MINERAL RESOURCE POTENTIAL OF THE EAST PART OF THE
RAYMOND PEAK ROADLESS AREA, ALPINE COUNTY, CALIFORNIA

SUMMARY REPORT

By

David A. John, Richard A. Armin, Donald Plouff, and
Maurice A. Chaffee,
U.S. Geological Survey

and

Francis E. Federspiel, Douglas F. Scott, and Eric E. Cather
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 in 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 east part of the Raymond Peak Roadless Area, Toiyabe National Forest, Alpine County, California. The Raymond Peak 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

The east part of the Raymond Peak Roadless Area has mineral resource potential in base and precious metals and uranium. Three areas have been identified as having potential for undiscovered precious-metal and skarn-type tungsten deposits (fig. 3). Area A in the southeastern part of the Roadless Area has geochemically anomalous elements, hydrothermal alteration, favorable rock types, and known mineralization in mines and prospects in the immediate area suggesting a high potential for undiscovered precious- and base-metal deposits. Area B, near Burnside Lake, has geochemically anomalous elements, favorable rock types, and mines and prospects in and near the area suggesting a moderate potential for undiscovered tungsten deposits. Area C, near Charity Valley, has geochemically anomalous elements suggesting a low potential for undiscovered molybdenum and tungsten deposits. Uranium mineralization is known in one prospect just south of the roadless area, but the potential for undiscovered uranium deposits is low.

An estimated 1,826,000 tons (1,657,000 t) of resources averaging from a trace to 0.04 oz gold per ton (1.37 g/t), and a trace to 23.5 oz silver per ton (805.7 g/t) occur within the roadless area on three properties (table 1 and fig. 2, nos. 3, 5, 9). About 1,500,000 tons (1,360,000 t) of inferred subeconomic resources are on the St. Helena prospect, and the California-Illinois property contains about 270,000 tons (245,000 t) of inferred subeconomic resources. At the Exchequer mine, an estimated 56,000 tons (56,800 t) of inferred marginal reserves averaging 0.04 oz gold per ton (1.37 g/t) and 23.5 oz silver per ton (805.7 g/t) occur in ore shoots. Other prospects adjacent to the southeastern boundary contain gold, silver, and uranium resources along structures which probably extend into the study area. Energy resource potential in the study area is low. A low geothermal potential exists near Grover's Hot Springs just east of the study area.

INTRODUCTION

LOCATION AND ACCESS

The Raymond Peak Roadless Area consists of two separate units. The west part (5985), about 12 mi (19 km) southwest of Markleeville in Stanislaus National Forest, has been studied separately as part of the Mokelumne Wilderness Area and vicinity (McKee and others, 1982) (fig. 1). The east part (4985) is the subject of this report (fig. 2). The east part of the Raymond Peak Roadless Area (4985) encompasses about 57.8 mi² (153 km²) along the crest and eastern slope of the Sierra Nevada, approximately 13 mi (21 km) south-southeast of Lake Tahoe. Markleeville, the county seat of Alpine County, lies about 1.5 mi (2 km) east of the area (fig. 2). The topography of the area is characterized by deeply incised canyons with glacially scoured canyon walls. Elevations range from 5,600 ft (1,700 m) near Markleeville to more than 10,000 ft (3,000 m) on Hawkins and Raymond Peaks.

Principal access is provided by California State Highways 89, 4, and 88, along the eastern and southern boundaries. Secondary roads from Highway 4 lead to the main mines in the southeastern part of the area, and a U.S. Forest Service road off of Highway 88 passes within 0.25 mi of the west side of the area.

PRESENT STUDIES

The U.S. Geological Survey gathered data on the geology, geochemistry, and geophysics of the area. Geologic mapping was conducted, geochemical sampling, and geophysical surveys, including compilation of existing gravity data and an aeromagnetic survey were conducted during 1979-80. Results of the geologic mapping are summarized in Armin and others (1982), a tabulation of the chemical analyses is given.
in Sutley and others (1982), and results of the geophysical surveys are in Plouff (1983).

U.S. Bureau of Mines personnel gathered data concerning mines, prospects, and mineralized areas. They searched literature and courthouse records and conducted fieldwork to determine mineral resources and potential of the area. A total of 414 samples from mines, prospects, and mineralized areas and analyzed them by atomic absorption, chemical, and fire-assay methods. At least one sample from every prospect was analyzed by semiquantitative spectrographic methods to determine the presence of unsuspected elements. Complete sample analyses are on file at the U.S. Bureau of Mines, Western Field Operations Center, Spokane, Wash.

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS PERTAINING TO MINERAL RESOURCE ASSESSMENT

GEOLOGY

The oldest rocks in the study area are metamorphic rocks of Triassic (?) and Jurassic (?) age, exposed near Burnside Lake in the northwest part of the area. These rocks consist mainly of calcareous siltstone and sandstone with minor amounts of volcanic rocks, and were regionally metamorphosed to amphibolite grade. Garnet-pyroxyene skarns are present locally along contacts with granitic rocks. About half of the area is underlain by granitic rocks of the Sierra Nevada batholith. Thirteen plutons, probably emplaced during a relatively short span of time during the Late Cretaceous, are exposed in the area. The plutons are composed mostly of fine- to coarse-grained equigranular to porphyritic granite and granodiorite. Contacts between the plutons are sharp, and textures at contacts typically indicate the relative ages of plutons. The only mineralization known to be related to the granitic rocks is tungsten-gold skarn mineralization in metamorphic rocks along contacts with the Burnside Lake Adammellite of Parker (1961).

Volcanic rocks of early Miocene through early Pleistocene age cover about half of the area. They range in composition from rhyolite to basalt, although andesite compositions are more prevalent. The composite thickness of these volcanic rocks is as much as 7,000 ft (2,150 m) and decreases toward the northwest.

