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MINERAL RESOURCE POTENTIAL OF THE SWEETWATER ROADLESS AREA, MONO COUNTY, CALIFORNIA, AND LYON AND DOUGLAS COUNTIES, NEVADA

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 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 resource potential survey of the Sweetwater Roadless Area (4-657), Toiyabe National Forest, Mono County, California, and Lyon and Douglas Counties, Nevada. The Sweetwater 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

A 9-mi^2 intensely altered area underlain by middle Miocene rhyolite of the Sweetwater volcanic center along the east side of the study area and two smaller areas within and east of the roadless area have a high to moderate resource potential for epithermal vein or disseminated silver and gold deposits. Since 1882, mines chiefly east of the roadless area have had an estimated production of $3,000,000, primarily in precious metals. Within the roadless area, extensive mineralization is indicated by assays of numerous vein, dump, and rock samples. The podiform nature of vein deposits, inaccessibility of underground workings, sporadic occurrence of disseminated mineralization, and extensive surficial deposits generally precluded estimation of mineral resources.

An area roughly coincident with the zone of Tertiary alteration and precious-metal enrichment has a moderate resource potential for a disseminated-molybdenum deposit. Anomalously high molybdenum abundances occur in shear zones, intensely altered rock, and veins in Tertiary rhyolite of the Sweetwater volcanic center within the same area as precious-metal mineralization. Lithologic characteristics, alteration, geochemical anomalies, and geophysical anomalies in the Tertiary rhyolitic rocks suggest a deep-seated Tertiary disseminated-molybdenum system. Molybdenum, in the form of molybdenite, also occurs in quartz veinlets in granite and was deposited during a Late Cretaceous mineralization event in plutonic rocks just east of the roadless area. The mineral resource potential for molybdenum in the granitic rocks is low because of unfavorable host-rock and mineral-deposit characteristics.

Three areas within and adjacent to the roadless area have a low or moderate resource potential for iron, copper, tungsten, gold, or uranium in thermally metamorphosed and metasomatized volcanic and sedimentary rocks. Moderate-sized metamorphic rock bodies are indicated by geophysical data; however, favorable carbonate facies within the bodies are of limited areal extent and exhibit only weak geochemical anomalies. Manganese occurs in three areas, but has a low resource potential.

The study area has nonmetallic mineral resource potential for silica and geothermal energy. One area has a low resource potential for silica, a pegmatitic quartz body vein. One area has a low resource potential for geothermal energy based on reservoir temperature and volume characteristics.

INTRODUCTION

The U.S. Geological Survey and the U.S. Bureau of Mines conducted a survey to evaluate the mineral resource potential of the Sweetwater Roadless Area during 1979-82. The roadless area, in east-central California and Nevada (fig. 1), encompasses some 72,240 acres of the Sweetwater Mountains in the Toiyabe National Forest near Bridgeport, Calif. The area is highlighted by a series of barren peaks along the crest of the range that are underlain by leached or brightly colored Mesozoic basement and Tertiary volcanic rocks. Elevations range from 11,673 ft on Mount Patterson to 6,160 ft near Devils Gate on the East Walker River. The climate of the area is semiarid. Vegetation ranges from a cold-steppe plant community of sage, forbs, and sparse conifers in protected sites at high elevations, to pinyon-juniper forests on side slopes, to a community of sage, grasses, and forbs on the lowest valley floors. Access to the area is from U.S. Highway 395 on the south and west, Risue Road on the north, and Nevada Highway 338 and California Highway 182 on the east. Several graded and unimproved dirt roads provide access to the west and east flanks of the range.

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS PERTAINING TO MINERAL RESOURCE ASSESSMENT

GEOLOGY

The Sweetwater Mountains, just east of the Sierra Nevada, contain a Mesozoic basement complex of dominantly silicic plutonic rocks with septa and roof pendants of metamorphic rocks that is nonconformably overlain by middle and upper Tertiary volcanic rocks and upper Tertiary(?) and Quaternary surficial deposits (Brem, 1983).

Metamorphic rocks crop out over less than 5 percent of the roadless area. The metamorphic protolith assemblage consisted of marine calcareous and tuffaceous clastic sedimentary rocks or intermediate to felsic volcanic rocks of Late Triassic(?) to Late Cretaceous age (Halsey, 1953; Schweickert, 1972, 1976) that have been thermally metamorphosed by plutonic rocks. The metamorphic rocks, particularly calcareous facies, are favorable hosts for iron, copper, and tungsten deposits primarily in skarn bodies near contacts with plutonic rocks and for gold and uranium deposits in silicified shear zones.

Plutonic rocks, predominantly Late Cretaceous in age, are exposed over about 20 percent of the roadless area. Granite is the most abundant rock type, however rocks range from gabbro to granite in composition. The plutonic rocks become more felsic and exhibit fewer thermal metamorphic effects with decreasing age. Plutonic rock compositions range from gabbro in the oldest pluton through mafic-mineral-rich granite to mafic-mineral-poor granite and granitic aplite in the youngest plutons. The oldest and intermediate age plutons, such as the Swauger Creek, Desert Creek, and East Fork, are bleached by metamorphism or have different mafic minerals near contacts with younger plutons. Multiple intrusive episodes and possible surface venting during pluton emplacement are suggested in the East Fork pluton where small irregularly shaped intrusions with finer grain size and more silicic composition intrude more mafic-mineral-rich granite. The East Fork and Green Creek plutons have been locally altered and mineralized with pyrite and molybdenite in four areas during Late Cretaceous mineralization events possibly related to the complex intrusive history of the East Fork pluton. A pegmatitic quartz body occurs within the Swauger Creek pluton, but is probably related to the granite of Devils Gate-Mack Canyon.

The metamorphic and plutonic rock assemblages in the study area are comparable to assemblages found in much of the Sierra Nevada and western Great Basin and may be related to a Mesozoic Andean-type arc along the west edge of North America (Dickinson, 1976). Mineral deposits within these rocks, as well as those within the roadless area, commonly include disseminated and quartz-vein molybdenum or contact-metasomatic tungsten, iron, copper, molybdenum, or gold types.

Upper Oligocene to upper Miocene volcanic rocks nonconformably overlie plutonic and metamorphic rocks and crop out over nearly 50 percent of the roadless area. The volcanic rocks and related mineralization events here and in adjacent parts of the Sierra Nevada and western Great Basin provinces are generally similar because the entire region is part of the same magmatic arc related to the subduction of the Farallon Plate beneath the west coast of North America (Dickinson, 1979; Dickinson and Snyder, 1979).

The oldest volcanic rocks in the Sweetwater Roadless Area are the upper Oligocene to lower Miocene Valley Springs Formation which consists of a few outcrops of silicic welded tuff that is not related to alteration or mineralization. The unconformably overlying middle Miocene Relief Peak Formation crops out discontinuously throughout the roadless area and consists of andesite lahar with less abundant autobrecciated flow, flow, or domal rocks. The andesite is weakly to strongly propylitized, except where more intense, local alteration and mineralization has occurred during events associated with rhyolitic volcanism.

Rhyolitic rocks are generally younger than the andesite and crop out throughout the roadless area. The rhyolitic rocks consist of a series of dikes and effusive rocks concentrated primarily in the central part of the range that have been informally named the Sweetwater volcanic center (Brem, 1982). Tuff and pyroclastic rhyolitic tuff breccia dominate the inner part of the center, whereas lava flows, dikes, and domal extrusions dominate the periphery. Much, if not all, of the rhyolitic rocks were extruded or intruded along a north-trending dike system. The dikes trend northerly irrespective of basement lithology and have steep to moderate dips that are inclined toward the north-trending central axis of the volcanic center. The rhyolite generally intrudes andesite of the Relief Peak Formation, although andesite is locally intercalated with rhyolite. In the central part of the Sweetwater volcanic center, the rhyolite, as well as the underlying rock, is intensely altered, mineralized, and contains silver, gold, and geochemically related metals in north-trending quartz veins, silicified shear zones, and possibly in disseminated deposits (Sutley and others, 1983). Anomalous concentrations of molybdenum and tin in these same rocks may indicate a deep-seated disseminated-molybdenum system.

