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MINERAL RESOURCE POTENTIAL OF THE DINKEY LAKES ROADLESS AREA, FRESNO COUNTY, CALIFORNIA

SUMMARY REPORT

By

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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; some of these 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 Dinkey Lakes Roadless Area (5244), Sierra National Forest, Fresno County, California. The Dinkey Lakes Roadless Area was classified as a futher planning area during the Second Roadless Area Review and Evaluation (Rare II) by the U.S. Forest Service, January 1979.

SUMMARY

The Dinkey Lakes Roadless Area comprises approximately 117,600 acres (47,590 ha) on the western slope of the central Sierra Nevada of California, Sierra National Forest, California. The area, underlain by various kinds of granitic rocks and remnants of metamorphosed pregranitic rocks, is extensively mantled with glacial till.

Tungsten has been produced from tactite zones in the area, and a high tungsten resource potential is in metasedimentary rocks in the southwestern part of the area. Most of the scheelite (calcium tungstate)-bearing outcrops have probably been discovered; however, subsurface exploration may disclose additional tungsten resources.

A nearly pure calcite marble in the southwestern part of the area meets limestone specifications for portland cement. The possibility of future major construction in the region is a major factor in assessing the marble's value; consequently, the present resource potential is considered only moderate.

Smoky quartz crystals occur in cavities in granite in the south-central part of the roadless area. The crystals have moderate mineral resource potential as semiprecious gem stones.

Thermal spring activity in the northeastern part of the area has low potential for geothermal energy. Reservoir temperatures are estimated to be too low for practical electrical power generation.

A prospect near the southwestern boundary of the area has yielded a minor amount of gold and has low potential for gold and silver resources.

The remaining geologic environments within the area have low potential for the occurrence of mineral resources.

INTRODUCTION

The U.S. Geological Survey and U.S. Bureau of Mines conducted field investigations during the summer of 1980 to determine the mineral resource potential of the Dinkey Lakes area. Field investigations included a reconnaissance of the geology of the area and field checking existing geologic maps (Bateman, 1965; Bateman and others, 1971; Bateman and Wones, 1972; Lockwood and Lydon, 1975), comprehensive examination of terrains with possible mineral resource potential, geochemical sampling, and detailed examination of mines, prospects, and mineralized zones.

Location and geographic setting

The Dinkey Lakes Roadless Area is located on the western slope of the central Sierra Nevada in Fresno County (fig. 1). Fresno, the nearest city, is approximately 50 miles (80 km) to the southwest. The area is in the Sierra National

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Forest and includes portions of four 15-minute quadrangles: Blackcap Mountain, Kaiser Peak, Huntington Lake, and Mount Abbot. The area is irregularly shaped, elongated north-south, nearly 25 miles (40 km) long, and as much as 17 miles (27 km) wide and encloses approximately 117,600 acres (46,750 ha). Elevations range from 10,648 feet (3,246 m) at the summit of Mount Givens to 6,450 feet (1,966 m) along the area's southwest boundary.

Small lakes and alpine meadows dot the rugged, mountainous terrain, which is mostly covered with forests of pine and fir. The spectacular scenery is typical of glaciated regions of the Sierra Nevada. California State Highway 168 provides access to the area from the southwest and passes near its northern boundary. Several paved and dirt roads branch from Highway 168, providing access to margins of the area.

Geologic setting

Most of the roadless area is underlain by various kinds of granitic rocks that are extensively mantled with glacial till; however, remnants of deformed pregranitic rocks, metamorphosed to the hornblende hornfels facies, are present locally. Ages of the metamorphic rocks are not known with certainty, but on the basis of regional setting and lithologic characteristics, the metasedimentary rocks are believed to be Paleozoic or Triassic, and the metavolcanic rocks, Triassic or Jurassic. Metasedimentary rocks, principally quartzite, schist, marble, and hornfels, occur in the southwest part of the area in the Dinkey Creek roof pendant and as scattered inclusions in plutonic rocks south of the pendant. The stratigraphy and structure of the pendant have been studied in detail by Kistler and Bateman (1966). Following folding and faulting of pendant rocks, intrusion of plutonic rocks metamorphosed and locally metasomatically altered these rocks. Metavolcanic rocks occur along the northeastern boundary of the area in the extreme northern tip of the the Goddard roof pendant, a large pendant that extends several miles southeast.