The oldest volcanic rocks exposed in the area are rhyolitic ash flow and air-fall tuffs of early Miocene age which are correlative with part of the Valley Springs Formation discussed by Slummons (1966). These rhyolites are locally preserved where they fill paleochannels cut into deeply weathered granite bedrock.

Unconformably overlying the rhyolitic tuffs and the granitic rocks is a thick sequence of andesitic flows, flow breccias, mudflows, and volcaniclastic sedimentary rocks of middle Miocene age which are correlative with the Relief Peak Formation (Slummons, 1966). Most of these andesite rocks are moderately to intensely propylitized. Uranium mineralization is locally present in the basalt part of this andesite sequence.

A thick sequence of andesitic mudflows and lava flows unconformably overlies the flat-lying to gently dipping older andesite sequence near Raymond and Reynolds Peaks. Curtis (1951) suggests that this younger sequence may represent part of the flank of a huge, deeply eroded composite volcano, the center of which lay to the southeast. These younger andesite rocks are generally unmetamorphosed.

Volcanic activity concluded during the latest Miocene and early Pliocene with the intrusion of several small rhyolite plugs exposed near and mostly outside the southeast border of the area. Silver and gold mineralization in the Silver Mountain district, and the nearby Monitor district (Zaca mine, 1.5 mi east of the area) apparently is associated with this younger silicic volcanism. The numerous silicified (jasperoid) zones in andesitic rocks at the east end of the area also probably formed as a result of these intrusions.

The major fault system along the east margin of the Sierra Nevada passes through this area. The present topography is a result of uplift and westward tilting that is occurring along this fault system and Pleistocene glaciation that cut deep canyons and valleys.

GEOCHEMISTRY

A total of 38 rock samples, 41 -60-mesh (0.25-mm) stream-sediment magnetic heavy-mineral-concentrate samples were analyzed for the geochemical investigation of the Raymond Peak Roadless Area. All of the samples were analyzed for 31 elements (silver, arsenic, gold, bismuth, cadmium, selenium, cadmium, cobalt, chromium, copper, iron, lanthanum, magnesium, manganese, molybdenum, nickel, lead, antimony, scandium, tin, strontium, thorium, titanium, vanadium, tungsten, yttrium, zinc, and zircon) by a six-step semiquantitative emission spectrographic method. All of the rock and stream-sediment samples were also analyzed for arsenic, bismuth, cadmium, antimony, and zinc by wet chemical methods. Two of the stream-sediment samples were also analyzed for gold by atomic-absorption spectrometry.

The rock samples were collected primarily to provide information on the normal, or background, chemical abundances of the rock units in the study area; consequently, only the stream-sediment and concentrate analyses are discussed here.

For the stream-sediment samples 11 elements (silver, arsenic, gold, bismuth, cadmium, copper, iron, molybdenum, lead, antimony, and zinc) were selected as possibly being related to mineralization; for the concentrate samples, 15 elements (silver, arsenic, bismuth, cadmium, cobalt, copper, iron, magnesium, molybdenum, lead, tin, strontium, tungsten, and zinc) were selected. Because of the small number of samples in the date set, the analyses for this study were compared to those of other study areas in the vicinity of the Raymond Peak Roadless Area, including the Freeland-Dardanelles, Carson-Iceberg, and Leavitt Lake Roadless Area. On the basis of analytical distributions of elements in all of these areas, threshold values (highest background values) were selected for the Raymond Peak samples. The concentrations for the individual selected elements in each sample were then weighted using a technique called Scoresum (Chaffee, 1983), and the anomalies were then plotted on a geologic base map of the roadless area.

Selected elements in the concentrate samples have been divided into three separate suites. Suite 1 (silver, arsenic, copper, manganese, lead, and zinc) includes those elements most closely associated with base- and precious-metal deposits. Suite 2 (boron, bismuth, molybdenum, tin, and tungsten) includes those elements most closely associated with molybdenum and tungsten deposits, particularly skarn-type deposits. Suite 3 (barium, cobalt, iron, and strontium) includes those elements most closely associated with hydrothermal alteration but not necessarily with mineralization. This last suite helps to identify the minerals pyrite and barite and seems to indicate areas of pyritization, argillization, silicification, and bleaching, particularly in the Tertiary volcanic rock units.

Geochemical anomalies

Significant anomalies are present in three areas of the east part of the Raymond Peak Roadless Area (fig. 3) and are described below.

Area A.—This area is bounded roughly by the drainage divide between Raymond and Reynolds Peaks on the southeast, by Pleasant Valley Creek on the north, and by Silver Creek to the southwest, by Pleasant Valley Creek on the north, and by Silver Creek to the southeast. Geochemically the area is characterized by generally low level anomalies for silver, arsenic, gold, bismuth, cadmium, copper, iron, molybdenum, lead, antimony, and (or) zinc in stream-sediment samples. The strongest anomalies occur in the drainage basins of IXL Canyon, Raymond Canyon Creek, and an unnamed north-flowing fork of Pleasant Valley Creek immediately west of Raymond Canyon Creek. Anomalies in the concentrate samples include most of the elements in suite 1 (base- and precious-metal suite) and suite 3 (hydrothermal alteration suite). Anomalies for suite 3 are very strong throughout area A; anomalies for
suites 1 elements are strongest in the IXL Canyon, Raymond Canyon Creek, Indian Creek, and Poor Boy Creek drainage basins. Geologically, area A is characterized by locally intensely altered Tertiary andesitic rocks that are known to be favorable host rocks for base- and precious-metal deposits. Some, but probably not all, of the geochemical anomalies may have resulted from contamination from past mining activity. On the basis of the above information, area A is considered to have a high potential for precious- and base-metal deposits.