Southwest of roadless area, latitic rocks of the upper Miocene Stanislaus Group from the Little Walker volcanic center (Brem, 1977; 1983) unconformably overlie andesite and rhyolite along much of the southeastern and southwestern part of the Sweetwater Mountains. This latitic sequence, consisting of latite lava flows and welded to nonwelded quartz latite ash-flow tuffs, postdates alteration and mineralization of the rhyolite and is not recognizably altered. Fales Hot Springs, located on the ring-fracture system of the Little Walker caldera, has a low resource potential for geothermal energy.

The late Tertiary and Quaternary history of the area reflects one of volcanic quiescence, but moderate to intense tectonic activity. Initial late Tertiary(?) uplift of the Sierra Nevada is suggested by the deposition from northeastward-flowing streams of coarse alluvial gravels of uncertain age along the northern and southern Sweetwater Mountains. Quaternary uplift of the Sweetwater Mountains and westward rotation of the entire range are indicated by a reversal of these early drainage patterns and by fanglomerates and normal faults along the east side of the range. The range today stands chiefly as a single fault block with few recognized large-displacement internal faults except for older normal faults along the southeast side of the range. Many small-displacement faults undoubtedly exist, particularly within the volcanic units, but remain unrecognized because of the prolonged and complex volcanic activity, hydrothermal alteration, and surficial or mass-wasting processes.

GEOCHEMISTRY

The geochemical investigation of the Sweetwater Roadless Area was based on the analysis of 127 rock, 59 stream-sediment, and 59 nonmagnetic heavy-mineral-concentrate samples (Sutley and others, 1983). Some rock samples were collected in order to provide information on the normal or background chemical abundances, whereas other rock samples from obviously mineralized and (or) hydrothermally altered outcrops and from selected mine dumps were collected to provide information about chemical abundances in potentially anomalous areas. Stream-sediment samples provide information about the chemical elements present in rock materials eroded from the drainage basin upstream from each sample site, and the composition of these samples identifies those basins that contain unusually high concentrations of elements that may be related to mineral deposits. Nonmagnetic heavy-mineral-concentrate samples were derived from the same active alluvium as stream-sediment samples. These concentrate samples provide information about selected elements in a limited number of minerals that may be ore related.

Some stream-sediment and heavy-mineral-concentrate samples include contaminating materials from mine dumps. It is assumed, in this reconnaissance study, that the contaminating material was from rock mined within that basin, and thus, the chemical effects of mining activity have a negligible effect on the mineral resource assessment.

All three types of samples were analyzed for 31 elements (Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Th, Ti, V, W, Y, Zn, and Zr) using a six-step semiquantitative emission spectrographic method. In addition, rock and stream-sediment samples were analyzed for bismuth, cadmium, antimony, and zinc by atomic-absorption spectrometry, and for arsenic by colorimetry; selected samples were analyzed for gold by atomic-absorption spectrometry.

Geochemical data were evaluated by the SCORESUM technique (Chaffee, 1983). In this technique, the range in concentration values for each element selected in stream-sediment and concentrate samples was divided into four categories at approximately the 90th, 95th, and 98th percentiles utilizing statistics available in the U.S. Geological Survey RASS-STATPAC system (VanTrump and Miesch, 1977). The values were given a "score" of 0, 1, 2, or 3 representing background, weakly anomalous, moderately anomalous, and strongly anomalous concentration levels. Scores were summed for all elements selected in each sample type to give a total geochemical anomaly score for the sample site. Thus, the assessment of weak, moderate, or strong geochemical anomalies for a site is based on the number of elements that are anomalous as well as the concentration levels of those elements. Areas and intensities of geochemical anomalies were then determined by plotting the total geochemical anomaly score (SCORESUMS) for each site on a topographic base map subdivided into drainage basins.

Certain elements, tabulated below for each sample type, were selected as having anomalous concentrations that might be related to mineralization or alteration. For concentrate samples, elements selected as being related to mineralization were further subdivided into base- and precious-metal or molybdenum-tungsten suites.

Sample type	Element suite	Indication
Rock	Ag, As, Au, Ba, Be, Bi, Cd,Cu Mo, Pb, Sb, Sn, W, Zn	Mineralization
Stream sediment	Ag, As, Au, Be, Bi, Cd, Cu, Mn, Mo, Pb, Sb, Sn, Zn	Mineralization
Concentrate	Ag, As, Au, Be, Bi, Cd, Cu, Mo, Pb, Sb, Sn, W, Zn	Mineralization
	Ag, As, Au, Cd, Cu, Pb, Sb, Zn	Base- and precious-metal suite
	Be, Bi, Mo, Sn, W	Molybdenum-tungsten suite
	Ba, Co, Fe, Sr	Hydrothermal alteration

GEOPHYSICS

Geophysical studies used for mineral resource assessment of the roadless area consisted of gravity and aeromagnetic surveys that were compiled in isostatic residual gravity and aeromagnetic maps (Donald Plouff, unpub. data, 1983). The isostatic residual gravity map was derived from a compilation of published gravity data (Plouff, 1982a). Gravity determinations at 175 stations were contoured at a 2-mGal interval. The only prominent gravity low within the general study area is a 4- by 14-mi gravity low attributed to more than 4,000 ft of tuffaceous rocks in the Little Walker caldera southwest of the roadless area (Plouff, 1982b).

Several small gravity anomalies are present. A gravity low between Wheeler Peak and Mount Patterson may reflect the lower density of a thick succession of intensely altered dominantly pyroclastic rocks that correspond to the central zone of alteration and mineralization in the Sweetwater volcanic center. Small gravity highs near Sheeles Camp and near the Bridgeport Ranger Station probably reflect a higher density of underlying metamorphic rocks compared to the density of surrounding plutonic and Tertiary volcanic rocks. A prominent gravity high near South Sister may indicate an underlying body of metamorphic rocks, although other rock types could be present.

An aeromagnetic map was prepared from two surveys that were drape flown at 1,000 ft above the ground along flight lines spaced at 0.5- and 1.0-mi intervals (U.S. Geological Survey, 1979; 1982). The flight path tended to be closer to the ground over peaks than over valleys. Because surface rocks generally have normal magnetizations, magnetic highs consequently tend to occur over hilltops and ridges and magnetic lows tend to occur over valleys.

Two magnetic lows, approximately 2 mi in diameter, extend northeast from Wheeler Peak and south of Star City and these lows generally correspond to areas of intensely altered volcanic rocks. Other irregularly shaped magnetic highs probably indicate relatively thick accumulations of unaltered volcanic rocks at the north end of the roadless area, north of the Bridgeport Ranger Station, and north of Fales Hot Springs.

Several magnetic anomalies are located over plutonic rocks. A complex magnetic high extends about 7 mi northward along the crest of the Sweetwater Mountains from Mount Patterson. The northern part of the magnetic high near Middle Sister may reflect the higher magnetization of an extensive body of granite underlying Middle Sister. Farther south along this magnetic high, similar plutonic or possibly metamorphic rocks are presumed to underlie the magnetic high, although only small exposures of the granite of East Fork and metamorphic rocks crop out within an extensive area of Tertiary volcanic rocks. The granite of East Fork may not be the source of the magnetic high as this pluton has only a low to moderate magnetization in other parts of the roadless area. Other magnetic anomalies overlying plutonic rocks are generally related to variations in plutonic rock composition and magnetization.

Metamorphic rocks generally have a moderate to high magnetization as reflected by magnetic highs located outside the roadless area east of Sweetwater Creek, west of the Bridgeport Ranger Station, and near Sheeles Camp. A circular-shaped magnetic high near the north end of Bridgeport Reservoir may represent an underlying body of metamorphic rocks, as such rocks crop out within an apparent northeast extension of the circular-shaped anomaly. A magnetic low in upper Sweetwater Creek is associated with magnetite-bearing metamorphic rocks which suggests that some metamorphic rocks are reversely magnetized.

MINING DISTRICTS AND MINERALIZATION

Present Studies

U.S. Bureau of Mines personnel researched pertinent Federal and county mining-claim records and files to determine claim locations and mining activity. Sixty-two mines and prospects were mapped and sampled by U.S. Bureau of Mines personnel during this study (fig. 2; table 1). A comprehensive report and all sample analyses are on file at the U.S. Bureau of Mines, Western Field Operations Center, Spokane, Washington.

Eight hundred forty-one rock samples were taken during the U.S. Bureau of Mines investigation. Three varieties of rock samples were taken: chip, grab, and select. Most were chip samples collected normal to a mineralized horizon or vein. Grab samples were collected from mine and prospect dumps to obtain an approximate grade. Select samples were often taken of the apparent highest grade material in a mineralized zone particularly in probable low-grade occurrences. Samples were taken for petrographic analysis at each prospect.