Numerous bodies of plutonic rocks ranging in composition from diorite and gabbro to felsic granite and granitic aplite are in sharp contact with one another. Contacts between plutons are steeply dipping or vertical. The oldest plutonic rocks, of Jurassic or Cretaceous age, which are locally sheared, occur along the northeast margin of the study area, and are included in the Goddard roof pendant. Other granitic rocks in the northwestern two-thirds sequence. Granitic rocks in the southwest third of the area belong to an Early Cretaceous sequence. Isolated, possibly Late Cretaceous plutons have intruded the older sequence.

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS PERTAINING TO MINERAL RESOURCE ASSESSMENT

The U.S. Geological Survey conducted geological, geochemical, and geophysical studies in support of the mineral resource assessment of the Dinkey Lakes Roadless Area.

Geology

Geological environments considered to have potential for mineral resource potential were examined comprehensively during field studies.

Tungsten

Krauskopf (1953) previously studied tungsten deposits in a large region which included much of the roadless area. The deposits are located in the Dinkey Creek roof pendant in the southwest part of the area. Metasedimentary rocks in the pendant underlie an area of about 8 mi^2 (21 km^2) and occur in small scattered inclusions south of the pendant. Kistler and Bateman (1966) studied the stratigraphy and structure of the pendant in detail and found that it is composed of five metasedimentary units of Paleozoic or Mesozoic (pre-Cretaceous) age. The stratigraphic units from youngest to oldest are schist, white quartzite, biotite-andalusite hornfels, calc-silicate hornfels, and gray marble. The entire exposed sequence is estimated to have a stratigraphic thickness of only 3,000 to 4,000 ft (900 to 1,200 m). Stratigraphic thickness of the white quartzite is estimated to be about 1,500 to 2,000 ft (460 to 600 m), the biotite-andalusite hornfels about 800 to 1,000 ft (240 to 300 m), and the calc-silicate hornfels about 200 ft (60 m). The gray marble and schist units are not sufficiently exposed to allow measurements. Three fold systems formed during three successive tectonic episodes have been recognized in the pendant. Thrust faulting occurred during late stages of the first episode. Following folding and faulting, intrusion of plutonic rocks thermally metamorphosed pendant rocks to the hornblende hornfels facies, and some lime-rich strata were metasomatically altered to form tactite. The tactites are coarse grained and contain garnet, quartz, epidote, and pyroxene. Scheelite (calcium tungstate) has been locally introduced in the tactite zones interbedded in the schist unit in the pendant and in small inclusions south of the pendant. These inclusions did not originate from the adjacent white quartzite unit, but may have been carried upward from the gray marble and calc-silicate hornfels during magma emplacement (Kistler and Bateman, 1966).

Marble

The lowest stratigraphic unit exposed in the Dinkey Lakes roof pendant is finely laminated medium-gray marble suitable for cement and aggregate. The formation is composed largely of calcite and is probably clastic in origin.

Gem quartz

Smoky quartz (morion) occurs at a well-known collectors locality in a 0.25 mi^2 area (0.65 km^2) on the north slope of Dogtooth Peak in the south-central part of the roadless area (Murdoch and Webb, 1966). Singly and doubly terminated smoky-grayish-brown to black quartz crystals occur in numerous miarolitic cavities that are typically 2 to 3 in. (5 to 8 cm) in diameter; however, pods as long as 20 ft (6 m) are present in light-colored garnet-bearing granite of Dinkey Dome. Crystals 6 in. (15 cm) long have been found in some of the larger cavities. The quartz crystals accompany potassium-feldspar and mica.