Areas B and C. These areas include basins that represent (1) most of the tributaries flowing westward into the West Fork of the Carson River in Hope, Faith, and Charity Valleys; (2) the north-flowing tributaries that flow into this same river on the north side of the study area; and (3) the upper part of Hot Springs Creek. Areas B and C are represented by generally low anomalies for silver, arsenic, cadmium, copper, iron, molybdenum, and (or) zinc in stream-sediment samples and generally low to moderate anomalies for elements in suite 1 (base- and precious-metal suite) and suite 2 (molybdenum-tungsten suite) in the concentrate samples. The strongest anomalies from concentrates are in those basins draining the areas of the Burnside and Cal-Pine mines and in the basin draining upper Hot Springs Creek. Geologically, area B, with the stronger anomalies of these two areas for both kinds of samples, has outcrops of highly altered metasedimentary rocks known to contain contact metasomatic-type tungsten deposits. Some of the anomalies seem to be related to contamination from past mining activity. Area B is considered to have a moderate mineral potential for tungsten deposits that may also contain other base and precious metals. Other less significant anomalies in the roadless area generally contain low levels of one or more of the molybdenum-tungsten suite of elements. The geology of these areas, particularly area C in the Faith and Charity Valleys, suggests the possibility of molybdenum-rich veins in the granitic plutons within these drainage basins. Area C is considered to have a relatively low potential for molybdenum and tungsten.

GEOPHYSICS

Gravity and aeromagnetic surveys were used to aid geologic mapping and mineral appraisals in the east part of the Raymond Peak Roadless Area (Plouff, 1983). The regional gravity survey resulted in a gravity anomaly map that is dominated by closely spaced north-trending contours that reflect thickening of the crust beneath the Sierra Nevada (Oliver and others, 1982). The gravity gradient obscures anomalies that might be related to anomalous distributions of near-surface rocks in most of the area. A gravity low east of Hawkins Peak interrupts the otherwise continuous gradient along the eastern edge of the Sierra Nevada batholith. The central part of the gravity low to the east probably reflects a thick section of Tertiary volcanic rocks. A relative gravity high, 3 mi (4.8 km) in diameter, east of Poor Boy Creek at the eastern edge of the area may outline a relatively dense underlying pluton.

An aeromagnetic survey was flown at about 1,000 ft (300 m) above the ground along northeast-trending flight lines spaced at 0.5-mi (0.8-km) intervals (U.S. Geol. Survey, 1984). The resulting magnetic intensity map is complex and mostly reflects the rugged topography. The surface rocks generally have normal magnetization, and consequently magnetic highs tend to occur over hilltops and ridges, while magnetic lows occur over valleys, where the observation level was higher above the ground. Tertiary andesitic rocks have a relatively high magnetization (Plouff, 1983) and, hence, produce intense magnetic highs over steep hilltops such as Hawkins, Markleville, and Raymond Peaks. Less intense magnetic highs occur over Tertiary rhyolitic rocks, which have moderate magnetization. The granitic and metamorphic rocks generally show low to moderate magnetization and produce magnetic lows and small magnetic highs. Broad complex magnetic lows generally overlie granitic rocks from Raymond Peak northwestward to Hope Valley. Superimposed local magnetic highs indicate that rocks at the surface are normally magnetized, but the larger negative anomalies may reveal underlying larger bodies of weakly magnetized or possibly reversely magnetized crystalline rocks.

The Burnside and Cal-Pine mines are located along the contact between metamorphic rocks and the Burnside Lake Adamellite. This contact appears to be parallel to fairly linear northwest-trending magnetic contours. These mines occur on the northeast edge of a 1-mi-diameter magnetic low that is located in the northern part of a broader low. This broad low is interrupted near Grover's Hot Springs by a magnetic high that is associated with relatively mafic granite rocks. Northeast of this high, the granite rocks underlying a magnetic low apparently have a relatively low magnetization, possibly caused by alteration associated with the hydrothermal system that feeds Grover's Hot Springs. Elsewhere the effects of topography and the variations in magnetization of the surrounding and deeper lying rocks tend to conceal possible aeromagnetic lows associated with occurrences of altered rocks.

