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 claims) 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 8,895 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 (1960, 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 Minessearched 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 roof 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 quartzo-feldspathic hornfelses derived from argillaceous limestones and shales. Weathered outcrops 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 quartzo-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 metavolcanic 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 metavolcanic rocks may have been derived from pyroclastic rocks. A broad area just east of the metavolcanic-metasedimentary rock contact is underlain by metavolcanic breccia (see map sheet) (Dodge and Fillo, 1967; Loomis, 1964).

Plutonic rocks

Dioritic rocks.—Several masses of dioritic 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 granitic and dioritic rocks are generally sharp, the age relations and mode of origin of the diorites are not consistent throughout the area. Some dioritic material was derived by metamorphic processes; some crystallized from magma and was injected into preexisting rocks.

The dioritic 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 potassium feldspar may or may not be present (Dodge and Fillo, 1967; Loomis, 1964).

Granitic 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 granitic units; but they made no distinctions between individual units on their geologic map. Loomis (1964, pl. 1) recognized seven distinct granitic 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.

Noritic 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, hypersthene, 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. Dalrymple (1964), dated by K-Ar volcanic rocks of middle and late Miocene age at many 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 Geneneral 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 (Cv), 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), zinc (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 metasedimentary rock and one of metavolcanic rock contained low concentrations of copper, and of copper and molybdenum, respectively. The analyses corroborate those of Dodge and Fillo (1967) 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 containing 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, lead, and tungsten, that are thought to be related to tungsten mineralization. Other anomalies that are less significant in terms of mineral potential are found scattered throughout Area A. No sources for any of the anomalies in this area are known; the only known mine, the Noonchester mine, is located about 1 mi north of McKinney Creek (outside map area). This mine was developed for gold, but no production had been recorded as of 1967 (Dodge and Fillo, 1967). Nevertheless, the anomalous element suites found in Area A indicate a low potential for precious-metal and (or) tungsten deposits in the McKinney Creek or General Creek areas. The uranium concentrations in the three anomalous samples (20 to 30 parts per million (ppm)) are not indicative of a potential for uranium resources in the Area A. Most of these elements found in anomalous concentrations in samples from Area A probably only represent higher than expected background concentrations that may result from the respective rock types associated with the anomalies.

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 Sierra Nevada batholith. Anomalous concentrations of 13 elements, silver, arsenic, boron, bismuth, cadmium, cobalt, copper, molybdenum, 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 as well as from 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 the anomalous elements, however, indicate only a low 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 south (fig. 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 the 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 some or all of the elements bismuth, molybdenum, lead, thorium, and tungsten in concentrate samples this suite of elements 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 rock types present in the respective source areas. On the basis of the 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 checked for radioactivity with a gamma-ray scintillometer and for fluorescence with an ultraviolet light. Most of the samples were also analyzed by semiquantitative spectrographic methods. No mineral resources were indicated by the Bureau of Mines investigation. The Cliff Ridge mining claims, north of Wrights Lake (fig. 1), were located for uranium in 1959 and 1979. Both claims are on a 4-ft-thick aplite dike that strikes N. 80° W. and dips 66° 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.

Silicified and limonite-stained metasedimentary rocks occur near a granitic contact west of Fallen Leaf Lake (fig. 2, no. 1b). The metamorphic rocks are part of the Mt. Tallac roof pendant and locally contain as much as 2 percent disseminated sulfide minerals. None of seven samples of altered metasedimentary rocks contained base or precious metal values.

Three quartz stringers containing molybdenite rosettes and massive arsenopyrite occur in slightly limonite-stained quartz monzonite near Grass Lake (fig. 2, no. 2). These stringers, 0.25 to 2 in. thick, trend northeast-southwest, but were not exposed in the roadless area. Four samples of mineralized parts of the stringers contained from 0.28 to 1.06 percent molybdenite.