Mineralized zones

Sulfide-bearing rocks crop out in two small areas in the northeastern part of the area. Sulfide mineralization occurs 1.5 mi (2.4 km) east of Florence Lake in a granitic host and 2 mi (3 km) southeast of Lake Thomas A Edison in a metarhyolite tuff cut by aplite dikes. Feldspars are commonly altered in the oxidized orange-weathering rocks. Pyrite is disseminated in the mineralized rocks, but other sulfide minerals are sparse or absent. There is no significant enrichment of base, precious, or ferro-alloy elements; consequently, there is little likelihood of mineral resource potential in the mineralized zones.

Geothermal resources

Thermal spring activity at Blaney Meadows in the northeastern part of the area is an identified hot-water convection system (Renner and others, 1975). The Blaney Meadows springs are the southernmost occurrences in a 20-mile (32 km) line of thermal springs paralleling the northwest-trending San Joaquin River. Other springs in the area are at ambient temperatures.

Other potential mineral deposits

The remaining geologic environments have little potential for the discovery of mineral resources. Pegmatites and massive quartz veins are sparse and, where present, are rarely more than a few inches (centimeters) thick and contain no concentrations of minerals of potential value. Small, low-grade placer gold deposits are near the northwest boundary of the area (Lockwood and others, 1972); however, none are known to occur within the area.

Geochemistry

A geochemical study of the Dinkey Lakes Roadless Area was undertaken to aid in evaluation of its mineral resource potential (Smith and others, 1983b). Reconnaissance geochemical sampling of 78 stream sediments and 102 panned concentrates from stream sediments taken throughout the area were used to delineate mineralized areas. Using these methods, only a previously known area of mineralization was found.

Geochemical sampling

Stream sediments were chosen as the primary sample medium for this sampling, because they represent a composite of rock and soil exposed in the drainage basin upstream from the sample site. In general, two stream-sediment samples were collected at each sample site. One sample was sieved to -80 mesh (less than 0.18 mm), pulverized, and analyzed for 31 elements by a semiquantitative spectrographic method (Grimes and Marranzino, 1968). The second stream-sediment sample was panned to produce a heavy-mineral concentrate (if insufficient material was present for two samples, a panned concentrate was collected to exhibit anomaly enhancement). After panning, remaining light minerals were removed from the concentrate using bromoform (specific gravity = 2.86) and magnetite was removed with a hand magnet. The resulting heavy-mineral fraction was divided into two subfractions based on magnetic susceptibility. A split of the heavy, nonmagnetic subfraction was ground and spectrographically analyzed. Details of the analytical methods used, analytical results, and statistical treatment of the results are discussed by Smith and others (1983a).

Spectrographic analyses were supplemented by a delayed neutron activation (Millard and Keaten, 1982) for the determination of U and Th for the -80 mesh (less than 0.18 mm) fraction of stream sediments.

Results

Semiquantitative spectrographic analyses of the heavy, nonmagnetic fraction of the panned concentrates from stream sediments proved to be of the most value in evaluating the area. This sample medium contains the common ore-forming sulfide and oxide minerals as well as other nonmagnetic minerals (for example, barite, zircon, sphene, rutile, and scheelite). It gives a greatly enhanced anomaly pattern because common, light, rock-forming minerals (quartz and feldspar) that tend to dilute the anomalies have been removed. By using this sample medium, an area was delineated which indicated anomalous concentrations of tungsten, beryllium, bismuth and copper in the southwest quadrant of the roadless area.

The anomalous area is composed primarily of metasedimentary rocks of the Dinkey Creek roof pendant and younger granitic rocks. Tungsten has been mined in the anomalous area around Miningtown Meadow and Mud Lakes. Tactite samples from the mines indicate the same tungsten-beryllium-bismuth-copper association seen in the panned concentrates.

