MINERAL RESOURCE POTENTIAL OF THE FREEL AND DARDANELLES ROADLESS AREAS, ALPINE AND EL DORADO COUNTIES, CALIFORNIA

SUMMARY REPORT

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and 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 Freel (5-271) and Dardanelles (4-982 and 5-982) Roadless Areas, El Dorado and Toiyabe National Forests, Alpine and El Dorado Counties, California. These areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Dardanelles Roadless Area (fig. 1) has potential for tungsten, zinc, silver, and copper resources. Copper disseminated in skarn and zinc-silver-copper sulfide mineralization in shear zones occur near Crater Lake along the southeastern margin of the Dardanelles Roadless Area (fig. 2, area A). Available data suggest that small undiscovered deposits of these commodities may exist in this area. Tungsten occurs as scheelite disseminated in skarn at the Alpine mine (fig. 2, No. 4) and surrounding area. Approximately 800,000 tons of resources averaging 0.19 percent tungsten trioxide (WO_3) in the Alpine mine are estimated to be in the Dardanelles Roadless Area. The Mountain Top mine (No. 10) in the Freel Roadless Area contains an estimated 2,000 tons of resources averaging 0.61 oz silver per ton, and 1.59 percent copper in a quartz vein.

INTRODUCTION

Location and access

The Freel and Dardanelles Roadless Areas comprise 60 mi^2 (155 km^2) in the central Sierra Nevada south of Lake Tahoe (fig. 1). The city of South Lake Tahoe is about 3 mi (5 km) north of the Freel Roadless Area. The Freel and Dardanelles Roadless Areas are separated by Luther Pass (California Highway 89). Parts of the northern and southern boundaries of the Dardanelles Roadless Area are near U.S. Highway 50 and California Highway 88, respectively.

The area is one of rugged mountainous topography with elevations ranging from about 6,000 ft (1,850 m) in the western part of the Dardanelles area to 10,881 ft (3,317 m) at the summit of Freel Peak. Other major peaks include Stevens Peak, Red Lake Peak, Waterhouse Peak, and Jobs Sister. The crest of the Sierra Nevada passes through the eastern part of the area with steep eastern slopes and generally gently sloping west- and northwest-trending ridges. With the exception of the higher peaks along the Sierra Nevada crest, most of the terrain is heavily forested. Winter snowfall is often heavy, and most of this part of the Sierra Nevada is covered with snow from November through May or June.

Present studies

The U.S. Geological Survey conducted field studies in the areas during 1978-80. These studies consisted of geologic mapping, geochemical sampling, and geophysical surveys, including compilation of existing gravity data and an aeromagnetic survey.

The U.S. Bureau of Mines gathered data on mines, prospects, and mineralized areas. The work included examination of literature and courthouse records and fieldwork at mines and mineralized areas. Two hundred thirty-two samples taken from mines, prospects, and mineralized areas were analyzed by atomic-absorption, chemical, and fire-assay methods. All samples were checked for radioactivity with a gamma-ray scintillometer and for fluorescence with an ultraviolet light. At least one sample from each mineralized area was analyzed for 40 elements by semiquantitative spectrographic methods. Complete sample analyses are on file at the U.S. Bureau of Mines, Western Field Operations Center, Spokane, Wash.

Geologic setting

Late Cretaceous granitic rocks of the Sierra Nevada batholith, Mesozoic metasedimentary and metavolcanic roof pendants, and Tertiary volcanic rocks are exposed in the Freel and Dardanelles Roadless Areas. Several small pendants of metasedimentary and metavolcanic rocks of Mesozoic (pre-Late Cretaceous) age are exposed along the eastern side of the Dardanelles Roadless Area. These metamorphic rocks are largely calcareous hornfels and marble. The granitic rocks of various plutons are distinct, easily distinguishable, and have contacts that are typically sharp.

The ridges and peaks at the southern end of the Dardanelles area are capped by volcanic rocks of late Tertiary age (26 to 5 m.y.). Andesite flows and lahars of

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Miocene age are the most common volcanic rocks. Volcaniclastic sandstone and conglomerate are commonly interbedded with the lahars, and several deeply eroded volcanic necks and dike systems intrude the andesites. Small outcrops of rhyolite tuff of Oligocene and Miocene age are locally preserved beneath the andesites.

