MINERAL RESOURCE POTENTIAL OF THE PYRAMID ROADLESS AREA,
EL DORADO COUNTY, CALIFORNIA

SUMMARY REPORT

By
Augustus K. Armstrong and Maurice A. Chaffee
U.S. Geological Survey

and
Douglas F. Scott
U.S. Bureau of Mines

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) 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 Pyramid Roadless Area (5023), Eldorado National Forest and Lake Tahoe Basin Management Unit, El Dorado County, California. The Pyramid Roadless Area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

Studies show there is low potential for small deposits of gold, silver, and base metals in the Pyramid Roadless Area. There are two uranium claims (Cliff Ridge mining claim) located within the roadless area, but samples from this site showed no uranium. There are no indications of geothermal resources, coal, oil, or gas.

INTRODUCTION

The Pyramid Roadless Area lies near the crest of the Sierra Nevada about 75 mi east of Sacramento, Calif. The area is adjacent to and almost encircles the Desolation Wilderness and encompasses approximately 31,400 acres in Eldorado National Forest and the Lake Tahoe Basin Management Unit in El Dorado County, Calif. (fig. 1).

The area is dominated by deep rugged canyons that run eastward from the Sierra Nevada crest to Lake Tahoe Basin and westward toward the Sacramento Valley. Elevations range from about 5,500 ft in Big Silver Canyon, to 8,885 ft at Echo Peak, along the southeast boundary of the roadless area. U.S. Highway 50 provides access to the area along the south side; California Highway 89 provides access to the east side of the area; secondary roads approach the roadless area in a number of places, but access to many areas is limited to trails. The nearest population center is South Lake Tahoe, Calif., about 3 mi east of the Pyramid Roadless Area. Placerville, Calif., is about 26 mi southwest of the roadless area.

PREVIOUS AND PRESENT STUDIES

Lindgren's folios on the California gold belt (1896, 1897) cover the geology of the Pyramid Roadless Area at a scale of 1:125,000. Loomis (1963, 1964) mapped and redescribed the geology of the Fallen Leaf Lake quadrangle. Other geologic reports include a structural analysis; (1) a statistical evaluation of specific mineral variations of stocks in the eastern part of the area (Peikert, 1958, 1962a, 1962b); (2) a study of noritic bodies (Loomis, 1963), also in the eastern part of the area; and (3) a study of contact reactions in metamorphic rocks (Loomis, 1966).

A geologic map and study of the mineral resources of the Desolation Primitive Area was published by Dodge and Fillo (1967). Burnett (1971) published a study and geologic map of Lake Tahoe basin. Geologic mapping and geochemical sampling for this study were done by the U.S. Geological Survey in 1982. Personnel of the U.S. Bureau of Mines searched the literature and county mining records and conducted field investigations for mines and prospects during 1981.

GEOLOGY

MESOZOIC

Metamorphic rocks

All the sedimentary and volcanic rocks intruded by the Sierra Nevada batholith in the Pyramid Roadless Area are thermally metamorphosed and show the effects of directed pressure. These rocks are mostly biotite-hornblende gneiss and schists, porphyroblastic granitoid rocks, and calc-silicate hornfels. Mineral assemblages suggest metamorphism to amphibolite facies or hornblende-hornfels contact facies (Dodge and Fillo, 1967; Loomis, 1964). The metamorphic rocks occur in the east-trending Mount Tallac rock pendant in the east central part of the roadless area (fig. 1). Two groups of metamorphic rocks have been recognized; a metasedimentary sequence and a metavolcanic sequence that conformably overlies it.