A single-point anomaly deserves mention, even though such anomalies are difficult to evaluate. The heavy, nonmagnetic fraction of a panned concentrate from the stream draining Bullfrog Lake (taken approximately 1.5 mi (2.4 km) from the lake) in the south-central part of the area showed anomalous concentrations of arsenic, lead and silver. Except for granite in the immediate vicinity of the lake, the sampled site drains glacial moraine. No evidence was found to indicate the granite was the cause of the high values; therefore, the source area for the glacial deposits is postulated as the origin of the anomaly. This source area, which lies outside the study boundaries, is known to contain fumarolic deposits which could possibly be the source of material with high arsenic, lead and silver (J. P. Lockwood, oral commun., 1981).

MINING DISTRICTS AND MINERALIZED LOCALITIES

Detailed examination of mines, prospects, and mineralized zones in the Dinkey Lakes Roadless Area was carried out by the U.S. Bureau of Mines.

Prior to field study, information pertaining to mining claims was gathered by examining claim records from Fresno County and Federal agencies. Fieldwork consisted of sampling, mapping, and evaluating known mineral occurrences. Bureau personnel collected 187 lode samples from mines, prospects, and mineralized areas. State and Federal reports and other previous studies were sources of supplemental information.

Approximately 200 lode claims and relocations have been recorded in or immediately adjacent to the study area since 1856; no records of placer claims were found. Six claims encompassing 108 acres (44 ha) of the Mud Lakes mine (fig. 2, no. 10) are patented. No mineral leases are currently held in the area. Dinkey Creek is the only mining district in the area.

Mining began near the study area in the mid-1880's. The first activity was primarily on gold placers along Dinkey Creek and its tributaries south of the area. These surficial deposits were soon worked out. The earliest known mining claims recorded in the area, near the McKesson prospect (fig. 2), were located in 1888 near the head of Exchequer Creek close to the area's southwestern boundary. U.S. Bureau of Mines records show 6.48 troy oz (202 g) of gold was produced from this area in 1894. The gold was recovered from quartz veins which crop out discontinuously along the margins of a granitic intrusion. Pyrite and numerous vugs are in the limonite-stained quartz veins.

In 1918 tungsten was first discovered near the study area at the Garnet Dike mine along the Kings River, 15 mi (24 km) southeast of the area. Joe Sadler located the first tungsten claim in the Dinkey Lakes Roadless Area in the fall of 1940. Tungsten demand spurred by World War II stimulated prospecting, which lead to additional discoveries within the area. Recorded tungsten production began in 1942. Tungsten production ceased with the rapid price decline following the war. Tungsten imports were disrupted during the Korean conflict, resulting in the U.S. Government's encouraging domestic mine expansion and Government stockpiling of tungsten concentrates. In 1951 these programs led to renewed production in the area. Tungsten mining operations were halted in 1956 after a fall in prices subsequent to suspension of the tungsten purchase program by the Federal Government. In recent years there has been sporadic production from the Rainbow mine (Garnet mine) (fig. 2, no. 5), which was reopened in 1967 and currently is the only active mine in the study area.

The two principal deposits in the Dinkey Creek tungsten district, the Mud Lakes and Rainbow mines, are 2-1/2 mi (4 km) apart in the southwestern corner of the study area (fig. 2). Both properties are on the margin of the Dinkey Creek roof pendant. Production from the Mud Lakes mine began in 1953 from an open pit. A substantial portion of the ore body had been removed when mining ceased in 1956; total production was about 4,800 short-ton units (43,500 kg) of tungsten trioxide concentrate. The Rainbow mine, intermittently mined since 1942, is developed by drifts and stopes; total production from 1942 to 1980 was about 3,000 short-ton units (27,000 kg) of tungsten trioxide concentrate. Minor production was recorded from the Young Group prospect (fig. 2) in 1955.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Information from the mining history, mineral exploration, and geological and geochemical data indicate parts of the Dinkey Lakes Roadless Area have high mineral potential. Within the area there is potential for tungsten, marble, gem stones, geothermal energy, gold, and silver. U.S. Bureau of Mines personnel have estimated mineral resources for individual properties in the area (table 1).