Pleistocene glaciation extensively modified the topography and left widespread morainal and outwash deposits. Glacial deposits and features are especially well developed in the valleys of Trout Creek and Cold Creek in the Freel area and in Hope Valley, just east of the Dardanelles area (map sheet).

GEOLOGY, GEOPHYSICS, AND GEOCHEMISTRY PERTAINING TO MINERAL RESOURCE ASSESSMENT

Geology

Metamorphic rocks

Metasedimentary and metavolcanic rocks of Mesozoic age crop out in four small roof pendants along the eastern side of the Dardanelles Roadless Area (John and others, 1981). The largest of these pendants surrounds Crater Lake and covers about 1.5 mi^2 (3.9 km^2). The other three pendants have an aggregate area of less than 0.2 mi^2 (0.5 km^2). The two southern pendants have been described by Parker (1959, 1961) and Kerrick and others (1973). Parker (1959) estimated that the thickness of the stratigraphic section in the Crater Lake pendant is in excess of 5,850 ft (1,800 m). The exact age of the metamorphic rocks is unknown, except that they are older than Late Cretaceous granitic rocks that intrude them.

The metamorphic rocks in the pendants are mostly metamorphosed calcareous siltstone, feldspathic sandstone, marly tuffs, andesite flows, and impure limestone. These rocks were strongly deformed into northwest-trending folds prior to thermal metamorphism by granitic intrusions (Parker, 1961). Most of the rocks are fine-grained calc-silicate hornfels, although porphyroblastic rocks are locally present. Common minerals in the calcareous rocks include calcite, quartz, wollastonite, grossular garnet, diopside, plagioclase, scapolite, clinozoisite, and actinolite. The quartzofeldspathic rocks are composed dominantly of quartz, oligoclase, microcline, biotite, muscovite, and diopside. Calcic plagioclase, hornblende, and biotite are common in the metamorphosed andesites. The mineral assemblages suggest the hornblende hornfels facies of contact metamorphism.

Marble beds at the northern edge of the Crater Lake pendant and at the southern edge of the pendant just east of Stevens Peak (map sheet), have been metasomatically altered to tungsten-bearing skarns. These skarns consist of coarse-grained aggregates of andraditic garnet, hedenbergitic pyroxene, hornblende, quartz, calcic plagioclase, and chlorite. Scheelite, magnetite, pyrrhotite, chalcopyrite, pyrite, sphalerite, and molybdenite are locally abundant.

Granitic rocks

Granitic rocks exposed in the Freel and Dardanelles Roadless Areas form 12 plutons (John and others, 1981). Potassium-argon radiometric dating suggests that all these plutons were emplaced during a relatively short span of time in the Late Cretaceous, approximately 90-95 m.y. before present (Evernden and Kistler, 1970; McKee and Howe, 1981; and John and others, 1981). One unit, the quartz diorite and diorite unit, appears to form large inclusions within younger plutons. Individual plutons vary considerably in texture. Contacts between plutons are generally sharp and easily mapped.

Most of the granitic rock is granodiorite in composition, although the rock ranges from alaskite to diorite. Texture ranges from coarse-grained porphyritic through hypidiomorphic granular to strongly gneissic.

The Burnside Lake Adamellite of Parker (1961) and the Bryan Meadow Granodiorite are the only granitic plutons known to be associated with significant mineralization. Tungsten skarns occur on both sides of Hope Valley where the Burnside Lake Adamellite intruded marble beds. The Alpine mine (fig. 2, No. 4) was developed in these skarns.

Volcanic rocks

Late Tertiary volcanic and volcaniclastic sedimentary rocks form many of the ridges and peaks in the Dardanelles Roadless Area. These rocks mainly consist of andesitic lahars, although andesite and basalt flows, volcaniclastic sandstone and conglomerate, andesite intrusives, and rhyolite tuff are also present. The volcanic section is as thick as 1,600 ft (500 m) on Stevens Peak. A paleochannel filled with andesite lahars is well exposed at the southern end of Hell Hole in the central Freel Roadless Area (map sheet).

Andesite lahars form prominent dark-orange-colored cliffs along the eastern edge of Dardanelles Roadless Area. They consist of heterogeneous mixtures of subrounded andesite clasts up to 3 ft (1 m) in diameter in a sandy matrix. Most of the andesite clasts are porphyritic and typically contain plagioclase and pyroxene phenocrysts. Generally there are clasts of many types of andesite present in single lahars.