MINING DISTRICTS AND MINERALIZATION

MINING HISTORY AND MINING DISTRICTS

Mining activity began in Alpine County in the 1850s, shortly after discovery of the Comstock lode in Nevada. Principal mining districts in the county including Monitor, Silver Mountain, Raymond, and Hope Valley, were established in the early 1860s. Most mineral production in the county estimated to be about $20 million since 1880 (Clark, 1977, p. 13) has been from the Levithan (sulfur) and the Zaca mines (silver and gold); both are in the Monitor district, 1.5 to 5 mi (2-8 km) east of the Raymond Peak Roadless Area. These mines were initially developed in the 1860s and have yielded ore periodically since then. Mining properties in and adjacent to the southeastern part of the roadless area are in the Silver Mountain district. Production records are incomplete, but Clark (1977, p. 28) reports district mines had an output of less than $300,000. Principal silver and gold deposits in this district are on the Eschequers, St. Helena, IXL, Acacia, Columbia, Bolin, and Pennsylvania properties (fig. 3 and table 1, nos. 9, 3, 13, 11, 23, 22, and 29, respectively). These deposits, excluding the Columbia, are in quartz veins in silicified shear zones in Tertiary andesitic breccia; deposits at the Columbia claim (fig. 3, no. 23) are in shear zones in Cretaceous granitic rocks. These claims have been developed since the 1860s; currently small-scale prospecting is being done in IXL Canyon. The Cindy and Deer claims (fig. 3, No. 24), located in 1869, were explored for uranium by the Utah Construction and Mining Company (presently Pathfinder Mines, Inc.) until 1973. The Raymond district, organized in the late 1860s along Raymond Canyon Creek, has been dissolved since the 1930s. Gold and silver deposits in this district are on the Eschequers, St. Helena, IXL, Acacia, Columbia, Bolin, and Pennsylvania properties (fig. 3 and table 1, nos. 9, 3, 13, 11, 23, 22, and 29, respectively). These deposits are similar to those in the Silver Mountain district. The Cindy and Deer claims (fig. 3, No. 23) are in shear zones in Cretaceous granitic rocks. These claims have been developed since the 1860s; currently small-scale prospecting is being done in IXL Canyon. The Cindy and Deer claims (fig. 3, No. 24), located in 1869, were explored for uranium by the Utah Construction and Mining Company (presently Pathfinder Mines, Inc.) until 1973. The Raymond district, organized in the late 1860s along Raymond Canyon Creek, has been dissolved since the 1930s. Gold and silver deposits in this district are on the Eschequers, St. Helena, IXL, Acacia, Columbia, Bolin, and Pennsylvania properties (fig. 3 and table 1, nos. 9, 3, 13, 11, 23, 22, and 29, respectively). These deposits are similar to those in the Silver Mountain district. The Cindy and Deer claims (fig. 3, No. 23) are in shear zones in Cretaceous granitic rocks. These claims have been developed since the 1860s; currently small-scale prospecting is being done in IXL Canyon. The Cindy and Deer claims (fig. 3, No. 24), located in 1869, were explored for uranium by the Utah Construction and Mining Company (presently Pathfinder Mines, Inc.) until 1973. The Raymond district, organized in the late 1860s along Raymond Canyon Creek, has been dissolved since the 1930s. Gold and silver deposits in this district are on the Eschequers, St. Helena, IXL, Acacia, Columbia, Bolin, and Pennsylvania properties (fig. 3 and table 1, nos. 9, 3, 13, 11, 23, 22, and 29, respectively). These deposits are similar to those in the Silver Mountain district. The Cindy and Deer claims (fig. 3, No. 23) are in shear zones in Cretaceous granitic rocks. These claims have been developed since the 1860s; currently small-scale prospecting is being done in IXL Canyon. The Cindy and Deer claims (fig. 3, No. 24), located in 1869, were explored for uranium by the Utah Construction and Mining Company (presently Pathfinder Mines, Inc.) until 1973. The Raymond district, organized in the late 1860s along Raymond Canyon Creek, has been dissolved since the 1930s. Gold and silver deposits in this district are on the Eschequers, St. Helena, IXL, Acacia, Columbia, Bolin, and Pennsylvania properties (fig. 3 and table 1, nos. 9, 3, 13, 11, 23, 22, and 29, respectively). These deposits are similar to those in the Silver Mountain district. The Cindy and Deer claims (fig. 3, No. 23) are in shear zones in Cretaceous granitic rocks. These claims have been developed since the 1860s; currently small-scale prospecting is being done in IXL Canyon. The Cindy and Deer claims (fig. 3, No. 24), located in 1869, were explored for uranium by the Utah Construction and Mining Company (presently Pathfinder Mines, Inc.) until 1973.
mine and Lady Franklin claim (fig. 3, nos. 9, 10) extend into the roadless area and are currently being developed by a small mining company.

No oil and gas, geothermal, or other mineral leases exist in the roadless area.

Geologic factors related to deposits

Silver and gold deposits occur in hydrothermally altered shear zones which cut Miocene andesite breccias, mainly in the southeast part of the area. Limonite-stained silicified country rock has quartz veins and stringers with disseminated pyrite and pyrargyrite; galena and stibnite also occur locally in the quartz veins. Steeply dipping shear zones trend north to northeast and are 1 to 34 ft (0.3-10.4 m) thick, averaging about 5 ft (1.5 m) thick. They are segmented by east-west fracture systems and are difficult to trace along strike.

Uranium occurs in a podiform-type deposit in a buried Tertiary stream channel, along a contact between granitic and volcanic rocks.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The potential for resources of silver and gold is high in the east part of the Raymond Peak Roadless Area; the potential for tungsten resources is moderate to low; and the potential for uranium, lead, zinc, copper, molybdenum, and antimony resources is low. Most of the mineral potential is in andesite breccias and granite rocks in the southeastern part of the area. These rocks have been broken by numerous northwest- and northeast-trending shear zones and faults and have been extensively altered.

The St. Helens, California-Illinois, and Exchequer properties contain approximately 1,826,000 tons (1,857,000 t) of silver and gold resources. These properties and others with mineral resources in similar geologic settings adjacent to the study area are shown on table 1. Resources are in north- and northeast-trending steeply dipping shear zones and faults and have been extensively altered.

The St. Helens, California-Illinois, and Exchequer properties consist of calcareous sedimentary rocks, which includes the southern end of a pendant of metamorphic rocks, this type in this area. Copper resources, similar to the quartz veins in the study area, are shown on table 1. Resources are in north- and northeast-trending shear zones and faults and have been extensively altered.

Area B. A moderate potential exists for undiscovered tungsten skarn resources in area B. Area C. A low potential exists for molybdenum- and tungsten-bearing quartz veins or pegmatite deposits in area C. There are anomalous concentrations of molybdenum and tungsten, but no alteration or extensive veining was observed in any of the four granite plutons here.

Uranium. A low potential exists for undiscovered uranium resources in area A. Uranium mineralization is locally present in the lower part of the Relief Peak Formation at the Cindy and Deer claims (No. 24) on the southern edge of the area and about 20 ml (32 km) farther south near Sonora Pass at the Juniper mine (Rapp and Short, 1980). In a detailed study of the Sonora Pass area, Rapp and Short (1980) concluded that uranium mineralization resulted from reduction of uranium-bearing groundwater by carbonaceous matter in the Relief Peak Formation. They also concluded that high permeability in the Relief Peak Formation was an important factor in groundwater circulation and mineralization, and that the uranium was probably leached from rocks in the overlying Stanislaus Group. In the east part of the Raymond Peak Roadless Area most of the andesite rocks correlated with the Relief Peak Formation are strongly propylitized and may have low permeabilities. Furthermore, the Stanislaus Group probably never extended as far north as this area. The lack of suitable host rocks, the lack of known uranium mineralization (except at the Cindy and Deer claims) and the lack of a uranium source suggest a low potential for undiscovered uranium resources in area A.