The samples were crushed, pulverized, and split. Each was routinely examined for abnormally high radioactivity to test for uranium and examined for fluorescence to determine the presence of tungsten minerals. Most samples were analyzed for gold and silver by fire-assay methods. When required, quantitative values of other elements were measured by atomic-absorption analysis, colorimetry, fluorimetry, cold-vapor atomic-absorption spectrometry, or inductively coupled argon spectrometry. At least one sample from each mineralized feature was checked by semiquantitative emission spectroscopy for anomalous content of 42 elements (Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hf, In, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Pt, Rh, Sb, Sc, Si, Sn, Sr, Ta, Te, Th, Ti, V, Y, Zn, and Zr); anomalous contents were checked by more quantitative methods.

Historical mining activity

The Patterson mining district includes all of the California part of the Sweetwater Roadless Area. Prospecting began in the Sweetwater Mountains in the 1850's during the same time mineral discoveries were being made in the nearby Bodie and Masonic districts. The Patterson mining district was organized in 1880, and by 1882, many of the mineralized areas were being developed and the Kentuck mine (No. 38, fig. 2; table 1) was producing silver. By 1888, mines in the district had produced approximately $500,000 (450,000 oz) of silver with most of the production from the Kentuck mine (Whiting, 1888).

Mining activity waned after the closing of the Kentuck mine in 1885 and only sporadic activity occurred in the district until 1925. From 1904 until 1925, the Monte Cristo mine (No. 49) produced 650 oz of silver and 90 oz of gold, reworking of the Kentuck mill tailings produced 24,000 oz of silver and 156 oz of gold, the Silverado mine (No. 36) produced an unknown amount of silver, and other mines and prospects in the area may have produced minor amounts of precious metals, but have no recorded production. The Silverado mine was worked from 1925-29 and 1933-39. Estimated total production of the mine is 3,000,000 oz of silver, 3,000 oz of gold, and 35,000 lb of copper, much of which was produced between 1933-39 (Lambeth and others, 1983).

Besides the Silverado mine, only minor mining activity is recorded in the Patterson district from 1932 until the present. Small amounts of molybdenite were produced from prospects in Green Creek during the period 1932 to 1935. Prospecting for precious metals; contact deposits of iron, copper, tungsten, gold and uranium; and manganese occurred at various times. Recently, major mining companies have been exploring for disseminated-molybdenum and epithermal precious-metal deposits.

Total value of mineral production for the district is estimated to be about $3,000,000 on the basis of recorded mineral production and accounts of workers in the district (Hanks, 1884; Whiting, 1888; Eakle and McLaughlin, 1917; Tucker, 1927; Bradley, 1927; Symons, 1928, 1929, 1935, 1936, 1937, 1938, 1939, Lambeth and others, 1983).

Mining claims

Federal and county mining records indicate approximately 2,500 claims have been located in or adjacent to the study area. The majority of these are within 2 or 3 mi of old mines, and almost all are lode claims. Approximately 300 claims in the study area and 200 claims adjacent to the area were maintained in 1982. The Star and Great Western claims, which contain 39.36 acres, are patented and lie within the study area (No. 19). Twenty-four lode claims incorporating the Silverado-Kentuck mine areas have been patented, as have one lode claim at the Longstreet mine (No. 53), and one lode claim and a millsite at the Monte Cristo mine. During 1981, several holes were drilled near the study area to establish a regional geothermal gradient, but no geothermal lease applications have been filed (Wayne Frye, oral commun., 1983).

Geology of deposits

Mineralization is of several general types: epithermal precious metals (silver and gold); hydrothermal molybdenum associated with volcanic and granitic rocks; contact-metasomatic iron, copper, gold, tungsten, and uranium; manganese of several origins; and quartz pegmatite. A low potential for geothermal energy also exists nears Fales Hot Springs.

Precious-metal deposits of the epithermal vein (bonanza) and disseminated types are associated with rhyolitic volcanic rocks and occur within and to the east of the roadless area (areas A1, A2, and A3, fig. 3). Vein deposits occur in sheared, intensely silicified, argillized, or sericitized rhyolitic rocks erupted from the Sweetwater volcanic center (Brem, 1982; Hunter, 1976). Typically, lenticular quartz veins from a few inches to several feet thick contain podiform bodies of argentite and (or) acanthite with minor hessite, galena, argentiferous galena, and native silver in a gangue of quartz, adularia, chalcedony, pyrite, minor fluorite, and rhyolite fragments. The veins are generally north-trending and dip moderately to steeply. These veins were assigned to three northerly trending belts by Whiting (1888)—the Cameron belt which corresponds to area A2, and the Clinton and Comstock belts which correspond to area A1. Deposits within each belt are comparable, although gold is slightly more abundant in the Cameron belt.

Disseminated precious-metal deposits are possible, particularly around the major vein systems with known mineral production such as the Kentuck-Silverado and California Comstock-Star and Great Western systems or in porous tuff and brecciated rock such as around the Monte Cristo mine and Wheeler Peak.

Gold and silver have been found in several areas not underlain by rhyolitic rocks. Traces of silver were found in a leached and slightly silicifed shear zone in andesite at the mouth of Water Canyon (No. 56; area A4). Gold and silver occur in silicified contact-metamorphic rocks north of Sweetwater Canyon (No. 12; area A5). The Longstreet mine (no. 53; area A6) was reportedly developed for gold, although no metal values were found in samples taken from the mine.

Molybdenum mineralization is associated with the precious-metal mineralization in the rhyolitic rocks in areas M1, M2, and M3. Although hypogene molybdenum minerals were generally not observed, geochemical analyses of veins, altered rock, and weakly altered shear zones indicate widespread occurrence of molybdenum, from background amounts of less than 10 parts per million to 0.11 percent (Lambeth and others, 1983; Sutley and others, 1983). A disseminated molybdenum system buried within or beneath Tertiary volcanic rocks may be indicated by the complex rhyolitic volcanic history, within an atectonic setting, magnetic and gravity lows suggestive of altered and low density rock, presence of fluorite and huebnerite, and strong geochemical anomalies of molybdenum, base metals, and other ore-related elements, and an epithermal silver system and its associated alteration.

Molybdenum mineralization also occurred during Late Cretaceous mineralization events associated with the East Fork and Green Creek plutons in the four small areas M4, M5, M6, and M7 just outside of the roadless area. In each area, molybdenite occurs in quartz veinlets or in quartz-sericite altered zones no larger than a few thousand square feet . Radiometric dating of sericite believed to be associated with molybdenum mineralization in Silverado Canyon yielded a Late Cretaceous age (C. P. Miller, oral commun., 1980). The mineralization age is considered to be similar for the other occurrences.

Contact-metasomatic deposits of iron, copper, tungsten, gold, and uranium are possible near contact zones between granitic plutonic rocks and septa or roof pendants of metamorphic rocks with carbonate lenses.

Iron and copper deposits occur near Sweetwater Canyon (No. 14, IC2) and Lobdell Lake (No. 6 and 10; IC1). Typically, the deposits consist of replacement bodies of disseminated to massive magnetite, traces of copper-bearing sulfides, and massive serpentine in carbonate-bearing lenses. The deposits are most commonly found within, but are not restricted to, contact zones with granitic or dioritic rocks. Individual deposits are generally only a few feet wide and less than 100 ft long, although one deposit in Sweetwater Canyon (No. 14) can be traced along strike for about 1,000 ft. Metamorphic rocks of similar character occur in the Swauger Creek area (No. 52; area IC3); however, iron and copper mineralization has not been recognized in this area.

The metamorphic rocks also locally contain precious metals, tungsten, and uranium. Precious metals, as discussed previously, occur in silicified shear zones in Sweetwater Canyon (area A5) and trace amounts of precious metals are associated with calc-silicate minerals near Swauger Creek (No. 52; area IC3). Tungsten occurs near Swauger Creek (No.

52; area W3) in a calc-silicate skarn mineral assemblage, and a low potential also exists for tungsten in the two other metamorphic bodies (areas Wl and W2). Uranium occurs only west of Lobdell Lake (Nos. 8 and 9; area Ul) where silicifed shear zones within metavolcanic rocks contain small amounts of uranium.