Interbedded with the lahars are aphanitic to porphyritic pyroxene andesite and basalt flows and well-stratified volcaniclastic sandstone and conglomerate. The sandstone is commonly crossbedded. Small remnants of pale-green rhyolite tuff containing phenocrysts of biotite, quartz, and sanidine are locally preserved beneath the lahars. A large outcrop of white rhyolite is visible from Highway 88 at the base of the ridge north of Caples Lake. Small plugs of hornblende andesite and columnar-jointed pyroxene andesite locally intrude the volcanic section. The largest of these intrusions forms the summit of Stevens Peak (map sheet).

Tertiary volcanic rocks unconformably overlie the granitic and metamorphic rocks. This unconformity is particularly evident on the east side of the Dardanelles area where nearly flat-lying lahars overlie highly deformed metamorphic rocks of the Crater Lake pendant. The unconformity may be important in assessing the mineral potential of the area, because the volcanic rocks bury metamorphic rocks that locally contain tungsten-bearing skarns.

Ages of the volcanic rocks range from late Oligocene to late Miocene or earliest Pliocene. The oldest known volcanic rock in the area is a rhyolite tuff exposed about 0.6 mi (1 km) southwest of Scotts Lake (near the east boundary of the Dardanelles Roadless Area) that yielded a biotite potassium-argon age of 25.9 ± 0.4 m.y. (John and others, 1981). One of the youngest volcanic rocks is the hornblende andesite plug forming Stevens Peak. This rock yielded a potassium-argon age of 5.2 ± 0.8 m.y. (John and others, 1981).

Surficial deposits

Surficial deposits of Quaternary age are widespread in the area. The most extensive deposits are morainal and outwash deposits of Pleistocene age. Unsorted bouldery to clayey gravel in undissected to deeply dissected moraines cover much of the Trout Creek and Cold Creek valleys in the Freel area, much of Echo Summit just north of the Dardanelles area, and most of Hope Valley. Extensive glacial outwash deposits, consisting of poorly sorted silt, sand, and gravel, are present along the western edge of the Freel area. Alluvial deposits of Holocene age occur on the valley floors (map sheet).

Structure

Parker (1959, 1961) described the structure of the metamorphic rocks in the two southern pendants. He recognized intense deformation of the metamorphic rocks into northwest-trending folds with steeply southwest dipping axial planes. His detailed maps suggest that marble beds may extend northwesterly beneath the Tertiary volcanic cover.

Geophysics

Two geophysical mapping methods were used to aid geologic mapping and mineral appraisal in the Freel and Dardanelles Roadless Areas. Compilation of regional gravity surveys (Plouff, 1982; and Snyder and others, 1982) resulted in preparation of Bouguer and isostatic gravity anomaly maps (Plouff, 1983) that are dominated by closely spaced north-trending contours that reflect major crustal features of the Sierra Nevada batholith. The only significant anomaly not masked by the regional background is a 3- by 6-mi gravity low trending east-west in the northern half of the Dardanelles area. The gravity low may reflect a pluton of relatively low density.

The aeromagnetic map (Plouff, 1983) was made from data obtained at about 1,000 ft above the ground along flight lines spaced at intervals of 0.5 mi (U.S. Geological Survey, 1981). This map has complex patterns that reflect variations of topography in this rugged area. Two large magnetic anomalies are noteworthy. One is a magnetic high almost 5 mi in diameter in the southern half of the Freel area and the northern tip of the Dardanelles area. The high may be underlain by a complex mafic pluton.

The other anomaly is a magnetic low located at the southeast corner of the Dardanelles area. Model studies indicate that a large body of metamorphic rocks of negligible average magnetization underlies this low and extends thousands of feet beneath the surface (Plouff, 1983). The Alpine mine and Alhambra prospect (fig. 2, Nos. 4, 5) just east of the roadless area and Brewers mine 3 mi to the southeast are located along the northeast edge of the magnetic low. The model studies indicate that the steeply dipping contact between the metamorphic rocks and surrounding plutonic rocks occurs along or, because of the normal inclination of the magnetization, somewhat northeast of the outer edge of the magnetic low. Therefore, deposits similar to those found at Alpine, Alhambra, and Brewers properties may exist under the volcanic cover rocks in the southeast corner of the Dardanelles Roadless Area along the edge of the magnetic low.