ASSESSMENT OF MINERAL RESOURCES

The areas of mineral resource potential within the Pyramid Roadless Area are defined by areas of anomalous concentrations of base and precious metals in geochemical analyses, by known deposits, and by assessment of geologically favorable host rocks.

Two uranium claims are present within the roadless area (Cliff Ridge mining claims, fig. 1). Studies show that the amount of uranium at the two claims is so small as to preclude mining given the present market value for uranium. There is low potential for deposits of base or precious metals in the roadless area. There are no indications of coal, oil, gas, or geothermal resources in the Pyramid Roadless Area.

The anomalous element suites found in Area A (fig. 2) indicate that precious-metal and (or) tungsten deposits might be present in the northeastern part of the Pyramid Roadless Area.

Rock samples collected from Area B, in the east-central part of the Pyrmaid Roadless Area, suggest that precious-metal deposits and contact-metasomatic tungsten deposits might be present.

Area C in the western part of the Pyramid Roadless Area is considered to have low potential for deposits of precious metals, tungsten, and (or) uranium, based on concentrations of these elements in analyzed samples.

Area D in the extreme northern end of the western part of the Pyramid Roadless Area, yielded strongly anomalous concentrations of silver and gold in one concentrate sample collected on 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 (at least) a low potential for precious-metal deposits.

REFERENCES CITED

Burnett, J. L., 1971, Geology of the Lake Tahoe Basin, California: California Geology, California Division of Mines and Geology, v. 27, no. 7, p. 119-130.

Chaffee, M. A., 1983, SCORESUM—A technique for displaying and evaluating multi-element geochemical information, with examples of its use in regional mineral assessment programs: Journal of Geochemical Exploration in press .

Dalrymple, G. B., 1964, Cenozoic chronology of the Sierra Nevada: University of California Publications in Geological Science, v. 47, 41 p.

Dodge, F. C. W., and Fillo, P. V., 1967, Mineral resources of the Desolation Primitive Area of the Sierra Nevada, California: U.S. Geological Survey Bulletin 1261-A, 27 p.

Lindgren, Waldemar, 1896, Description of the Pyramid Peak quadrangle, California: U.S. Geological Survey Geologic Atlas, Pyramid Peak Folio 31.

——1897, Description of the Truckee quadrangle, California: U.S. Geological Survey Geologic Atlas, Truckee Folio 39.

Loomis, A. A., 1960, Petrology of the Fallen Leaf Lake area, California: Stanford, California, Stanford University, Ph.D. dissertation, 174 p.

——1963, Noritic anorthosite bodies in the Sierra Nevada batholith: Mineralogical Society of America Special Paper 1, p. 62-68.

——1964, Geology of the Fallen Leaf quadrangle: California Division of Mines and Geology Open-File Report, 174 p.

——1966, Contact metamorphic reactions and processes in the Mount Tallac roof remnant, Sierra Nevada, California: Journal of Petrology, v. 7, p. 221-245.

Peikert, E. W., 1958, The Mount Tallac roof pendant, Sierra Nevada, southwest of Lake Tahoe: Berkeley, University of California, M.A. thesis, p. .

——1962a, Three-dimensional specific-gravity variation in the Glen Alpine stock, Sierra Nevada, California: Geological Society of America Bulletin, v. 73, no. 11, p. 1437-1441.

——1962b, Three-dimensional mineralogical variation in the the Glen Alpine stock, Sierra Nevada, California abs. : Geological Society of America Special Paper 73, p. 214.