The metasedimentary rocks are fine-grained calc-silicate and quartz-feldspathic hornfelses derived from argillaceous limestones and shales. Weathered cutups of these hornfels generally are brown, but fresh rock ranges from bluish white to black. The calc-silicate-hornfelses are massive light-colored rocks consisting chiefly of calcite, quartz, plagioclase, and diopside, but also contain subordinate epidote, grossularite, idocrase, actinolite, scapolite, sphene, wollastonite, and unidentified opaque minerals. In contrast, the quartz-feldspathic hornfelses generally are finely laminar dark, and consist principally of quartz, plagioclase, biotite, and actinolite in zones of lower grade metamorphism and contain hornblende in zones of higher grade metamorphism. Locally, light-colored quartz-rich beds are interlayered with darker mafic hornfels giving these rocks a banded appearance (Dodge and Fillo, 1967; Loomis, 1964).
The metasomatic rocks in the roadless area south of Fallen Leaf Lake are dark quartzo-feldspathic hornfels. Relict textural features typical of volcanic rocks are present. The presence of quartz and biotite, as well as hornblende or tremolite and minor amounts of epidote suggest that the parent rocks were probably andesites or dacites. Pneumatolytic rocks commonly contain tourmaline.

Most of the metasomatic rocks may have been derived from pyroclastic rocks. A broad area just east of the metasomatic-metasedimentary rock contact is underlain by metasomatic breccia (see map sheet) (Dodge and Fillo, 1967; Loomis, 1964).

**Plutonic rocks**

Diorite rocks.—Several masses of diorite rocks are exposed in the northeastern and southwestern part of the Pyramid Roadless Area. In some places a complete transition from dark igneous rocks to dark metamorphic rocks can be seen. Although the contacts between granite and diorite rocks are generally sharp, the age relations and mode of origin of the diorites are not consistent throughout the area. Some diorite material was derived by metamorphic processes; some crystallized from magma and was injected into preexisting rocks.

The diorite rocks range from quartz diorite to hornblende gabbro, hornblende-rich quartz diorite being most abundant. Hornblende is common to all the mafic rocks, and biotite is also widespread; augite, quartz, magnetite, and potassiumfeldspar may or may not be present (Dodge and Fillo, 1967; Loomis, 1964).

Granite rocks.—The major rock type in the northeastern, southern, and western parts of the Pyramid Roadless Area is quartz-bearing plutonic rock. Within the Desolation Wilderness, Dodge and Fillo (1967) recognized eight discrete granite units; but they made no distinctions between individual units on their geologic map. Loomis (1964, pl. 1) recognized seven distinct granite plutons within the roadless area. Granodiorite is the most prevalent rock type. However intrusive masses range from alaskite through quartz monzonite to quartz diorite. Potassium feldspar occurs in all but the most mafic quartz diorites. Hornblende is present in most granodiorites and quartz diorites. Magnetite, apatite, zircon, sphene, and allanite are common accessory minerals. Sericite, chlorite, epidote, and limonite are alteration products.

Norite rocks.—Loomis (1963, 1964) and Dodge and Fillo (1967) described and mapped a small mass of noritic rocks near the east side of the Pyramid Roadless Area, southwest of Emerald Bay (see map sheet). These rocks comprise fine- to medium-grained leucocratic norite containing plagioclase, hypersthen, hornblende, magnetite, and minor amounts of quartz, calcite, augite, biotite, and apatite. Compositional banding is a conspicuous feature of these rocks.

**CENOZOIC**

Volcanic rocks

Andesite breccias and interbedded epiclastic stream conglomerates and sandstones are absent within the Pyramid Roadless Area; however, these rocks occur adjacent to the south and southeast parts of the area.

Porphyritic olivine basalt occurs on the northwest side of the roadless area. Four Cornered Peak and two unnamed peaks in the west-central part of the area are composed of olivine basalt. Duhrymple (1984), dated by K-Ar volcanic rocks from the middle Miocene Miocene localities in the central Sierra Nevada, and the volcanic rocks adjacent to the Pyramid Roadless Area may be of similar age.