Geochemistry

Geochemical studies

A total of 21 rock samples, 35 stream-sediment samples, and 35 nonmagnetic heavy-mineral concentrates of the stream-sediment samples collected in the study area were analyzed for 31 elements by a six-step semiquantitative emission spectrographic method. Rock and stream-sediment samples were also analyzed for arsenic, bismuth, cadmium, antimony, and zinc by wet-chemical methods. The rock samples were collected primarily to provide information on background values. For the stream-sediment samples, 8 elements (arsenic, boron, bismuth, cadmium, copper, molybdenum, antimony, and zinc) were selected as possibly being related to mineralization; for the concentrate samples, 12 elements (arsenic, boron, bismuth, cadmium, cobalt, copper, iron, manganese, molybdenum, lead, tungsten, and zinc) were selected.

Geochemical anomalies

Anomalies in both sample media are present in both areas. The most significant anomalies in the Dardanelles Roadless Area are in the drainage basins along the east side of the Carson Range between Luther Pass and Carson Pass (fig. 1). All of the selected elements are present in this general area. The highest concentrations are centered in the vicinity of the Alpine mine and Alhambra prospect (fig. 2, Nos. 4, 5) These strong anomalies indicate a favorable environment for contact-metasomatic tungsten deposits.

Two drainage basins in the Freel Roadless Area have anomalous concentrations of elements. The northern of the two basins, the drainage southeast of Monument Peak, has moderately strong anomalies for bismuth and molybdenum; the southern basin, draining the southside of Freel Peak and Jobs Sister, contains only weak values of copper and molybdenum (fig. 1). Neither of these areas is associated with any known mineralization or hydrothermal alteration. These anomalies may only represent higher than expected concentrations of these elements that are related to the specific rock types present in these areas and not to mineralization.

MINING DISTRICTS AND MINERALIZATION

Mining activity began in the region in the late 1860's, shortly after the discovery of the Comstock lode in Nevada. Principal mining districts near the study areas include Mogul-Monitor, Silver Mountain, Raymond, Summit City, and Hope Valley, which were established in the 1860's. Mines in and adjacent to the Dardanelles Roadless Area are in the Hope Valley district. Zinc, silver, and copper occur in a shear zone and a sulfide vein in metasedimentary rocks at the Alhambra and Drumlummon prospects (fig. 2, Nos. 5, 3, respectively). Tungsten occurs as disseminated scheelite in a skarn zone at the Alpine mine (fig. 2, and table 1, No. 4), where 500 tons of tungsten ore were mined before 1943 (Hopson, 1943, p. 1) and possibly 1,000 tons of tungsten ore was mined by 1947 (Benson, 1947, p. 2).

Mining claims

Since 1883 approximately 100 lode mining claims have been located in the Dardanelles Roadless Area. The active Anderson Claims (fig. 2, No. 8), southwest of the Alhambra prospect, were staked after our fieldwork was completed (1981). The Alpine mine (No. 4) and Alhambra prospect (No. 5) are outside the roadless area on private land.

Twenty-seven lode claims are known to have been located in the Freel Roadless Area. Most were on or near the Mountain Top mine (fig. 2, No. 10). Two groups of claims were located for uranium; one is approximately 1 mi (1.6 km) north of the Mountain Top mine, and the other is near High Meadows. Scintillometer traverses across the claim groups indicated no evidence of radioactivity.

No oil, gas, or geothermal leases exist in the study areas.

Mines, prospects and mineralized areas

Zinc, silver, copper, molybdenum, and tungsten deposits occur at three properties along the eastern boundary of the Dardanelles Roadless Area and in the Freel Roadless Area. These and other properties are shown on fig. 2 and information about them is summarized in tables 1 and 2.

Mineral deposits in the Dardanelles Roadless Area occur in shear and skarn zones. The most intensely mineralized and persistent shear zones strike N. 5°-15° W. and dip 60°-80° NE.; these zones are cut by northeast-trending, less strongly mineralized shear zones. The northwest-trending zones range from 2 to 20 ft (0.6 to 6.1 m) thick and contain massive quartz with sphalerite, pyrite, chalcopyrite, and minor silver sulfides. Skarn zones, resulting from metasomatism of marble and calcareous hornfels by intruding granitic rocks trend northwest and dip steeply southwest. The main skarn zone at the Alpine mine (No. 4) contains, in decreasing amounts, garnet, epidote, calcite, quartz, pyrite, sphalerite, chalcopyrite, and scheelite. The scheelite is disseminated and occurs in varying amounts. A sulfide layer 2 in. (5 cm) thick in skarn strikes N. 35° W. and dips vertically at the Drumlummon prospect (No. 3). This layer contains about 90 percent chalcopyrite and 10 percent pyrrhotite.