Manganese occurs in brecciated volcanic rocks or manganiferous quartz veins in granite in three areas (MNl, MN2, and MN3) with outcrop areas of less than a few thousand square feet. These are possibly of hot-spring or hydrothermal-vein origin (Lambeth and others, 1983).

Quartz occurs in two nearly circular pegmatite bodies with the mafic complex of Swauger Creek in one area (No. 57; area Sl) east of Swauger Creek. The quartz bodies have a thin feldspar shell suggesting that the bodies are pegmatites derived from the nearby granite of Devils Gate-Mack Canyon. Other pegmatitic bodies are rare within the study area; however, pegmatitic quartz bodies are known from similar granite outcrops approximately 8 mi south of the study area.

Geothermal resources are most likely in the Fales Hot Springs area just south of the study area (No. 59, area Gl). The hot springs are located on the ring fracture of the Little Walker volcanic center; however, a late Miocene age for the youngest volcanic rocks in the center would suggest that the current hot-spring activity may be related to more recent tectonic activity rather than hot volcanic rocks or magma.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mineral resource potential of the Sweetwater Roadless Area has been evaluated on the basis of the following criteria: 1) host-rock composition, structure, and alteration; 2) known mineral occurrences; 3) geochemical anomalies in samples of rock, stream sediment, and nonmagnetic heavy-mineral concentrates; 4) aeromagnetic and gravity anomalies; and 5) mining activity. Map areas assigned a high to moderate resource potential for various types of mineral deposits have favorable characteristics in at least three of these criteria; areas assigned a low to moderate resource potential have fewer favorable characteristics.

Precious metals

The mineral resource potential for epithermal vein and disseminated silver and gold deposits associated with rhyolitic volcanic rocks is high to moderate based on strongly favorable characteristics in all five criteria. Favorable host-rock characteristics include numerous intrusive bodies, abundant shearing and brecciation, extensive deposits of porous tuff, and widespread intensive alteration. Strong geochemical anomalies for a wide spectrum of ore-related elements in all types of samples are highly favorable as are known mineral occurrences. Additionally, areas Al and A2 have associated magnetic and gravity lows suggesting the presence of a thick body of low-density altered rock.

The mineral resource potential for precious metals in rock types other than rhyolite are low primarily because shear and alteration zones are not large or well developed, geochemical anomalies and mineral occurrences are weak, and geophysical characteristics are not supportive of large features.

The following tabulation lists areas with a precious-metal resource potential, evaluation of the areas as to potential, and a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
A1	High	a) Rhyolitic host rocks have maximum thicknesses and greatest petrologic diversity of any locality in roadless area. b) Intensely silicified and mineralized north-trending shear zones and veins and locally silicified porous or brecciated rhyolitic host rocks within a larger zoned epithermal alteration system. c) Silver- and gold-bearing area with recorded mineral production of about 3,400,000 oz of silver, 3,000 oz of gold, and 35,000 lb of copper primarily east of the roadless area. d) Strong geochemical anomalies of numerous elements in stream-sediment samples, and of elements of the base- and precious-metal suite and hydrothermal alteration suite in heavy-mineral-concentrate samples. e) Selected vein, dump, and altered-rock samples have low to high precious-metal abundances. f) 120,000 tons of resources averaging 11 oz of silver per ton at the Silverado mine; 4,500 ton occurrence averaging 7.8 oz of silver and 0.06 oz of gold per ton at the California Comstock. g) Gravity and magnetic lows suggest a thick accumulation of low-density altered rock.
A2	High	a) Host rock consists of rhyolitic intrusive and extrusive rocks of the Sweetwater volcanic center. b) Pervasively silicified and epithermally altered porous rhyolitic host rock and veins, silic sinter, abundant adularia. c) Moderate geochemical anomalies of selected elements in stream-sediment samples and weak anomalies of base- and precious-metal suite elements in heavy-mineral-concentrate samples. d) Moderate anomaly of ore-related elements, and low to moderate gold and silver assay values in vein and altered rocks around the Monte Cristo mine. e) Gravity and magnetic lows suggest a thick accumulation of low-density rock.
A3	Moderate	a) Host rock consists of rhyolitic intrusive and extrusive rocks of the Sweetwater volcanic center. b) Intensely silicified 30-ft-wide shear zone and argillized host rock. c) Moderate geochemical anomaly of selected elements in a stream-sediment sample, and moderate to strong anomalies of elements of the base- and precious-metal suite and hydrothermal alteration suite in heavy-mineral-concentrate samples. d) Weak geochemical anomaly of ore-mineral related elements, and very low assay values for silver in altered rock and vein samples.
A4	Low	a) Relief Peak Formation andesite host rock.

Area (fig. 3)	Resource potential	Assessment criteria
		b) Silicified and leached zone 22 ft wide by 300 ft long. c) Weak geochemical anomaly of elements of the base- and precious-metal suite and hydrothermal alteration suite in heavy-mineral-concentrate samples. d) Weak geochemical anomaly of ore-related elements and only traces of silver in vein sample.
A5	Low	a) Silicified shear zones in contact-metamorphic rocks. b) Chip samples of silicified rock had significant gold, minor silver, and moderate amounts of base metals.
A6	Low	a) Irregular silicified zones of granitic aplite host rock associated with the granite of Devils Gate-Mack Canyon in 10,000-ft^2 area. b) Weak geochemical anomaly of elements of the base- and precious-metal suite in heavy-mineral-concentrate samples. c) No significant metal values in vein sample.

Molybdenum

The mineral resource potential for a disseminated-molybdenum system associated with the Tertiary rhyolitic volcanic rocks is moderate. Host rocks, alteration, and geochemical and geophysical characteristics are favorable for this type of deposit; however, the mineralization event could have either concentrated or dispersed molybdenum.

The mineral resource potential for molybdenum in granite is low because altered and mineralized areas are small and only weakly favorable, the upper parts of granitic bodies where molybdenum may have been more likely to occur have been lost by erosion, and geophysical characteristics are not favorable.

The following tabulation lists areas with a molybdenum resource potential, evaluation of the areas as to potential, and a summary of data supporting the assignment of potential.

Area (fig. 3	Resource potential	Assessment criteria
M1	Moderate	a) Intrusive and extrusive rhyolite host rock of Sweetwater volcanic center. b) Intensely altered epithermal silver veins and host rocks possibly indicating an underlying porphry system. c) Strong geochemical anomaly of elements in stream-sediment samples and molybdenum-tungsten, base- and precious-metal, and hydrothermal alteration suites in concentrate samples. d) Small gravity and aeromagnetic lows associated with intensely altered Tertiary and older rocks. e) Altered and (or) mineralized rock samples contain background or trace to moderate molybdenum abundances. f) Extensive prospecting by numerous mining companies.
M2	Low to moderate	a) Rhyolite host rock of Sweetwater volcanic center b) Epithermal gold veins intensely altered host rocks. c) Weak geochemical anomaly of elements of the molybdenum-tungsten and hydrothermal alteration suites in heavy-mineral-concentrate samples. d) Small gravity and aeromagnetic lows.
M3	Low	a) Rhyolite host rock of the Sweetwater volcanic center. b) Epithermal gold and silver veins intensely argillized and silicified host rock. c)Moderate to strong geochemical anomaly of elements in stream-sediment samples, base- and precious-metal and hydrothermal alteration suites in heavy-mineral-concentrate samples. d) Altered and (or) mineralized rock samples contain trace to moderate molybdenum abundances
M4	Low	a) Medium- to coarse-grained granite of East Fork host rock. b) Sericite alteration and molybdenum mineralization restricted to area of 5,000 ft^2. c) Strong geochemical anomaly of elements of the molybdenum-tungsten and hydrothermal alteration suites in heavy-mineral-concentrate samples. d) Altered and (or) mineralized rock samples contain low to moderate molybdenum and low tin abundances.
M5	Low	a) Fine-grained granitic intrusive phase of East Fork pluton host rock. b) Leached, sericitized, and silicified host-rock envelope. c) Quartz-molybdenite veinlets in altered rock. d) Weak geochemical anomaly of elements of the molybdenum-tungsten and hydrothermal alteration suites in heavy-mineral-concentrate samples. e) Altered and (or) mineralized rock samples contain moderate molybdenum abundances.
M6	Low	a) The granites of East Fork and Green Creek host rock. b) Sericitized and pyritized host-rock envelope with more intense alteration and silicification near veinlets. c) Quartz-molybdenite veinlets exposed in two open cuts less than 100 ft long. d) Weak geochemical anomaly of elements of the molybdenum-tungsten and base- and precious-metal suites in heavy-mineral-concentrate samples.