Place resources.—Alluvial deposits consisting of silt and sand and gravel occur along all drainages in the study area. Nine samples were collected from various creeks; no gold was detected, but two pan concentrates from Pleasant Valley Creek had 0.016 percent e 3 g (uranium oxide equivalent).

Energy resources.—A small potential for geothermal energy is present near Grovers Hot Springs near the eastern part of the area. The reservoir is estimated to have a volume of 3.2+0.9 km 3 and a mean temperature of 126°+6°C (Muffler, 1979, p. 64), not hot enough for steam-fire power generation. There is no oil or gas potential in the roadless area.

REFERENCES CITED


Clark, W. B., 1977, Mines and mineral resources of Alpine County, California: California Division of Mines and Geology County Report 8, 48 p.


Figure 1. Index of wilderness and roadless areas in the vicinity of the east part of the Raymond Peak Roadless Area.

4-985 East part of the Raymond Peak Roadless Area
NF-051 Mokelumne Wilderness
5-027 Caples Creek Roadless Area
5-984 Tragedy-Elephants Back Roadless Area; part in Toiyabe National Forest
5-984 Tragedy-Elephants Back Roadless Area; part in El Dorado National Forest
5-985 Raymond Peak Roadless Area
Figure 2.—Index map of the east part of the Raymond Peak Roadless Area and vicinity, Alpine County, California.
Figure 3.—East part of the Raymond Peak Roadless Area showing areas of mineral resource potential and mines and prospects described in tables 1 and 2.
### Map No. | Name (Commodity) | Summary | Workings and Production | Assessment of Resources or Potential
--- | --- | --- | --- | ---
1 | Good Hope prospect (gold, silver) | Rhyolite and andesite breccia underlie the prospect; no mineralized structure is exposed. Raymond (1874) reports a 3- to 10-ft (0.9-3 m)-thick quartz vein striking northerly and dipping 40° W. was developed for 400 ft (120 m) in presently caved portions of the prospect adit. | An adit is reported to be 600 ft (183 m) long; only 100 ft (30 m) are accessible. | Ten samples of dump material and county rock assayed trace gold and 0.1 oz silver per ton (3.4 g/t). Mill tests of vein material in 1874 (Raymond) reportedly averaged 13.79 g/t per ton gold. Based on previous reports, this prospect has a high potential for gold and silver resources. |
2 | Easy N. 1-9 claims (Highland Mary) (gold, silver) | Rhyolite flows, tuffs, and breccia underlie most claims; andesite breccia occurs locally. Rhyolite is highly stained by iron and manganese oxides and in places is highly silicified. Prominent fracture systems trend northwest and dip steeply northeast. | One small, sloughed pit | Seventeen chip samples, mainly of silicified rhyolite, contained no more than trace gold and 0.6 oz silver per ton (16.9 g/t). These claims have a moderate potential for the discovery of gold and silver resources. |
3 | St. Helena prospect (silver, gold) | A 2- to 4-ft (0.6-1.2 m)-thick shear zone strikes north to N. 41°E. and dips 55° W. in Pliocene andesite breccia. The zone contains silicified and kaolinized breccia and quartz stringers as much as 2 ft (0.6 m) thick with disseminated pyrite, galena, and pyrrhotite. A sterile vein 3 in. (8 cm) thick occurs locally along the shear zone. Segments of the shear zone are exposed intermittently along strike for about 5,600 ft (1,676 m). | Clark (1977, p. 46) reports 100 ft (30 m) of development on shear zone. | Approximately 1,500,000 tons (1,360,000 t) of inferred subeconomic resources averaging 0.014 oz gold per ton (0.479 g/t) and 0.2 oz silver per ton (6.9 g/t) are in shear zones on the prospect. |
4 | Silver Cloud claim (gold, silver) | A north-trending shear zone in andesite breccia is exposed intermittently along strike for about 1,200 ft (366 m). The zone ranges from 1.5 to 4.5 ft (0.46 to 1.4 m) thick and contains limonite-stained andesite and quartz stringers with about 1 percent finely disseminated pyrrhotite. | Historical field survey notes indicate a 157-ft (48 m) long adit, and shaft developed a 2- to 4-ft (0.6 to 1.2 m)-thick shear zone containing quartz with disseminated sulfides. | Nine samples across the zone contained much as trace gold and 0.3 oz silver per ton (10.36 g/t). A grab sample assayed 0.4 oz silver per ton (11.99 g/t) and 57.0 oz silver per ton (0.12 oz gold per ton (3.4 g/t) and 0.1 oz silver per ton (13.7 g/t). The other sample assayed 0.01 oz gold per ton (0.34 g/t) and no silver. This property has moderate gold-silver resource potential. |
5 | California-Illinois prospect (gold, silver) | Andesite breccia contains numerous northwest-trending, steeply dipping shear zones. These zones are 3 to 5 ft (1 to 1.5 m) thick and contain silicified, bleached andesite breccia and quartz stringers as much as 2 ft (0.6 m) thick with disseminated pyrrhotite. | Seven sawed adits totaling an estimated 1,500 ft (580 m) of underground workings and 13 prospect pits and trenches are on the prospect. | Approximately 270,000 tons (245,000 t) of inferred subeconomic resources averaging 0.03 oz gold per ton (1.039 g/t) and 0.1 oz silver per ton (3.4 g/t) are in shear zones on the prospect. |
6 | Unnamed prospect (gold, silver) | Two shear zones 2 ft (0.6 m) thick strike N. 10° - 25° W. and dip 80° NE. to 80° SW. in greenish gray andesite. They contain bleached and silicified andesite and limonite-stained quartz stringers. | One prospect pit, 12 ft (3.7 m) long, 8 ft (2.4 m) wide, and 5 ft (0.25 m) deep | One chip sample from each zone; one sample contained 0.13 oz gold per ton (4.11 g/t) and 0.4 oz silver per ton (13.7 g/t). The other sample assayed 0.01 oz gold per ton (0.34 g/t) and no silver. This property has moderate gold-silver resource potential in the shear zones. |
7 | Unnamed prospect (gold, silver) | Discontinuous segments of subparallel shear zones strike N. 10° - 25° W. and dip 70° - 80° NW. in andesite breccia. Zones are 2 to 50 ft (0.6-1.5 m) thick and consist mainly of silicified andesite with a few quartz veins and stringers; they are not traceable more than 100 ft (30 m) along strike. Quartz contains 1-5 percent disseminated pyrrhotite. | Two small prospect pits | Four chip samples and one grab sample were taken. Two samples across the 30-ft (9 m)-thick zone contained 0.56 and 0.1 oz gold per ton (19.10 g/t and 3.4 g/t) and 0.9 and 0.2 oz silver per ton (29.3 g/t and 6.9 g/t). Samples of other zones had as much as 0.1 oz gold per ton (3.4 g/t) and 1.0 oz silver per ton (34.26 g/t). A moderate potential for the discovery of gold-silver resources is in the shear zones. |
8 | Unnamed prospect (gold, silver) | Quartz and calcite are along fractures that strike N. 35° - 55° W. and dip nearly vertical in andesite breccia. The quartz and calcite have 1 to 2 percent disseminated pyrrhotite and numerous pseudomorphs after sulfides. | One prospect pit, 30 ft (9 m) long, 10 ft (3 m) wide, and 5 ft (1.5 m) deep | Four chip samples ranged from trace to 0.35 oz gold per ton (11.95 g/t) and trace to 0.3 oz silver per ton (10.3 g/t). Zones at the prospect have a moderate potential for gold-silver resources. |