Tungsten

Mineral resource potential for tungsten is high in the southwestern part of the area. Tungsten resources are in contact metamorphic deposits along the margins of the metasedimentary Dinkey Lakes roof pendant and in inclusions in granitic rocks near the pendant. The presence of tactite as beds in the schist unit of the pendant and small inclusions of tactite south of the pendant favors the occurrence of scheelite-rich lenses and shoots.

Most of the scheelite-bearing surface outcrops in the area have probably been found; however, subsurface exploration may lead to the discovery of additional tungsten resources in the southwestern region. No current exploration by major mining companies is known.

The Rainbow, Mud Lakes, Lone Wolf, and Young Group properties have a total of approximately 220,000 tons (200,000 t) of tungsten resources averaging about 0.13 percent WO_3 and are summarized in table 1.

Marble

The gray marble unit of the Dinkey Creek pendant is exposed over an area at least 1,300 ft (400 m) long and 400-600 ft (120-180 m) wide; it may contain more than 20 million tons (18 million t) of limestone resources. The marble is nearly pure calcite. Analyses of six samples taken at 2-ft (0.6 m) intervals across the unit by the U.S. Bureau of Mines averaged 87 percent $CaCO_3$, 3 percent P_2O_5, 1 percent each of SiO_2 and MgO, 0.5 percent Al_2O_3, and less than 0.5 percent each of Fe_2O_3 and MnO; two grab samples analyzed by the U.S. Geological Survey averaged 96 percent $CaCO_3$, 2 percent each of SiO_2 and MgO, and less than 0.5 percent each of Fe_2O_3, MnO, and P_2O_5. These analyses meet limestone specifications for portland cement, and much of the stone is suitable for limestone aggregate. Transportation costs would greatly limit the distance the material could be shipped to major markets.

Gem stones

Smoky quartz crystals in cavities in granite on the north slope of Dogtooth Peak are a potential semiprecious gem stone resource.

Geothermal energy

There is minor potential for low-temperature ($\leq 90^\circ$C) geothermal resources at Blaney Meadows in the northeastern part of the area. Reservoir temperatures are estimated to be between 43° and 73°C, most likely 56°C, with a calculated resource of 0.028×10^{18} joules, based on reservoir volume of 1 km^3 and 25-percent energy recovery (Mariner and others, 1983). The system may be adequate for space and process heating; however, electrical generation requires significantly higher temperatures.

Other resources

The McKesson prospect, adjacent to the southwestern boundary of the area near the head of Exchequer Creek, has low potential for gold and silver resources. Quartz vein and float samples containing low gold and silver values have been collected from this property.

Information from stream-sediment samples indicates that no major deposits of metals, other than those discussed above, are exposed at the surface (Smith and others, 1983). the area; however, similar and more accessible deposits are available closer to potential markets. Coal, oil, and gas resource potential is unlikely.

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Table 1.--Estimated mineral resources in the Dinkey Lakes Roadless Area

Map No. (fig. 1)	Property	Type	Resource classification	Tonnage	Product	Grade (percent WO_3)
4	Unnamed	Marble	Indicated and inferred resources.	20,000,000 (18,000,000 t)	Cement, limestone aggregate.	----
5	Rainbow mine	Tactite	Indicated and inferred subeconomic resources	164,000 (149,000 t)	Tungsten	0.12
9	Young Group prospect	---do---	Inferred subeconomic resources.	800 (700 t)	-------do-------	.15
10	Mud Lakes mine	---do---	Measured subeconomic resources.	20,000 (18,000 t)	-------do-------	.18
			Inferred subeconomic resources.	15,000 (14,000 t)		.06
13	Lone Wolf prospect	---do---	--------do--------	17,000 (15,000 t)	-------do-------	.24