Quaternary deposits

A record of the glacial advances and retreats is preserved in moraines. Four main advances are known and a fifth minor advance is represented by several rock glaciers that still may be active. The glacial deposits within the Pyramid Roadless Area are mostly outwash gravels (Lingren, 1896; Burnett, 1971) and thick lateral and terminal moraines are found around Fallen Leaf Lake, Cascade Lake, Emerald Bay, and Geneperal and Meeks Creeks in the northeast. Moraines and outwash gravel are extensive south and east of Wrights Lake.

**GEOCHEMICAL STUDIES**

The geochemical investigation of the Pyramid Roadless Area was based on analyses of 35 rock samples, 90 minus-60-mesh stream-sediment samples, and 88 nonmagnetic heavy-mineral-concentrate samples derived from stream sediment. All samples were collected in the summer of 1982.

All samples were analyzed for 31 elements: silver (Ag), arsenic (As), gold (Au), boron (B), barium (Ba), beryllium (Be), bismuth (Bi), calcium (Ca), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), lanthanum (La), magnesium (Mg), manganese (Mn), molybdenum (Mo), niobium (Nb), nickel (Ni), lead (Pb), antimony (Sb), scandium (Sc), tin (Sn), strontium (Sr), thorium (Th), titanium (Ti), vanadium (V), tungsten (W), yttrium (Y), zine (Zn), and zirconium (Zr) using a six-step semiquantitative emission spectrographic method. The rock and stream-sediment samples were also analyzed for arsenic, gold, and zinc by atomic-absorption spectrometry and for uranium by a fluorometric method. Further details on the collection and analysis of the samples, as well as a complete listing of the analyses can be found in Chaffee and others (1983).

For the rock samples, three elements—copper, molybdenum, and uranium—were selected as possibly being related to types of mineralization that are known or thought to occur in the study area; for stream-sediment samples, eight elements—arsenic, boron, cadmium, copper, molybdenum, antimony, uranium, and zinc—were selected as possibly being mineralization related; and for the concentrate samples, 12 elements—silver, arsenic, gold, boron, bismuth, cobalt, copper, molybdenum, lead, tin, thorium, and tungsten—were selected for the same reason. The data sets were searched for anomalous samples, anomalous limits were identified, and the data was sorted to define anomalous drainage basins (Chaffee, 1983).

**DISCUSSION OF GEOCHEMICAL ANOMALIES**

**Rock samples**

Only five of the 35 rock samples collected for this study contain anomalous concentrations of elements suggestive of mineralization. Three granodiorite samples from the west side of the Pyramid Roadless Area contained weakly anomalous concentrations of uranium. One sample of a metasedimentary rock and one of metasomatically altered metasedimentary rocks contained low concentrations of copper, and of copper and molybdenum, respectively. The analyses corroborate those of Dodge and Fillo (1987) for samples from the adjacent Desolation Wilderness. Their findings indicated that, with the exception of rock samples collected from several previously known prospects, none of the rock samples collected in that wilderness contained anomalous concentrations of any elements that might be indicative of hydrothermal mineral deposits.

**Stream-sediment and heavy-mineral-concentrate samples**

Geochemical anomalies for stream-sediment or heavy-mineral-concentrate samples are present in several parts of the Pyramid Roadless Area. For purposes of discussion, the drainage basins have been divided into four areas.

Area A.—Area A, in the northern part of the Pyramid Roadless Area, extends from McKinney Creek on the north to Emerald Bay on the south (figs. 1 and 2). The area is composed of granodiorite country rock as much as about 5 percent dioritic inclusions. Strong anomalies for gold and/or silver are present in the concentrate samples from the McKinney and General Creek drainage basins and from a
small drainage basin just north of Lonely Gulch. The associated stream-sediment samples are not anomalous for either silver or gold. The stream-sediment samples from three scattered drainage basins in Area A contain anomalous concentrations of uranium. The concentrate samples from the McKinney and General Creek drainages also contain anomalous concentrations of a suite of elements, boron, molybdenum, cobalt, copper, silver, arsenic, antimony, tin, tungsten, and (or) zinc, are present in samples of stream-sediment and heavy-mineral concentrate from the drainage basins radiating away from Mt. Tallac and as far as Glen Alpine Creek and the basins above upper Echo Lake. The anomalous samples were all collected near roof-pendant rocks, suggesting that precious-metal deposits and (or) contact-metasomatic tungsten deposits might be present in one or more of these drainage basins. The generally low concentration levels of some or all of the elements bismuth, molybdenum, antimony, tin, tungsten, and (or) zinc are indicative of a potential for either type of deposit in this area.