Area (fig. 3)	Resource potential	Assessment criteria
		e) Altered and (or) mineralized rock samples contain low to high molybdenum abundances. f) Green Creek prospect has yielded small amounts of molybdenum from quartz-molybdenite veinlets.
M7	Low	a) Granite of East Fork host rock. b) Quartz-molybdenite veinlets in zone less than 100 ft across. c) Weak geochemical anomaly of elements of the molybdenum-tungsten suite in heavy-mineral-concentrate samples. d) Altered and (or) mineralized rock samples contain moderate molybdenum abundances.

Iron and copper

The mineral resource potential for iron and copper contact-metasomatic deposits is low generally because favorable carbonate lenses are small in the metasedimentary host rocks and geophysical characteristics are not suggestive of large, dense, or highly magnetic bodies. The only exception is the iron deposit in Sweetwater Canyon which has a moderate potential because of its larger size and high iron content.

The following tabulation lists those areas with an iron and copper resource potential, evaluation of the areas as to potential, and a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
IC1	Low	a) Carbonate lenses in metasedimentary host rock. b) The granite of Desert Creek exposed nearby to north. c) Magnetite and traces of copper silicates or carbonates exposed in prospect pits. d) Select samples average 24.2 percent iron. e) Magnetic and gravity highs associated with eastern outcrops of metamorphic rocks.
IC2	Moderate	a) Carbonate lenses in metasedimentary host rock. b) Diorite and granite of the East Fork pluton in nearby exposures. c) Magnetite-bearing lens approximately 6 by 1,000 ft. d) Estimated occurrence of 1,000,000 tons of ore with 52 percent iron in upper Sweetwater Canyon. e) Magnetic low indicates a reversely polarized metamorphic rock body.
IC3	Low	a) Host rock of carbonate lenses in metasedimentary rocks. b) The granites of Devils Gate-Mack Canyon and East Fork exposed nearby.

Tungsten

The resource potential for tungsten is low in spite of exposed and inferred favorable host rocks because geochemical anomalies for the molybdenum-tungsten suite of elements are weak and rock samples contain background or very low tungsten abundances.

The following tabulation lists those areas with a tungsten resource potential, evaluation of the areas as to potential, and a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
W1	Low	a) Carbonate lenses in metasedimentary host rock. b) Presence of iron and copper minerals, and a metasomatic-skarn mineral assemblage. c) Weak geochemical anomaly of elements of the molybdenum-tungsten suite in heavy-mineral-concentrate samples. d) Magnetic and gravity highs over metamorphic rock exposures.
W2	Low	a) Host rock of carbonate lenses in metasedimentary rocks. b) Presence primarily of iron and copper minerals, and a metasomatic-skarn mineral assemblage. c) Weak geochemical anomaly of elements of the molybdenum-tungsten suite in heavy-mineral-concentrate samples. d) Steep gradient of magnetic low may indicate contact between metamorphic and plutonic rocks.
W3	Low	a) Host rock of calcareous lenses in metasedimentary rocks. b) Contact-metasomatic silicate mineral assemblage near contact with the Devils Gate-Mack Canyon pluton. c) Weak geochemical anomaly of elements of the molybdenum-tungsten suite in heavy-mineral-concentrate samples. d) Selected vein sample contained 0.005 percent WO3.

Uranium

The mineral resource potential for uranium is low because of generally unfavorable host-rock type, weak controlling structure, and absence of extensive alteration. The following tabulation evaluates the one area as to uranium resource potential and lists a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
U1	Low	a) Metavolcanic host rock. b) A small controlling structure - a silicified shear zone less than 2 ft wide by 30 ft long exposed in prospect pits. c) Samples of shear zone and selected samples on dump contain 0.004 to 0.05 percent U3O8.

Manganese

The mineral resource potential for manganese is low because of unfavorable host-rock and mineral-deposit characteristics. The following tabulation lists those areas with manganese potential, evaluation of the areas as to potential, and a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
MN1	Low	a) Manganese oxide-bearing quartz vein, 8 in. wide by 5 ft long.
MN2	Low	a) Manganese-bearing area 150-200 ft in diameter by 15-20 ft thick in weakly altered rhyolite; possible hot-spring origin. b) Rock samples contain moderate to high manganese abundances.
MN3	Low	a) 1- to 3-in. wide stringers and 1-ft-wide by 20-ft-long breccia zone in rhyolite. b) Botryoidal psilomelane and manganite(?). c) High manganese abundance in breccia zone.

Silica

The mineral resource potential for silica is low because the pegmatitic quartz bodies are of relatively small size and are not in a geologically favorable environment. The following tabulation evaluates the one area as to silica resource potential and lists a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
S1	Low	a) Located in mafic complex of Swauger Creek near contact with the granite of Devils Gate-Mack Canyon. b) Two vertical 300-ft-diameter quartz pegmatite bodies with feldspar shell; no indication of large controlling structure or presence of other nearby bodies.

Geothermal energy

The resource potential for geothermal energy is low in the vicinity of Fales Hot Springs based primarily on the relatively old age of the potential igneous heat source and unfavorable reservoir characteristics. The following tabulation evaluates the one area as to geothermal energy resource potential and lists a summary of data supporting the assignment of potential.

Area (fig. 3)	Resource potential	Assessment criteria
G1	Low	a) Hot springs located on ring fracture of Little Walker volcanic center; most favorable volcanic reservoir rock located south of study area. b) Current activity may be related to opening of fractures along old ring-fracture system as youngest volcanic activity associated with volcanic center is late Miocene. c) Reservoir volume estimated to be 0.8 mi^3 with temperature of 241°F (Muffler, 1979).

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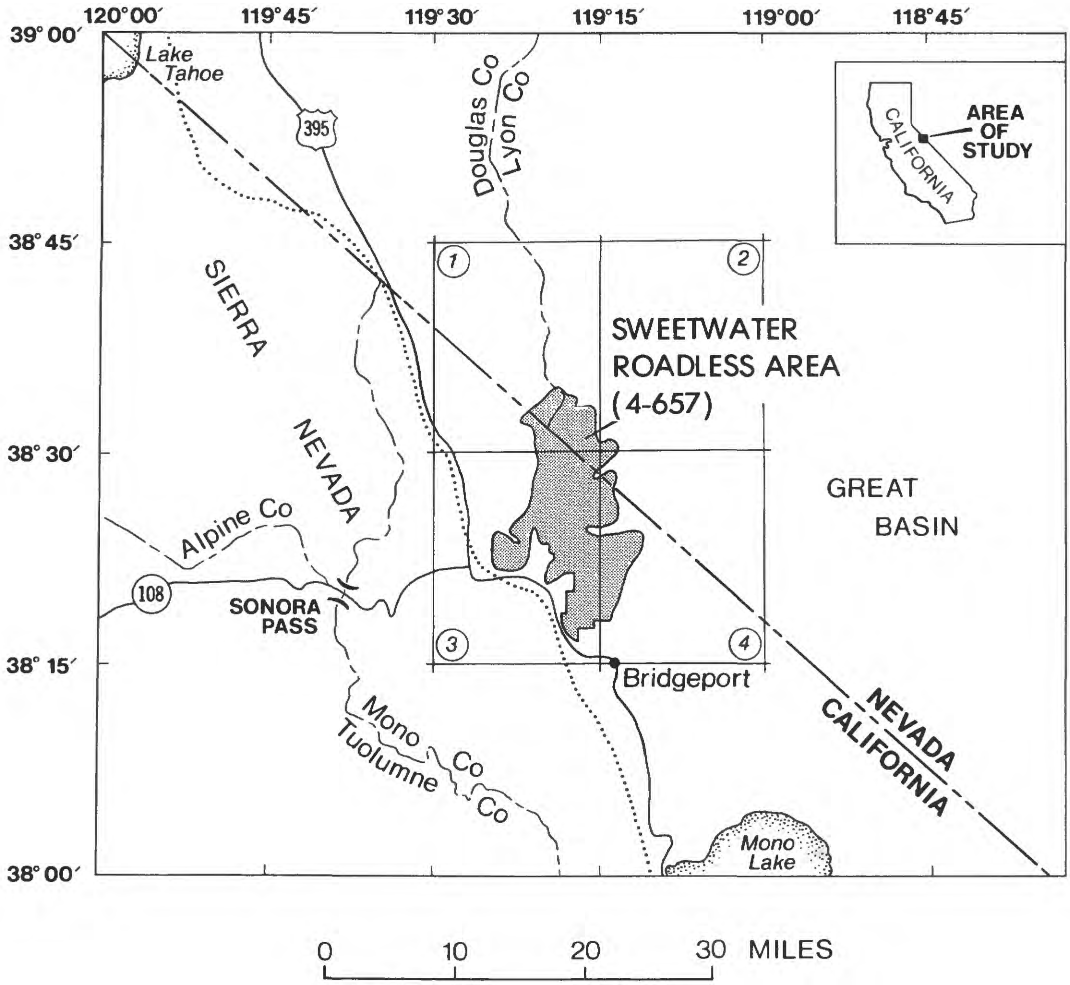

Figure 1.—Location of Sweetwater Roadless Area, Calif. and Nev. Numbers indicate 15-minute quadrangles; 1, Desert Creek Peak, 2, Pine Grove Hills, 3, Fales Hot Springs, 4, Bridgeport. Dotted line represents approximate boundary between Sierra Nevada and Basin and Range provinces.