The Mountain Top mine (No. 10) in the Freel Roadless Area was originally located in October 1932, by Fred Denner, and relocated in 1939 and in 1968. Workings include seven shallow prospect pits and two shafts, 16 and 50 ft (5 and 15 m) deep. These workings are along a fracture filled with a quartz vein or, in places, quartz stringers within the Bryan Meadow Granodiorite. The vein strikes N. 10°-30° W., dips 70°-80° NE., and ranges from 2 to 14 in. (5.1-35.6 cm) thick. Most quartz is coated with small amounts of malachite and contains blebs of bornite, chalcopyrite, and molybdenite.

A quartz vein containing molybdenite is present 2 mi (3 km) south of the Mountain Top mine. The vein is poorly exposed but appears to strike due north. Three grab samples of vein quartz, granodiorite, and pegmatite from this prospect contained only trace amounts of molybdenum.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The southeastern part of the Dardanelles Roadless Area has a high resource potential for tungsten, zinc, copper, and silver (fig. 2, area A). Low potential for silver, copper, and molybdenum exists at the Mountain Top mine (No. 10) in the Freel Roadless Area. Mineral resource potential at three properties is estimated in table 2.

Area A

Area A along the southeastern corner of the Dardanelles Roadless Area has a high potential for tungsten resources in skarns and for zinc, copper, and silver resources in sulfide-enriched shear zones. Known mineralization occurs at the Alpine mine and the Alhambra and Drumlummon prospects (fig. 2 and table 1, Nos. 3, 4, 5), with an estimated 800,000 tons of resources averaging 0.19 percent tungsten trioxide (WO_3) occurring in the roadless area. Four other prospects for base and precious metals and limestone also occur in area A (fig. 2 and table 1, Nos. 6, 7, 8, 9).

The Alpine mine (No. 4) contains an estimated 1,700,000 tons of resources averaging 0.19 percent tungsten trioxide (WO_3) in a skarn zone that averages 100 ft (30.5 m) thick, 520 ft (158 m) long and 170 ft (52 m) in depth. An estimated 800,000 tons of this resource extends into the Dardanelles Roadless Area. Scheelite is disseminated in the skarn which contains garnet, pyroxene, epidote, quartz, calcite, pyrite, pyrrhotite, chalcopyrite, and magnetite. There is a high potential for the discovery of additional tungsten resources in the skarn along strike and at depth.

The Alhambra prospect (No. 5) contains an estimated 2,200,000 tons of resources averaging 1.85 percent zinc, 0.25 oz silver per ton, and as much as 0.17 percent copper in a north- to northwest-striking, vertically-dipping shear zone. The shear zone occurs in silicified metasedimentary rocks and averages 5.5 ft (1.7 m) thick. Disseminated sphalerite, chalcopyrite, magnetite, pyrite, and arsenopyrite occur throughout the zone. There is a high potential for the discovery of additional zinc, silver, and copper resources in the shear zone along strike to the southeast and at depth.

The Drumlummon prospect (No. 3) contains a vein of massive chalcopyrite 2 in. (5 cm) thick in metasedimentary rocks. The vein strikes N. 35° W. and dips vertically. Two samples across the vein contained a weighted average of 10.15 percent copper, as much as 8.7 oz silver per ton, and 0.94 percent zinc. A moderate potential exists for the discovery of copper, silver, and zinc resources in the vicinity of that prospect.

The potential for undiscovered copper and tungsten skarn deposits in area A is indicated by aeromagnetic data that suggest that the Crater Lake pendant may extend several miles west, to near Meiss Lake, beneath the Tertiary cover (map sheet). Detailed stratigraphic and structural mapping of the Crater Lake pendant by Parker (1961) suggests that several marble beds may be present beneath the volcanic rocks if the pendant extends west. However, it is impossible to estimate the proximity of marble beds (if present) to granitic intrusives (particularly the Burnside Lake Adamellite). In addition, there may be as much as 1,600 ft (500 m) of Tertiary volcanic rocks above the metamorphic rocks.

The potential for undiscovered zinc-copper-silver-bearing sulfide veins in shear zones and metasedimentary rocks is difficult to evaluate, but geologic mapping, geochemical analyses, and aeromagnetic data suggest that geologic environments similar to those of the Alhambra and Drumlummon prospects are present in the northern part of area A.

