p. 422.

Clifton, C. G., Buchanan, L. J., and Durning, W. P., 1980, Exploration procedure and controls of mineralization in the Oatman mining district, Oatman, Arizona: American Institute of Mining, Metallurgical and Petroleum Engineers, Society of Mining Engineers, Preprint 80-143, 41 p.

Kamilli, R. J., and Ohmoto, H., 1977, Paragenesis, zoning, fluid-inclusion, and isotopic studies of the Finlandia vein, Colqui district, central Peru: Economic Geology, v. 72, no. 6, p. 950-982.

Kelley, W. N., Jr., 1967, Geology and origin of the Woods Creek iron deposit, Ravalli County, Montana: University Park, Pennsylvania State University M.S. thesis, 54 p.

Kleinkopf, M. D., Bankey, Viki, and Brickey, Michael, in press, Geophysical maps of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1557-D, scale 1:50,000.

Lopez, D. A., 1981 1982, Stratigraphy of the Yellowjacket Formation of east-central Idaho: U.S. Geological Survey Open-File Report 81-1088, 218 p.

Lund, Karen, Rehn, W. M., and Holloway, C. D., 1983, Geologic map of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1557-B, scale 1:50,000.

Morganti, J. M., 1981, Ore deposit models-4. Sedimentary-type stratiform ore deposits—Some models and a new classification: Geoscience Canada, v. 8, no. 2, p. 65-75.

Rehn, W. M., Lund, Karen, and Holloway, C. D., in press, Geochemical maps of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1557-C, scale 1:100,000.

Rostad, O. H., 1967, Geochemical case history at the Little Falls molybdenite prospect, Boise County, Idaho, in Symposium on geochemical prospecting: Ottawa, 1966, Proceedings; Canada Geological Survey Paper 66-54, p. 249-252.

Sahinen, U. M., 1957, Mines and mineral deposits, Missoula and Ravalli Counties, Montana: Montana Bureau of Mines and Geology Bulletin 8, 63 p.

Ward, S. H., Ross, H. P., and Nielson, D. L., 1981, Exploration strategy for high-temperature hydrothermal systems in the Basin and Range Province: American Association of Petroleum Geologists Bulletin, v. 65, no. 1, p. 86-102.

Westra, Gerhard, and Keith, S. B., 1981, Classification and genesis of stockwork molybdenum deposits: Economic Geology, v. 76, no. 4, p. 844-873.