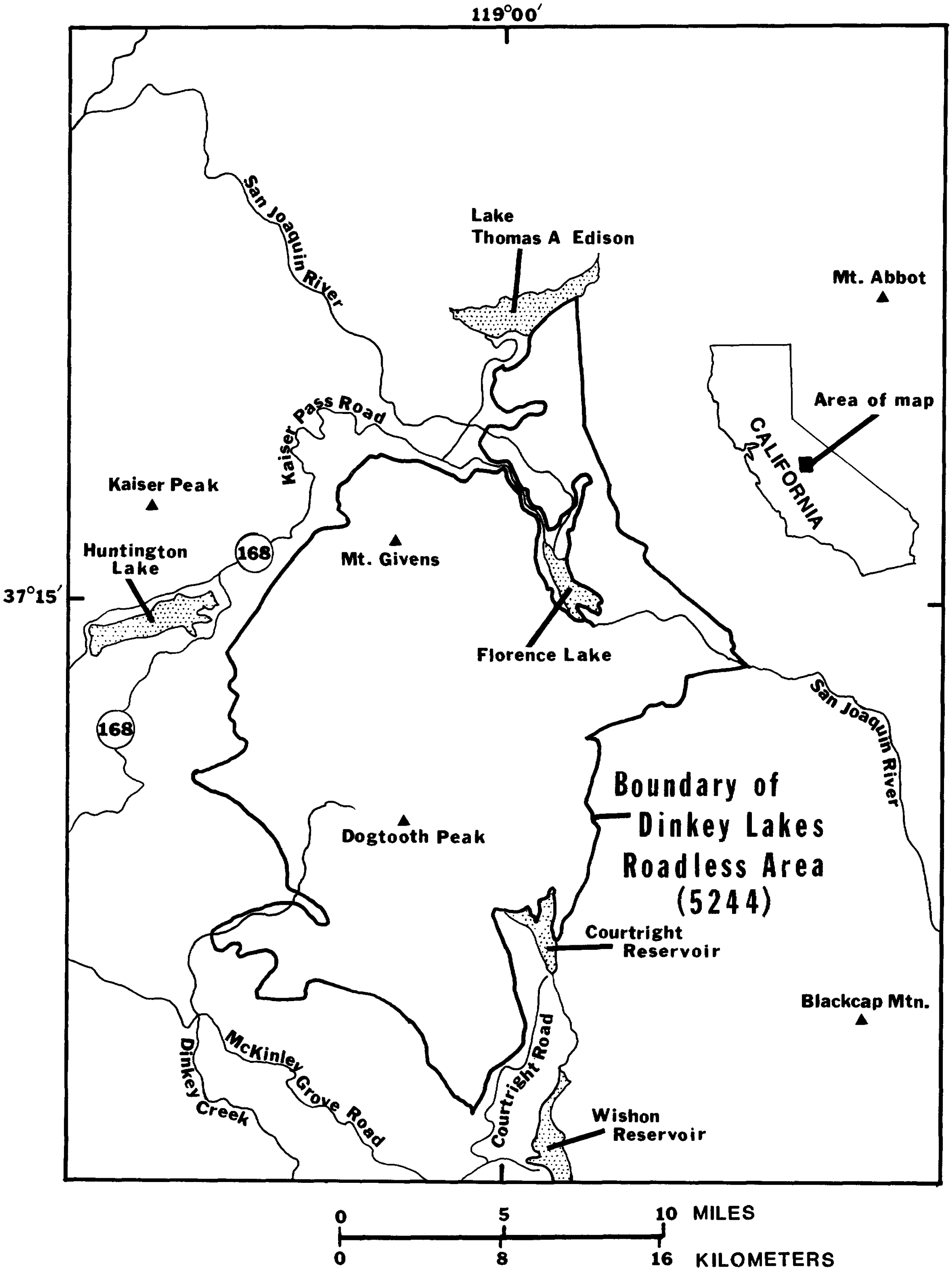

Figure 1.—Location map showing the Dinkey Lakes Roadless Area.