Mountain Top mine

The Mountain Top mine in the Freel Roadless Area (fig. 2, No. 10) has a low potential for resources of silver, copper, and molybdenum. It contains an estimated 2,000 tons of indicated resources averaging 0.61 oz silver per ton, 1.59 percent copper, and 0.042 percent molybdenum (table 2). The mine is developed in an isolated quartz vein in the Bryan Meadow Granodiorite.

Other resources

An estimated 360,000 tons of limestone is on the Anderson Claims (No. 8) southwest of Crater Lake in the Dardanelles area. However, intense fracturing and high silica values indicate that limestone does not meet specifications for metallurgical flux or industrial specifications for dimension or decorative stone or cement.

Alluvial deposits consisting of silt, sand, and gravel occur along all drainages in the area. The gravel and sand deposits are too remote to be economically developed, and no placer mineral values were detected in them.

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Table 2.--Properties with mineral resource potential in the Freel and Dardanelles Roadless Areas and vicinity

Map number	Name (commodity)	Bedrock and mineralization	Workings and production	Assessment of resources or potential
1	Unnamed (gold, silver)	A shear zone 1- to 2-ft (0.3-0.6 m)-thick in Mesozoic metasiltstone strikes N. 50° W., dips 70° NE., and contains silicified metasiltstone with about 1 to 2 percent disseminated pyrite. A pegmatite dike 1-3-in. (25-76 mm)-thick is near the shear zone.	2 prospect pits about 10 ft (3.0 m) wide, 20 ft (6.1 m) long, 4 ft (1.2 m) deep, and trending southeasterly.	3 samples collected across the shear zone contained no gold or silver; 1 sample across the pegmatite dike contained no values. The shear zone has a low resource potential.
2	Unnamed (gold, silver)	Iron-oxide-stained andesite	None	1 grab sample contained no gold or silver. No potential for the discovery of resources.
3	Drumlummon prospect (copper, silver, zinc)	Mesozoic metasedimentary rocks, intruded by Cretaceous granitic rocks, and capped by Tertiary volcanic conglomerate. A thick massive chalcopyrite vein 2-in. (50 mm)-thick strikes N. 35° W. and dips vertically in a skarn zone.	A 60-ft (18.3-m) long adit, a caved adit and a prospect pit.	2 samples across the vein contained a weighted average of 10.15 percent copper, as much as 8.7 oz silver per ton (298.3 g/t), and 0.94 percent zinc. The prospect has a moderate potential for the discovery of copper, silver, and zinc resources.
4	Alpine mine (tungsten)	Mesozoic metasedimentary rocks, intruded by Cretaceous granitic rocks, and locally capped by Tertiary volcanic rocks. Developed in a skarn zone that averages 100 ft (30.5 m) thick, 520 ft (158 m) long, and 170 ft (52 m) in depth. Scheelite is disseminated in the skarn, which contains garnet, epidote, quartz, calcite, pyrite, pyrrhotite, chalcopyrite and magnetite.	2 adits totaling over 1,100 ft (335 m) of workings and 2 trenches. Hopson (1943, p. 1) reported 500 tons (454 t) of ore had been mined before 1943 and Benson (1947, p. 1) reported possibly 1,000 tons (900 t) of ore mined by 1947.	An estimated 1,700,000 tons [1](1,540,000 t) of inferred subeconomic resources averaging 0.19 percent tungsten are in the zone. Approximately 800,000 tons (726,000 t) of this resource are inferred to be in the roadless area. A high potential for the discovery of additional tungsten resources is along strike and at depth in the skarn.