9 | Exchequer mine (gold, silver) | A shear zone in andesite breccia strikes N. 21° W. and dips 87° SE. The zone is 1 to 18 ft (0.3-5.4 m) thick and contains limonite-stained, silicified and kaolinized country rock and quartz veins and stringers with disseminated pyrite and pyrrhotite. This zone is exposed for about 200 ft (61 m) at the surface and is segmented by east-west fracture systems. | Raymond (1874) reported an adit 811 ft (247 m) long and a shaft in excess of 300 ft (91 m) deep. The adit is accessible for 52 ft (16 m) but the shaft is completed caved. | An estimated 56,000 tons (50,000 t) of inferred marginal reserves containing 0.04 oz gold per ton (1.37 g/t) and 0.35 oz silver per ton (10.75 g/t) are in ore shoots along the shear zones. |
10 | Lady Franklin claim (gold, silver) | A 3-ft (0.9-m) zone strikes N. 20° E. and dips from 80° SE. to vertical in andesite breccia. The zone contains limonite-stained, silicified, and kaolinized andesite breccia and quartz veins with disseminated sulfides, mainly pyrite and pyrrhotite. | One adit with 135 ft (41 m) of workings | Eight samples across sulfide-bearing quartz stringers assayed as much as 0.339 oz gold per ton (11.623 g/t) and 0.2 oz silver per ton (6.9 g/t). The shear zones have a high potential for the discovery of gold and silver resources. |
<table>
<thead>
<tr>
<th>Map no.</th>
<th>Name (commodity)</th>
<th>Summary</th>
<th>Workings and production</th>
<th>Assessment of resources or potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Acacia claim</td>
<td>Andesite breccia underlies the claim. A 0.5- to 5-ft (0.15-1.5-m) thick shear zone strikes from N. 22° W. to the east and west. The zone has limonite-stained silicified andesite breccia with quartz and calcite veins containing disseminated pyrite and pyrrhotite.</td>
<td>Development consists of a 430-ft (131-m) adit with 165 ft (50.3 m) of crosscuts and drifts.</td>
<td>Thirty-two samples: 30 samples across shear zones assayed from trace to 0.02 oz gold per ton (0.69 g/t) and trace to 0.9 oz silver per ton (30.9 g/t); two samples of mineralized quartz veins averaged 0.03 oz gold per ton (1.03 g/t) and 8.55 oz silver per ton (303.14 g/t). The shear zones have high potential for gold-silver resources.</td>
</tr>
<tr>
<td>12</td>
<td>Adolphus Canyon prospect (gold, silver)</td>
<td>Shear zones in andesite breccia range from 3 to 7 ft (0.9 to 2 m) thick, strike N. 30° W. and dip from 70° W. to vertical. These zones contain silicified, andesite breccia and quartz veins with about 1 percent finely disseminated sulfides.</td>
<td>None</td>
<td>Seven chip samples across the shear zones assayed from trace to 0.02 oz gold per ton (0.69 g/t) and trace to 1.6 oz silver per ton (54.9 g/t) per ton. The shear zones have high gold-silver resource potential.</td>
</tr>
<tr>
<td>13</td>
<td>IXL mine (gold, silver)</td>
<td>Numerous shear zones strike from N. 16° E. to N. 35° E., dip steeply to the northwest and northeast in biocenose andesite breccia. The zones range in thickness from 1 to 7 ft (0.3 to 2 m) and contain limonite-stained silicified andesite breccia and quartz veins with disseminated pyrite and pyrrhotite.</td>
<td>Raymond (1874) reported the lower adit was 990 ft (302 m) long with an additional 1,040 ft (317 m) of crosscuts and drifts. In 1979 only 530 ft (162 m) of this adit and 390 ft (91 m) of crosscuts and drifts were open. Other mine workings include a caved upper adit of unknown length and two caved shafts, one of which was more than 200 ft (61 m) deep.</td>
<td>There is approximately 150,000 tons (136,000 t) of inferred subeconomic resources containing 0.01 oz gold per ton (0.34 g/t) and 0.93 oz silver per ton (31.6 g/t) along shear zones. Ore shoots within these zones contain an estimated 15,000 tons (13,600 t) of marginal reserves averaging 0.36 oz gold per ton (19.2 g/t) and 48.47 oz silver per ton (1,661.8 g/t).</td>
</tr>
<tr>
<td>14</td>
<td>Pine Tree prospect (gold, silver)</td>
<td>Shear zones in andesite breccia range from 3 to 5.5 ft (0.9-1.7 m) thick, strike N. 60°-140° W. and dips 70° NE. to vertical. These zones contain silicified, andesite breccia and quartz stringers with about 1 percent finely disseminated sulfides.</td>
<td>One prospect pit</td>
<td>Four chip samples across the shear zone contained trace gold and as much as 0.3 oz silver per ton (9.9 g/t). This prospect has a moderate potential for discovery of gold-silver resources in shear zones.</td>
</tr>
<tr>
<td>15</td>
<td>Big Sandy prospect (gold, silver)</td>
<td>A shear zone in andesite breccia ranges from 3 to 10 ft (0.9 to 3 m) thick, strike N. 21° W., and dips 70° NE. The zone contains silicified, andesite breccia and quartz veins with about 1 percent finely disseminated sulfides.</td>
<td>One prospect pit</td>
<td>Two chip samples across a shear zone contained as much as 0.01 oz gold per ton (0.34 g/t) and 4.3 oz silver per ton (147.4 g/t). A moderate potential for gold-silver resources is in shear zones at the prospect.</td>
</tr>
<tr>
<td>16</td>
<td>Little Sandy prospect (gold, silver)</td>
<td>A shear zone in andesite breccia averages 1 ft (0.34 m) thick, strike N. 42° W., and dips 60° NE. The zone contains silicified andesite breccia and quartz veins with about 1 percent disseminated sulfides.</td>
<td>None</td>
<td>One chip sample across the shear zone contained 0.01 oz gold per ton (0.34 g/t) and no silver. A moderate potential for discovering gold-silver resources in shear zones on the prospect is based on values from samples in nearby zones.</td>
</tr>
<tr>
<td>17</td>
<td>Pittsburgh prospect (gold, silver)</td>
<td>A shear zone in andesite breccia averages 1 ft (0.34 m) thick, strike N. 43° W., and dips 60° E. to vertical. These zone segments are 0.5 to 5.0 ft (0.15-1.5 m) thick and contain silicified country rock and quartz stringers.</td>
<td>Carl Munck (oral comm., 1979) reported the caved adit to be 800 ft (244 m) in length. A prospect pit is northwest of the caved working.</td>
<td>Six chip samples across a shear zone contained from trace to 0.02 oz gold per ton (0.69 g/t) and trace to 0.3 oz silver per ton (10.6 g/t). Two select grab samples contained from trace to 0.01 oz gold per ton (0.34 g/t) and trace to 0.1 oz silver per ton (3.4 g/t). This prospect has moderate potential for the discovery of gold-silver resources.</td>
</tr>
<tr>
<td>18</td>
<td>Gould and Curry prospect (gold, silver)</td>
<td>A shear zone 3 ft (0.9 m) thick in andesite breccia strikes due north and dips 85° E. in the adit. Surface exposures of shear zones in andesite breccia range from 1 to 17 ft (0.3-4.3 m) thick, strike from N. 40° W. to N. 20° W., and dip 85° NE. to vertical. The zones contain silicified andesite breccia and quartz veins with finely disseminated sulfides.</td>
<td>An adit is inaccessible 75 ft (23 m) from the portal because of a flooded wisue. One caved shaft and a prospect pit are northwest of the adit.</td>
<td>Ten chip samples across the shear zones assayed from trace to 0.06 oz gold per ton (2.06 g/t) and from trace to 1.6 oz silver per ton (54.3 g/t). Three chip samples from the adit contained as much as 0.03 oz gold per ton (0.69 g/t) and 0.5 oz silver per ton (17.1 g/t) and 0.1 oz silver per ton (3.4 g/t). The prospect has a moderate gold-silver resource potential.</td>
</tr>
</tbody>
</table>
Table 1.—Properties with mineral resource potential in the east part of the Raymond Peak (4985) Roadless Area and vicinity—Continued