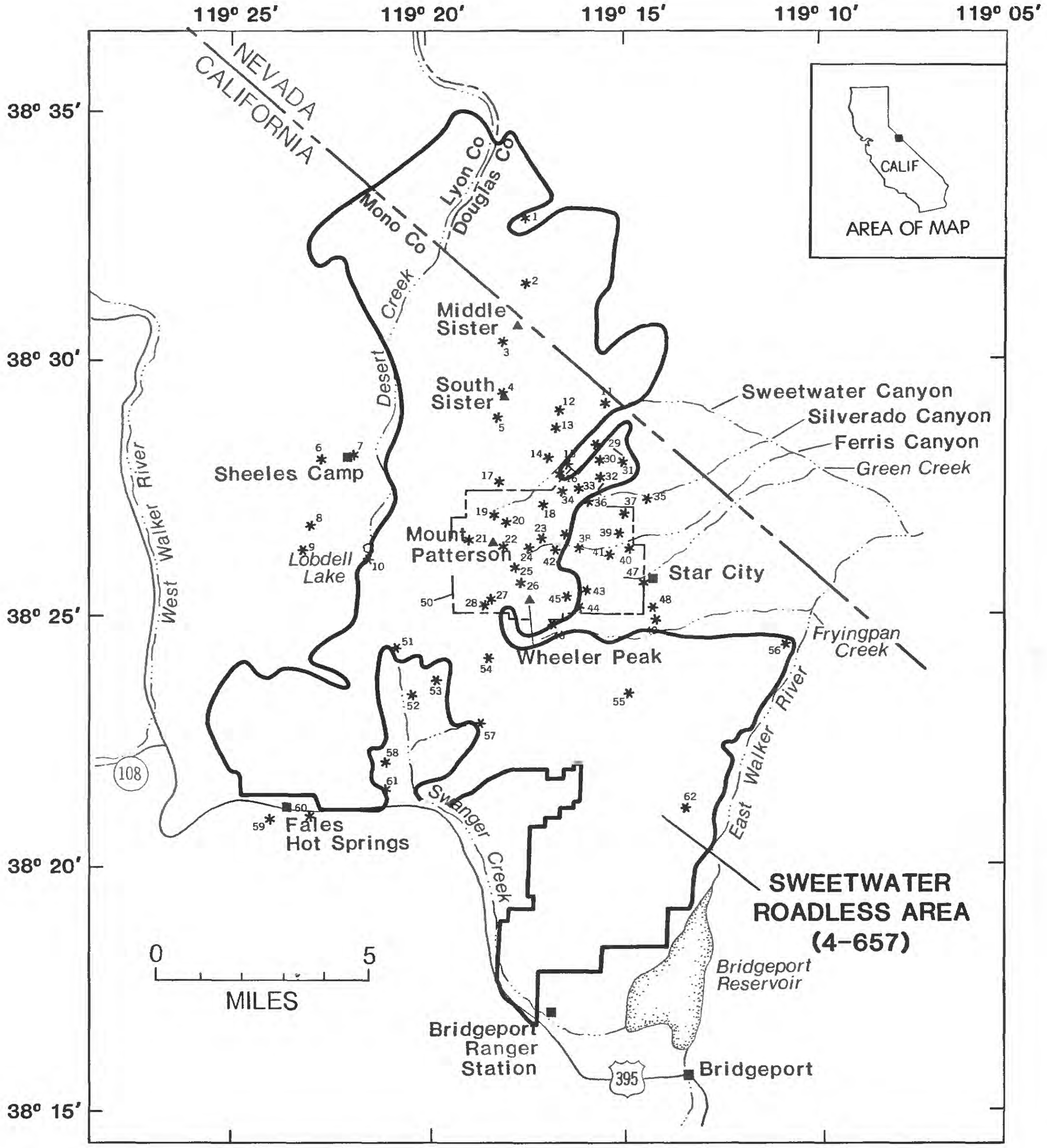

Figure 2.—Locations of mines and prospects in the Sweetwater Roadless Area. Numbers refer to list of mines and prospects and table 1.

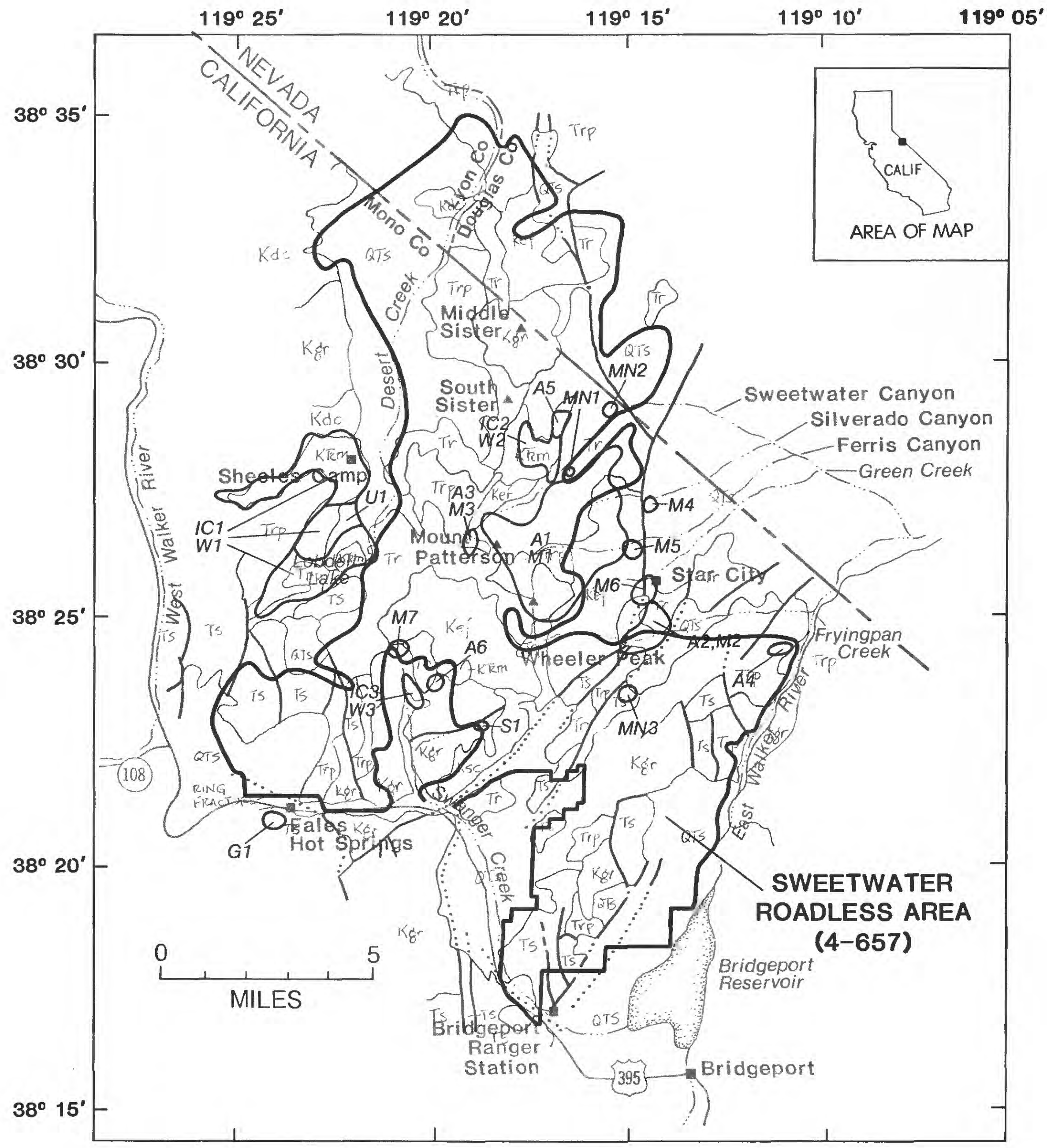

Figure 3.—Sweetwater Roadless Area, showing areas of mineral resource potential. Complete mineral resource assessment is tabulated in text.