Area B.—Area B, in the east-central part of the Pyramid Roadless Area, near Cascade Lake (figs. 1 and 2). This area is characterized by metamorphosed blocks of pre-Cretaceous sedimentary and volcanic sequences that have been intruded mainly by granodioritic plutons of the Nevada batholith. Anomalous concentrations of 13 elements, silver, arsenic, boron, bismuth, antimony, tin, tungsten, and (or) zinc, are present in samples of stream-sediment and heavy-mineral concentrate from the drainage basins radiating away from Mt. Tallac and as far as the basin of Glen Alpine Creek and the basins above upper Echo Lake. The anomalous samples were all collected near roof-pendant rocks, suggesting that precious-metal deposits and (or) contact-metasomatic tungsten deposits might be present in one or more of these drainage basins. The generally low concentration levels of silver, arsenic, boron, bismuth, antimony, tin, tungsten, and (or) zinc are indicative of a potential for the occurrence of either type of deposit in this area.

Area C.—Area C, in the western part of the Pyramid Roadless Area, extends from Tells Creek on the north to the Jones Fork of Silver Creek on the southern part (figs. 1 and 2). Granodioritic plutonic rocks of the Sierra Nevada batholith predominate here. Outcrops of metamorphosed pre-batholithic sedimentary and volcanic rocks and Tertiary andesitic or basaltic flow rocks are present locally. A heavy-mineral-concentrate sample from one drainage basin at the extreme southern end of Area C contains high concentrations of silver and gold. The other anomalous drainage basins in Area C, particularly those associated with Big Silver Creek, consistently contain anomalous concentrations of silver. Four elements of all of the elements bismuth, molybdenum, lead, thorium, and tungsten in concentrate samples from these basins may indicate the presence of tungsten deposits.

In addition, the stream-sediment samples from various branches of Bassi Fork, Big Silver Creek, and the Jones Fork of Silver Creek contain anomalous concentrations of uranium. No sources for any of these elements are known. Most of these elements probably represent higher than expected background concentrations that may result from the drainage basins. The generally low concentration levels of the various elements, the resource potential for precious-metal, tungsten, or uranium deposits in Area C is low.

Area D.—Area D, in the extreme northern end of the western part of the Pyramid Roadless Area (figs. 1 and 2), yielded strongly anomalous concentrations silver and gold in one concentrate sample collected on one of the upper tributaries to Bassi Fork. The source of this precious-metal anomaly is not known. On the basis of this one concentrate sample, this area has a low potential for precious-metal deposits.

MINERALIZED AREAS

The U.S. Bureau of Mines gathered information concerning mines, prospects, and mineralized areas. Twelve rock samples taken from prospects and mineralized areas in and adjacent to the Pyramid Roadless Area were analyzed by atomic-absorption, and other wet chemical methods as well as by fire-assay methods. All samples were then analyzed by radioactivity with a gamma-ray scintillometer and for fluorescence with an ultraviolet light. Most of the samples were also analyzed by semiquantitative spectrophotographic methods. No mineral resources were indicated by the Bureau of Mines investigations. The Cliff Ridge mining claims, north of Wrights Lake (fig. 1), were located for uranium in 1959 and 1970. Both claims are on a 4-ft-thick aplite dike that strikes N. 80° W. and dips 60° SW in quartz monzonite. The dike is characterized by a slightly-higher-than-background gamma-ray count as measured with a scintillometer, but samples from this area (fig. 2, no. 3) showed no visible uranium minerals.