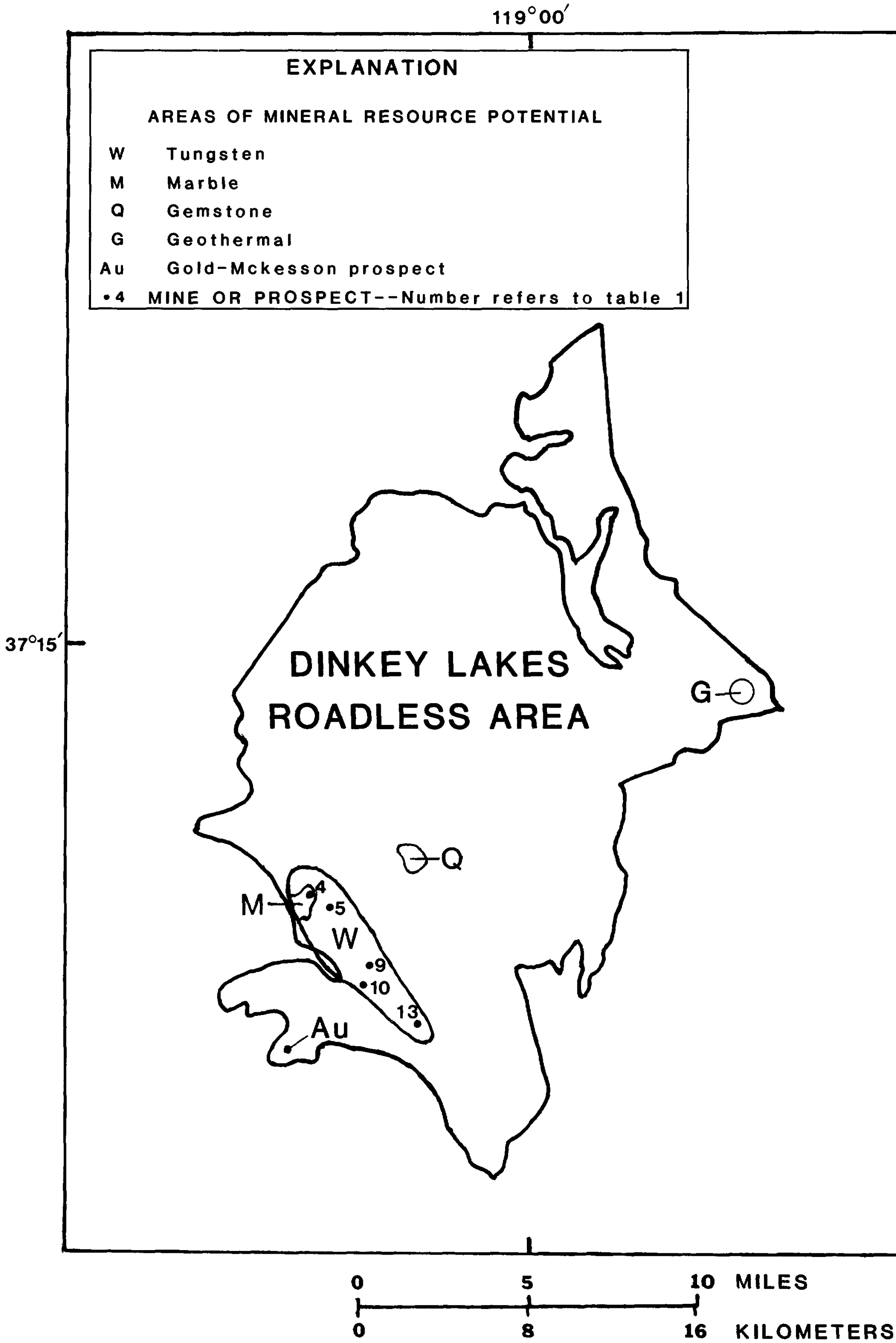

Figure 2.--Map showing the location of potential mineral resources in the Dinkey Lakes Roadless Area.