<table>
<thead>
<tr>
<th>Map no.</th>
<th>Name</th>
<th>Summary</th>
<th>Workings and production</th>
<th>Assessment of resources or potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Knox prospect</td>
<td>A shear zone in andesite breccia is 3 ft (0.9 m) thick, strikes N. 40° E., and dips 65° SE. The zone contains silicified andesite breccia and quartz veins with about 1 percent disseminated sulfides. Three adits are on the prospect. The longest adit was reported to be 916 ft (280 m) long.</td>
<td>One caved shaft</td>
<td>Two chip samples across the shear zone contained as much as 0.01 oz gold per ton (0.34 g/t) and 0.1 oz silver per ton (3.4 g/t). This prospect has a moderate gold-silver resource potential.</td>
</tr>
<tr>
<td>20</td>
<td>Pennsylvania claim</td>
<td>A shear zone 2 to 8 ft (0.6-2 m) thick segmented strikes from N. 20° W. to N. 5° E., and dips from 73° to 84° E. in andesite breccia. The zone is segmented but continuous for about 700 ft (213 m) and contains limonite-stained silicified country rock and a quartz vein 2 ft (0.6 m) thick with about 1 percent disseminated sulfides, mainly pyrite.</td>
<td>None</td>
<td>Five samples from the zone assayed as much as trace gold and 0.08 oz silver per ton (2.74 g/t). Four select dump grab samples contained as much as trace gold and 2.3 oz silver per ton (78.9 g/t). A moderate gold-silver resource potential is in shear zones on the claim.</td>
</tr>
<tr>
<td>21</td>
<td>Sa Sha prospect</td>
<td>Several shear zones trend from N. 18°-80° W. and dip from 75°-80° SW. in granodiorite. These zones are 1.5 to 10 ft (0.56 to 3 m) thick and contain silicified granodiorite and massive, limonite-stained quartz.</td>
<td>None</td>
<td>Three chip samples across the shear zones contained as much as 0.072 oz gold per ton (2.469 g/t) and 0.4 oz silver per ton (13.7 g/t). On the basis of sample values, the shear zones have a moderate potential for gold-silver resources.</td>
</tr>
<tr>
<td>22</td>
<td>Bolin claims</td>
<td>Granodiorite capped by andesite breccia underlies the claims. Segments of a shear zone strike N. 5°-10° W. and dip 70° NE. Zone exposures are 1 to 6 ft (0.3 to 2 m) thick and contain limonite-stained, silicified andesite breccia and quartz stringers with disseminated sulfides.</td>
<td>None</td>
<td>Twelve chip samples across the shear zones contained from 0 to 0.028 oz gold per ton (0.960 g/t) and 0 to 5.6 oz silver per ton (192.0 g/t). A moderate potential for gold-silver resources is in shear zones at the claims.</td>
</tr>
<tr>
<td>23</td>
<td>Columbine claim</td>
<td>A principal shear zone strikes N. 20°-55° W. and dips 40°-61° SW. in granodiorite. The zone ranges from 3 to 20 ft (0.9 to 6 m) thick and contains silicified and brecciated granodiorite with quartz veins as much as 2 ft (0.6 m) thick containing disseminated sulfides. One 85-ft (26-m) adit, two prospect trenches about 20 ft (6 m) long, 8 ft (2.4 m) wide, and 10 ft (3 m) deep; and several small pits</td>
<td>None</td>
<td>An estimated 94,000 tons (85,300 t) of inferred subeconomic resources averaging 0.06 oz gold per ton (1.7 g/t) and 0.4 oz silver per ton (13.7 g/t) are in shear zones at the prospect.</td>
</tr>
<tr>
<td>24</td>
<td>Cindy and Deer claims</td>
<td>Cretaceous granodiorite capped by Miocene volcanic rocks underlies the claims. Small amounts of uranium oxide are in a buried stream channel along the granodiorite-volcanic rocks contact. This podiform-type deposit contains granodiorite and andesite cobbles, sand and gravel, and woody carbonaceous debris. There is an adit 12 ft (4 m) long and 12 ft (4 m) wide and several trenches as much as 50 ft (15 m) long. Eighteen holes totalling 2,100 ft (640 m) were drilled by Utah Construction and Mining Company (now Pathfinder Mines) Reno, Nev.</td>
<td>Approximately 8,000 tons (7,300 t) of inferred subeconomic resources containing 0.05 percent U3O8 are in carbonaceous material in a buried stream channel. Samples across the shear zones assayed as much as trace gold and 0.3 oz silver per ton (10.3 g/t).</td>
<td></td>
</tr>
</tbody>
</table>