5	Alhambra prospect (zinc, silver, copper)	Pre-Cretaceous metasedimentary rocks, intruded by Cretaceous granitic rocks, and locally capped by Tertiary volcanic rocks. A mineralized shear zone 5.5 ft (1.7 m) thick strikes N. 30° E. to N. 32° W., dips nearly vertically, and contains silicified hornfels and quartzite, quartz veins and veinlets, and gouge. Disseminated sphalerite, chalcopyrite, magnetite, pyrite, and arsenopyrite occur throughout the zone.	8 prospect pits, 4 adits (totaling about 1,275 ft (389 m)), 2 shafts, and 1 trench.	An estimated 2 million tons (1,800,000 t) of inferred subeconomic resources averaging 1.85 percent zinc, 0.25 oz silver per ton (8.57 g/t), and as much as 0.17 percent copper are in the persistent shear zone. Potential is high for the discovery of additional zinc, silver, and copper resources in the shear zone southeast along strike and at depth.
6	Unnamed (limestone, tungsten)	Limestone 75 ft (23 m) thick strikes N. 15° W., dips 75° SW., and is in contact with biotite-bearing quartzite along the west edge and with a skarn zone along the east edge. The skarn zone is about 5 ft (1.5 m) thick and contains about 25 percent quartz, 25 percent calcite, 20 percent epidote, 15 percent quartzite, and 15 percent garnet.	None	2 samples taken: 1 sample across the limestone bed contained 32.1 percent calcium oxide; 1 sample across the skarn zone contained no gold, silver, or tungsten. The limestone and tactite have a low potential for the discovery of resources.
7	Unnamed (gold, silver, zinc, lead)	A sulfide vein 2 in. (51 mm) thick strikes N. 50° E. and dips 73° NW. in Mesozoic metasedimentary rocks.	2 prospect pits.	4 samples taken: 1 sample across the sulfide vein contained 0.014 oz gold per ton (0.48 g/t), 0.4 oz silver per ton (13.7 g/t), 0.82 percent lead, and 0.95 percent zinc; 1 sample across the footwall of the vein contained no gold, 0.24 oz silver per ton (8.23 g/t), and 0.10 percent lead; 2 samples of silicified metasedimentary rock contained no gold, as much as 0.11 oz silver per ton (3.77 g/t), and 0.21 percent lead. The prospect has a moderate potential for the discovery of gold, silver, zinc, and lead resources.
8	Anderson claims (limestone)	Mesozoic limestone 15-80 ft (4.5-24 m) thick containing localized tactite pods; strikes N. 43° W., and dips 60° NE; partially covered by talus.	2 adits totaling 90 ft (27.4 m) of workings 1 caved shaft of unknown depth.	11 samples taken. 8 chip samples across the limestone averaged 54.48 percent calcium carbonate, 0.04 percent manganese dioxide, 0.81 percent iron trioxide, 2.75 percent aluminum trioxide, and 24.36 percent silicon dioxide. 3 samples across tactite pods contained less than 0.005 oz gold per ton (0.17 g/t), less than 0.2 oz silver per ton (6.9 g/t), and nil tungsten. The claims have a low potential for the discovery of limestone or tungsten resources.
9	Unnamed (gold, silver)	Highly fractured limonite-stained hornfels. Massive white quartz float in talus.	None	2 samples taken: 1 chip sample across the hornfels and 1 select grab of massive white quartz float contained no gold or silver. Potential for the discovery of resources is low.
10	Mountain Top mine (copper, silver, molybdenum)	A quartz vein 2 to 14 in. (5.1-35.6 cm) thick in the Bryan Meadow Granodiorite strikes N. 10°-20°W., and dips 70°-80° NE. Quartz is coated by malachite. Quartz from dumps contains blebs of bornite, chalcopyrite, and molybdenite.	7 shallow prospect pits and 2 shafts, 16 and 60 ft (5 and 18 m) deep, respectively.	An estimated 2,000 tons (1,800 t) of indicated subeconomic resources. The weighted average of 4 chip samples taken across the vein is 0.61 oz silver per ton (20.91 g/t), 1.59 percent copper, and 0.042 percent molybdenum.

[1]Metric conversions: tons x 0.9072 = tonnes (t); oz per ton x 34.285 = grams per tonne (g/t).