DESCRIPTION OF MAP UNITS

SEDIMENTARY DEPOSITS

Qts SURFICIAL DEPOSITS (QUATERNARY AND TERTIARY?)—Alluvium and landslide deposits

VOLCANIC ROCKS

Ts STANISLAUS GROUP (MIOCENE)—Latite from the Little Walker volcanic center

Tr RHYOLITE OF SWEETWATER MOUNTAINS (MIOCENE)—Rhyolite pyroclastic, lava flow, and intrusive rocks

Trp RELIEF PEAK AND VALLEY SPRINGS FORMATIONS, UNDIVIDED (MIOCENE AND OLIGOCENE)—Andesite effusive rocks with very minor silicic welded tuff

PLUTONIC ROCKS

Kgr GRANITE OF DEVILS GATE-MACK CANYON, ROCK CREEK, TAYLOR VALLEY, MIDDLE SISTER, AND BELFORT, UNDIVIDED (CRETACEOUS)—Granite and granitic aplite

Kef GRANITE OF EAST FORK AND GREEN CREEK, UNDIVIDED (CRETACEOUS)—Porphyritic granite, locally metamorphosed or altered

Kdc GRANITE OF DESERT CREEK (CRETACEOUS)—Granular to porphyritic granite; metamorphosed

Ksc MAFIC COMPLEX OF SWAUGER CREEK (CRETACEOUS)—Layered gabbroic complex; metamorphosed

METAMORPHIC ROCKS

KTRm METAMORPHIC ROCKS (CRETACEOUS, JURASSIC, AND (OR) TRIASSIC)—Thermally metamorphosed sedimentary and volcanic rocks

CONTACT

FAULT—Dotted where inferred

APPROXIMATE BOUNDARY OF SWEETWATER ROADLESS AREA

EXPLANATION

AREA OF MINERAL RESOURCE POTENTIAL—Letters refer to metals, nonmetals, or metallic suites; numbers designate unique areas discussed in text. Line patterns are combined when more than one mineral occurs within a given area. Complete mineral resource assessment is tabulated in text

PRECIOUS METALS (GOLD AND SILVER)

A1	High
A2	High
A3	Moderate
A4	Low
A5	Low
A6	Low

MOLYBDENUM

M1	Moderate
M2	Low to moderate
M3	Low
M4	Low
M5	Low
M6	Low
M7	Low

IRON AND COPPER

IC1	Low
IC2	Moderate
IC3	Low

TUNGSTEN

W1	Low
W2	Low
W3	Low

URANIUM

U1	Low

MANGANESE

MN1	Low
MN2	Low
MN3	Low

SILICA

S1	Low

GEOTHERMAL ENERGY

G1	Low

*9 MINE OR PROSPECT—Numbers refer to list of mines and prospects and table 1 of accompanying pamphlet.

MINES AND PROSPECTS

1. Rickey mine
2. Golden Rule prospect
3. Unnamed prospect
4. Unnamed pospect
5. Unnamed prospect
6. Iron King prospect
7. Unnamed prospect
8. C and B prospect
9. Unnamed prospect
10. Lobdell Lake prospect
11. Unnamed prospect
12. Apollo prospect
13. E. G. No. 1 prospect
14. Iron Cap prospect
15. Penrose (Lucky Joe) prospect
16. Unnamed prospect
17. Unnamed prospect
18. Unnamed prospect
19. Star and Great Western prospect
20. Angelo Mission mine
21. Montague mine
22. California Comstock prospect
23. Unnamed prospect
24. Unnamed prospect
25. Sweetwater Rose prospect
26. Unnamed prospect
27. Unnamed prospect
28. Unnamed prospect
29. Unnamed prospect
30. Silverado Extension No. 3 prospect
31. Unnamed prospect
32. Cottonwood Canyon prospect
33. Unnamed prospect
34. Red Dog prospect
35. Unnamed prospect
36. Silverado mine
37. Unnamed prospect
38. Kentuck mine
39. Tiger I mine
40. Tiger II mine
41. Unnamed prospect
42. Unnamed prospect
43. Frederick mine
44. Boulder Flat prospect
45. Wheeler Peak prospect
46. M and T prospect
47. Green Creek prospect
48. Thorougbrace prospect
49. Monte Cristo mine
50. AMAX prospect
51. Pits prospect
52. Unnamed prospect
53. Longstreet mine
54. Unnamed prospect
55. Black Horse prospect
56. Sims prospect
57. Unnamed prospect
58. Quartz Hill No. 6 prospect
59. Fales Hot Springs
60. Red Gold prospect
61. Unnamed prospect
62. Unnamed prospect

Table 1.--Mines and prospects

Underlined names indicate properties with identified mineral resources or potential; those not underlined are poorly exposed and may have mineral potential. "Mine" in quotation marks indicates historical name, there is no record or indication of production

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
1	Rickey "mine" (water wells?)	Shafts sunk probably as water wells in alluvial and colluvial valley fill at the base of the Sweetwater Mountains in an area of intermittent springs.	Two shafts, 10 and 30 ft deep.	No samples. Location is a potential water source of unknown flow or reliability.
2	Golden Rule prospect (silver)	Milky quartz vein from 2 to 4 ft thick strikes N. 8° E. and dips 45° SE. The vein, which is in a granitic country rock, can be traced by float to another vein outcrop 150 ft south of workings. Vein fractures are heavily iron oxide stained.	One trench 30 ft long, 10 ft wide, and 5 ft deep; two small exploratory pits.	Three chip samples across the vein, two grab samples, and one select sample were taken. One chip sample had 0.13 oz silver per ton. Other samples assayed no more than 0.09 oz silver per ton.
3	Unnamed prospect (iron)	Massive, black magnetite float is abundant over an area of about 600 ft^2. Country rock is iron oxide-stained quartz monzonite.	None.	Two samples taken: one grab sample of magnetite float contained 66.3 percent iron; one chip sample across the quartz monzonite contained no significant metal values.
4	Unnamed prospect (silver)	Trench is in flow-banded biotite rhyolite talus. Rock is iron oxide stained with no obvious metallic minerals or alteration.	One 10-ft-long, 3-ft-wide trench.	One grab sample contained no significant metal values.
5	Unnamed prospect (silver)	The prospect is underlain by manganese oxide-stained silicified rhyolite.	One pit, 22 ft long, 10 ft wide, and 2 ft deep; one caved adit of unknown length.	Two grab samples taken from the pit and the adit dump contained no significant metal values.
6	Iron King prospect 1/ (iron, tungsten)	Contact zones between granitic rocks and calcareous metasedimentary rocks contain magnetite and minor amounts of copper. Magnetite occurs in pods and disseminations in metasediments exposed in two trenches. Tactite containing garnet and epidote is present along a contact between granite and a large marble unit at the south side of the property.	Twenty-three exploratory bulldozer trenches as long as 500 ft.	Eight chip, six select, and one grab sample were taken of magnetite-bearing metasedimentary bedrock and float. One chip sample had 17.0 percent FeO, 25.7 percent Fe_2O_3, and 0.2 percent copper. Four select samples averaged 14.7 percent FeO and 18.6 percent Fe_2O_3. No significant amounts of tungsten were found.