1 Equivalent percent uranium oxide assuming uranium is in equilibrium with daughter products which emit gamma radiation.
Table 2.—Estimated mineral resources in the east part of the Raymond Peak Roadless Area and vicinity
(Underlined numbers refer to properties with mineralized structures which probably extend into the study area)

<table>
<thead>
<tr>
<th>Map number</th>
<th>Property</th>
<th>Type</th>
<th>Tonnage(^1) (tons)</th>
<th>Resource(^2) classification</th>
<th>Product</th>
<th>Grade</th>
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<tbody>
<tr>
<td>3</td>
<td>St. Helena</td>
<td>Shear zone</td>
<td>1,500,000</td>
<td>Inferred subeconomic</td>
<td>Gold</td>
<td>0.01 oz/ton</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Silver</td>
<td>2.5 oz/ton</td>
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<tr>
<td>5</td>
<td>California-Illinois</td>
<td>Shear zone</td>
<td>270,000</td>
<td>Inferred subeconomic</td>
<td>Gold</td>
<td>0.03 oz/ton</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Silver</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Exchequer</td>
<td>Shear zone</td>
<td>56,000</td>
<td>Inferred marginal reserve</td>
<td>Gold</td>
<td>0.04 oz/ton</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(in shoots)</td>
<td></td>
<td>Silver</td>
<td>23.5 oz/ton</td>
</tr>
<tr>
<td>13</td>
<td>IXL</td>
<td>Shear zone</td>
<td>150,000</td>
<td>Inferred subeconomic</td>
<td>Gold</td>
<td>0.01 oz/ton</td>
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<td></td>
<td></td>
<td></td>
<td>(in shoots)</td>
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<td>Silver</td>
<td>0.93 oz/ton</td>
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<td></td>
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<td></td>
<td>15,000</td>
<td>Marginal reserve</td>
<td>Gold</td>
<td>0.36 oz/ton</td>
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<td>Silver</td>
<td>48.47 oz/ton</td>
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<tr>
<td>23</td>
<td>Columbine (Sawmill)</td>
<td>Shear zone</td>
<td>94,000</td>
<td>Inferred subeconomic</td>
<td>Gold</td>
<td>0.005 oz/ton</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Silver</td>
<td>0.5 oz/ton</td>
</tr>
<tr>
<td>24</td>
<td>Cindy and Deer</td>
<td>Stream channel</td>
<td>8,000</td>
<td>Inferred subeconomic</td>
<td>Uranium</td>
<td>0.05% (\text{U}_3\text{O}_8) ^3</td>
</tr>
</tbody>
</table>

\(^1\)Metric conversions: tons x 0.9072 = metric tons (t); oz per ton x 34.285 = grams per metric ton (t).


\(^3\)Equivalent percent uranium oxide assuming uranium is in equilibrium with daughter products which emit gamma radiation.