Criticized from the drainage basins radiating away from Mt. Tallac and as far as the basin of Glen Alpine Creek and the basins above upper Echo Lake. The anomalous samples were all collected near roof-pendant rocks, suggesting that precious-metal deposits and (or) contact-metasomatic tungsten deposits might be present in one or more of these drainage basins. The generally low concentration levels of silver, arsenic, boron, bismuth, antimony, tin, tungsten, and (or) zinc are indicative of a potential for either type of deposit in this area.

Area B.—Area B, in the east-central part of the Pyramid Roadless Area, near Cascade Lake (figs. 1 and 2). This area is characterized by metamorphosed blocks of pre-Cretaceous sedimentary and volcanic sequences that have been intruded mainly by granodioritic plutons of the Nevada batholith. Anomalous concentrations of 13 elements, silver, arsenic, boron, bismuth, antimony, tin, tungsten, and (or) zinc, are present in samples of stream-sediment and heavy-mineral concentrate from the drainage basins radiating away from Mt. Tallac and as far as Glen Alpine Creek and the basins above upper Echo Lake. The anomalous samples were all collected near roof-pendant rocks, suggesting that precious-metal deposits and (or) contact-metasomatic tungsten deposits might be present in one or more of these drainage basins. The generally low concentration levels of silver, arsenic, boron, bismuth, antimony, tin, tungsten, and (or) zinc are indicative of a potential for either type of deposit in this area.

Area C.—Area C, in the western part of the Pyramid Roadless Area, extends from Tells Creek on the north to the Jones Fork of Silver Creek on the southern part (figs. 1 and 2). Granodioritic plutonic rocks of the Sierra Nevada batholith predominate here. Outcrops of metamorphosed pre-batholithic sedimentary and volcanic rocks and Tertiary andesitic or basaltic flow rocks are present locally. A heavy-mineral-concentrate sample from one drainage basin at the extreme southern end of Area C contains high concentrations of silver and gold. The other anomalous drainage basins in Area C, particularly those associated with Big Silver Creek, consistently contain anomalous concentrations of silver. Four elements of all of the elements bismuth, molybdenum, lead, thorium, and tungsten in concentrate samples from these basins may indicate the presence of tungsten deposits.

In addition, the stream-sediment samples from various branches of Bassi Fork, Big Silver Creek, and the Jones Fork of Silver Creek contain anomalous concentrations of uranium. No sources for any of these elements are known. Most of these elements probably represent higher than expected background concentrations that may result from the drainage basins. The generally low concentration levels of the various elements, the resource potential for precious-metal, tungsten, or uranium deposits in Area C is low.

Area D.—Area D, in the extreme northern end of the western part of the Pyramid Roadless Area (figs. 1 and 2), yielded strongly anomalous concentrations silver and gold in one concentrate sample collected on one of the upper tributaries to Bassi Fork. The source of this precious-metal anomaly is not known. On the basis of this one concentrate sample, this area has a low potential for precious-metal deposits.

REFERENCES CITED

Chaffee, M. A., 1983, SCORUSB-A Technique for Mineral Deposits, On the Evaluating Multi-element Geophysical Information, with examples of its use in regional


---120° 15' 120° 10' 120° 05' 120° 20'

0 5 MILES

---39° 00'

---38° 55'

---38° 50'

---Area of study

---Approimate boundary of roadless area

---LAKE TAHOE

---EMERALD BAY

---CASCADE LAKE

---GRASS LAKE

---FALLEN LEAF LAKE

---GLEN ALPINE CR

---CLIFF RIDGE MING CLAIMS

---WRIGHTS LAKE

---McKINNEY CREEK

---JONES CREEK

---FOUR CORNERED PEAK

---SILVER CREEK

---Basil Fork

---Loon Lake

Figure 1.--Index map showing location of the Pyramid Roadless Area (5023), El Dorado County, California.
Figure 2.—Map showing areas of low mineral potential within and adjacent to the Pyramid Roadless Area, California.