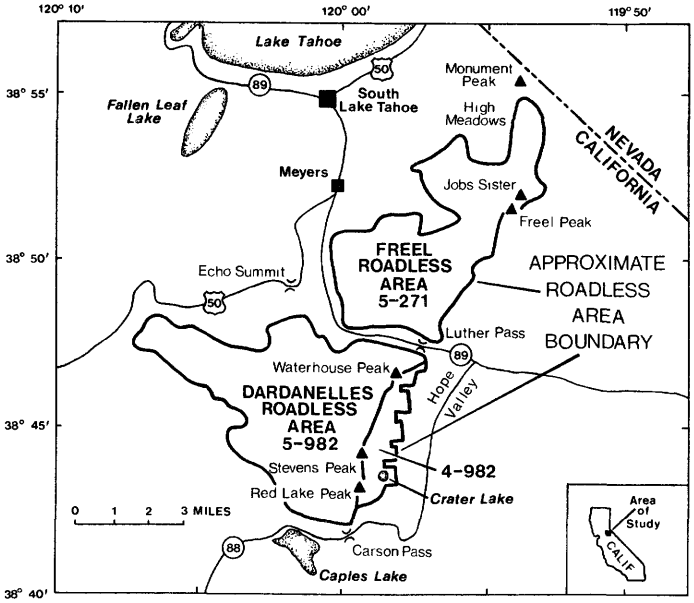

Figure 1. Index map showing geographic location of the Freel (5-271) and Dardanelles (4-982, 5-982) Roadless Areas, Calif.

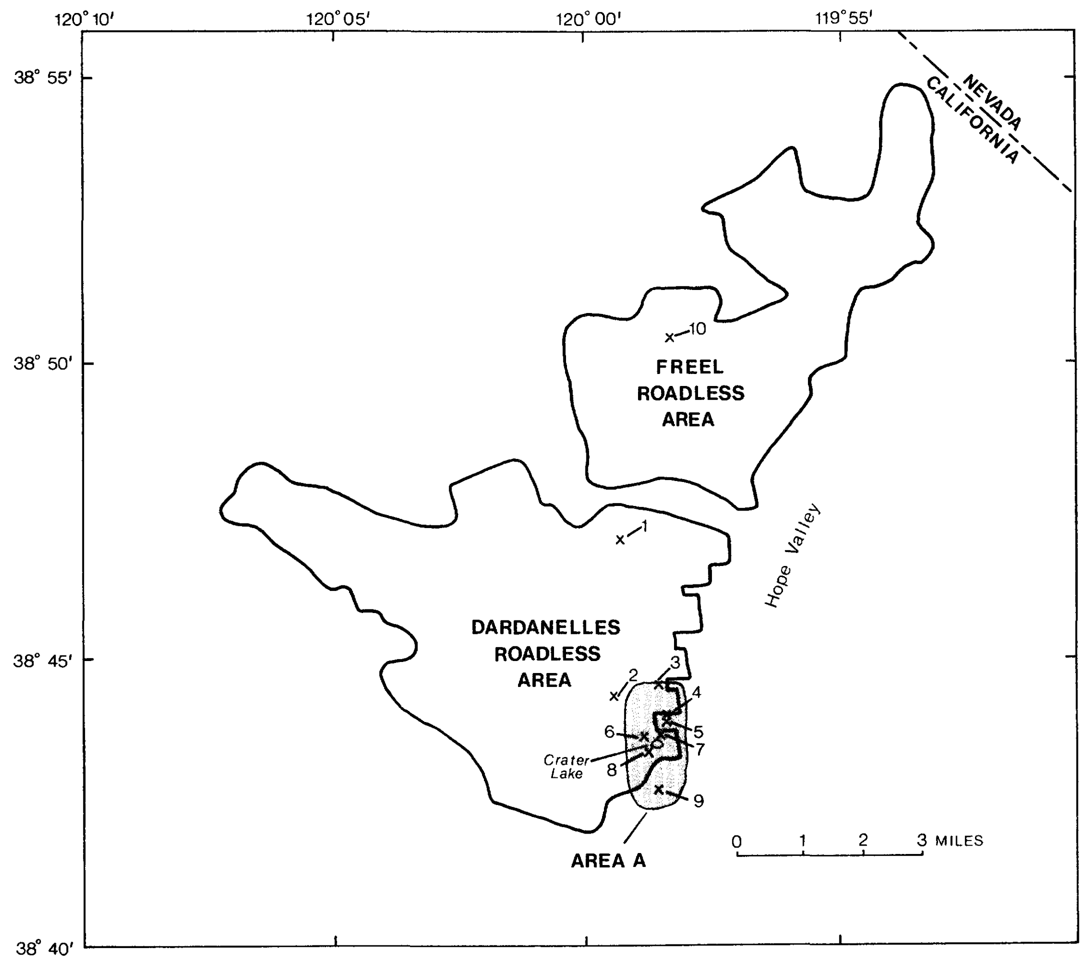

Figure 2. Freel and Dardanelles Roadless Areas showing area of mineral resource potential and mines and prospects described in tables 1 and 2.

EXPLANATION

Area of high potential for tungsten, zinc, silver, and copper resources

Mine or prospect locality described in Table 2

Approximate boundary of Roadless Area