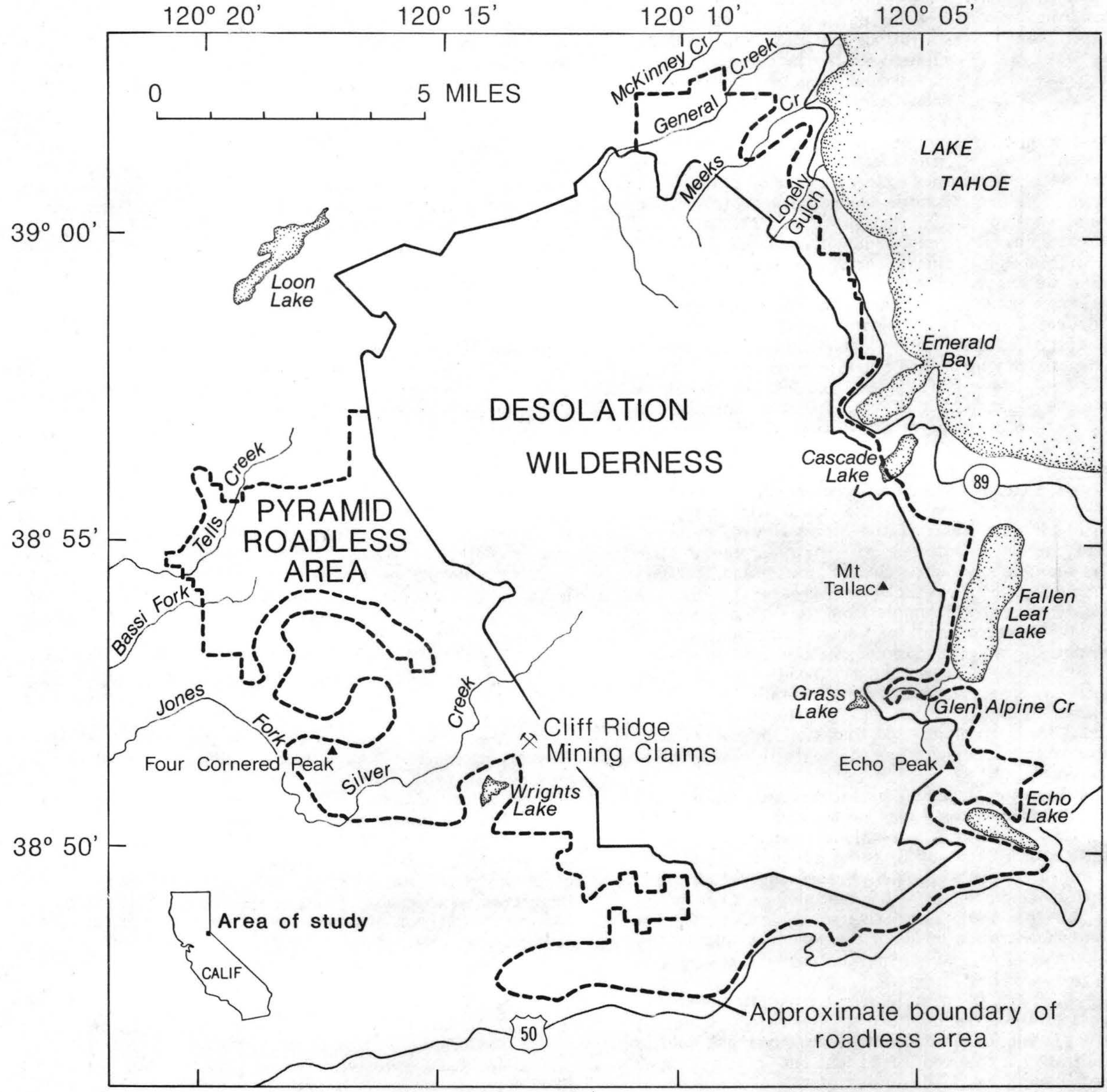
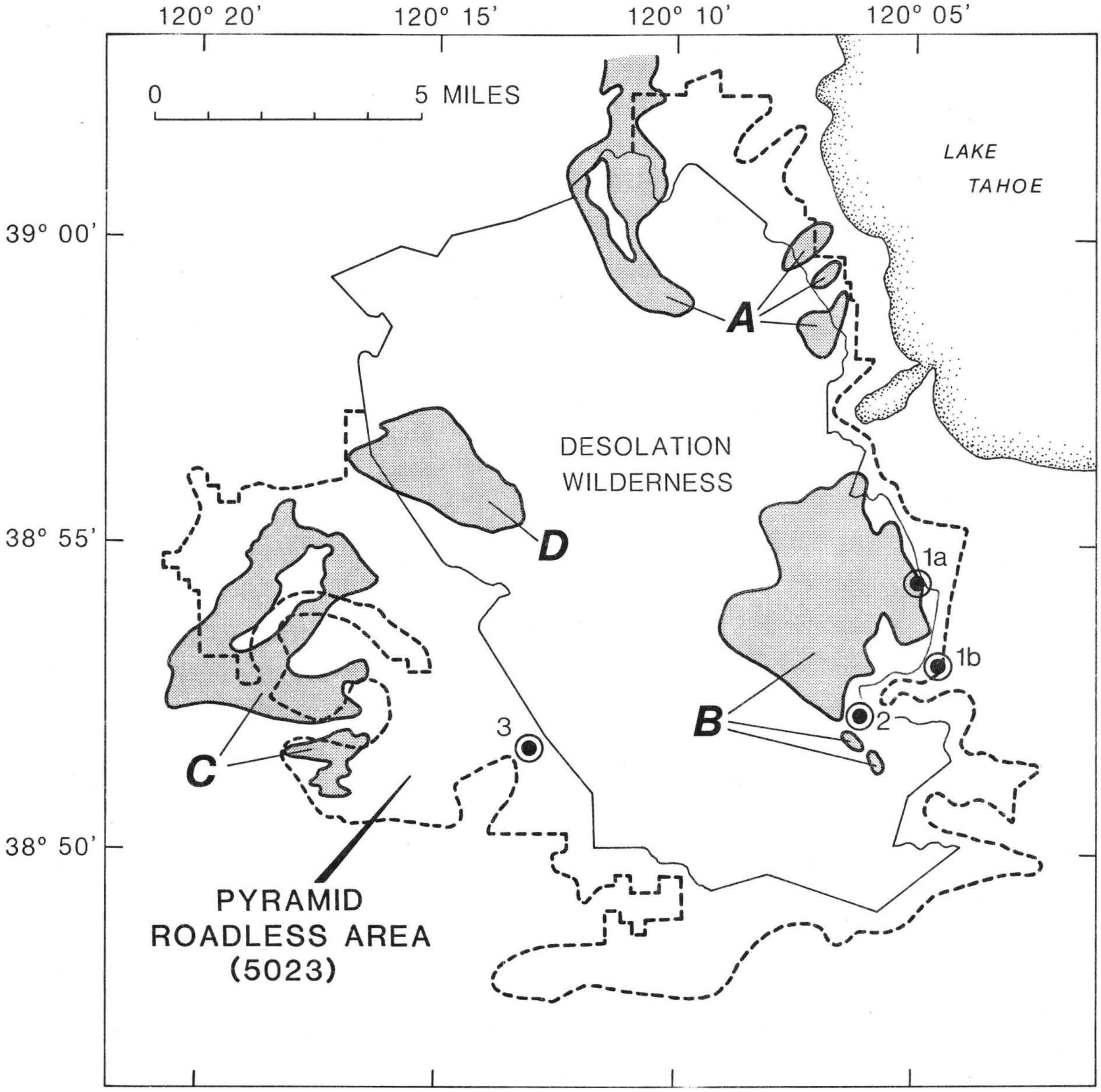


Figure 1.--Index map showing location of the Pyramid Roadless Area (5023), El Dorado County, California.



EXPLANATION

B Area with low potential for gold, silver, tungsten, zinc, molybdenum, and (or) uranium. See text for further discussion

3 U.S. Bureau of Mines sample locality (number referred to in text)

——— Approximate boundary of Desolation Wilderness

– – – – Approximate boundary of Pyramid Roadless Area (5023)

Figure 2.--Map showing areas of low mineral potential within and adjacent to the Pyramid Roadless Area, California.