7	Unnamed prospect 1/ (iron, tungsten)	Workings are in metasediments and metabasalt (?) near the observed contact with silicic intrusive rock. The metasedimentary rock protolithic assemblage was marine calcareous and tuffaceous clastic sediments which have been thermally metamorphosed to metasiltstone and metasandstone of the albite-epidote-hornblende facies. The only observed metallic minerals were magnetite blebs and disseminated magnetite and pyrite. Part of the strata is calcareous. Garnet, epidote, and mica are common.	Eight trenches as much as 200 ft long an 10 ft deep.	Six random grab samples, one select sample, and one chip sample of magnetite-bearing metasedimentary bedrock and float. The select sample contained 23 percent FeO and 40 percent Fe_2O_3. The chip sample contained 8 percent FeO and 25 percent Fe_2O_3.
8	C and B prospect 1/ (uranium)	The prospect consists of two distinct groups of workings, one north and one south of Deep Creek, within marine calcareous and tuffaceous metasandstone and metasiltstone. Regional trend is northwest, but the local trend is north-northeast. Poorly defined fractures and shear zones follow a similar trend and dip 30° to 50° southeast. Iron oxide stains are prevalent; minor chrysocolla occurs on one thin shear zone in the northern group. Disseminated pyrite is common throughout the strata.	Northern workings consist of one trench 200 ft long, 30 ft wide, and 15 ft deep, one drill hole, and two small pits. Southern workings consist of one 50-ft-long shallow trench, one 30-ft-long shallow trench, two small pits, and seven drill holes.	Four chip samples, one grab sample, and two select samples. Three chip samples across a fracture in the north workings contained 0.01 to 0.05 percent U_3O_8. The richest sample also contained 0.04 percent vanadium. A chip sample across the copper-bearing shear zone contained 0.26 percent copper and 0.004 percent U_3O_8. A grab sample and two select samples at the southern workings contained 0.007 to 0.02 percent U_3O_8. The deposit has low potential for uranium.
9	Unnamed prospect 1/ (uranium)	Iron oxide-stained fractures are in a marble bed underlain by impure quartzite. Scintillometer readings in the area are six times normal background.	One caved inclined shaft and two, 4-in.-diameter drill holes.	Three samples were collected, one grab sample of drill hole cuttings contained no uranium; two chip samples of the fractured quartzite contained no uranium oxide. Low potential exists for uranium resources.

Table 1.--Mines and prospects--Continued

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
10	Lobdell Lake prospect 1/ (iron)	Hornfels with massive black magnetite, epidote, and garnet float are in sloughed trenches. These minerals indicate that a contact-metasomatic magnetite zone underlies this colluvium and volcanic flow-covered prospect.	Eight trenches, each averaging about 75 ft long, 12 ft wide, and 3 ft deep.	Nine samples were collected. Six grab samples of magnetite ranged from 52 to 67 percent total iron content. Three grab samples of hornfels with disseminated magnetite ranged from 5.8 to 20 percent total iron content.
11	Unnamed prospect (manganese)	Eight-in.-thick quartz vein with concentric black bands of manganese oxides. Vein strikes N. 33° E. and dips 68° NW. in granitic country rock.	One small prospect pit.	One chip sample of quartz vein contains 0.63 percent manganese and 0.05 percent WO_3.
12	Apollo prospect (iron, gold, copper)	Shear zones in interbedded metabasalt and metarhyolite contain quartz veins and stringers with magnetite, garnet, epidote, and copper-bearing minerals. Contact metasomatism of calcareous metasediments by granitic intrusions have formed iron- and copper-bearing skarn occurrences. One mineralized zone is a replacement of calcareous metasiltstone and tends to parallel volcanic beds which strike N. 50° W. and dip 45° NE.	Two exploratory bulldozer cuts greater than 3,700 ft in combined length; two trenches with lengths of 100 and 200 ft; one caved adit estimated to be 50 ft long; and one pit 30 ft long, 10 ft wide, and 4 ft deep.	Nine samples were collected. Four chip samples of shear zones contained an average of 0.17 oz gold per ton and 0.13 oz silver per ton and three of the chip samples also contained 0.1, 0.84, and 0.05 percent copper. One select sample of skarn had 13.5 percent FeO. Another select sample of skarn had 1.93 percent copper. The occurrence has low potential for iron, gold, and copper resources.
13	E. G. No. 1 prospect (silver)	A 2-ft-thick shear zone in hornfels strikes N. 72° E. to N. 75° E. and dips 74° SE. The zone contains silicified hornfels with less than 1 percent finely disseminated sulfides.	One adit with 165 ft of workings.	Ten chip samples taken from the silicified hornfels and shear zone in the adit contained no significant metal values.
14	Iron Cap prospect (iron)	A 4- to 10-ft-thick magnetite zone strikes from N. 54° E. to N. 36° W. and dips in calc-silicate hornfels country rock from 34° SE. to 44° NE. The magnetite is contact metasomatic in origin and is black and massive. The zone is inferred to be 1,050 ft long, 260 ft deep, and 6.0 ft thick.	In excess of 1,000 ft of roads and as much as 240 ft of shallow trenches are on the prospect.	Nine chip samples across the magnetite zone ranged from 30.3 percent to 63.0 percent total iron content. An estimated one million tons of magnetite-bearing skarn may average 52 percent iron. A moderate potential for iron resources exists.

15	<u>Penrose (Lucky Joe)</u> prospect (manganese)	A manganese oxide occurrence of possible hot springs origin. It is probably a surficial phenomenon 100-200 ft in diameter and a few tens of ft thick with near-horizontal attitude.	Five trenches as much as 30 ft long and 6 ft deep; eight small trenches and two short caved adits in adjacent tuff and breccia.	Three chip samples contained 1, 21, and 31 percent manganese; three select samples of nearby rhyolite contained negligible amounts of metals. The deposit is localized and has low potential for manganese resources.
16	<u>Unnamed prospect</u> (silver, gold)	Silicified zones in rhyolite contain breccia cemented by milky quartz. Finely disseminated sulfide minerals appear as gray patches and veinlets in silicified rocks. Andesite near Sweetwater Creek contains disseminated pyrite. Some workings are in pyritized metasedimentary rocks.	One caved adit estimated to be greater than 100 ft long, four caved adits estimated less than 40 ft long, and three prospect pits.	Six samples were taken of silicified rhyolite breccia. One select sample contained 5.0 oz silver per ton, and 0.09 oz gold per ton. Two other select samples contained 0.41 and 1.1 oz silver per ton. Three grab samples ranged from 0.03 to 0.07 oz silver. A low potential for silver-gold resources is present in zones of silicified rhyolite breccia.
17	Unnamed prospect (silver)	A segment of a 4-ft-thick quartz vein is in iron oxide-stained silicified rhyolite tuff breccia.	Eight trenches average 75 ft long, 12 ft wide, and 3 ft deep.	Twelve samples taken: eleven grab samples from the pits and one chip sample across the quartz vein contained no significant metal values.
18	Unnamed prospect (silver)	Brecciated rhyolite cemented by limonite and near a 15-ft-diameter breccia pipe. Disseminated pyrite locally present in rhyolite.	Two small prospect pits.	Three grab samples of rhyolite and rhyolite breccia contained no significant metal values.
19	<u>Star and Great Western prospect</u> (silver, gold)	A precious metal mineral deposit is associated with silicified rhyolite. A 4-ft-thick silicified shear zone strikes N. 21° W. and dips 66° NE. in silicified rhyolite country rock. The zone is brecciated and contains about 80 percent quartz, 10 percent quartz clasts, 5 percent limonite, and 5 percent argentiferous sulfides. Other less prominent mineralized zones are also at the prospect.	Fifteen caved adits (estimated in excess of 2,200 ft of workings), six pits, and one adit 28 ft in length.	Twenty-six samples were taken; one chip sample across the only zone exposed contained 40.9 oz silver per ton. One select stockpile sample contained 77.8 oz silver per ton and 0.167 oz gold per ton; one select dump sample had 1.58 oz silver per ton and 0.26 oz gold per ton; 24 grab samples from dumps contained from 0.04 to 9.6 oz silver per ton. High potential for silver-gold resources exists.

Table 1.--Mines and prospects--Continued

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
20	Angelo Mission "mine" (silver)	Country rock is pyritized and slightly silicified rhyolite tuff and tuff breccia. The longer adit was apparently driven to crosscut a possible offset segment of the fault exposed on the California Comstock, and Star and Great Western properties. The shorter adit follows a vertical quartz vein which strikes north-northwest. Only minor quartz veining is in the adits.	Two adits, 700 and 300 ft long.	Ten chip samples, one select sample, and two grab samples contained up to 0.007 percent molybdenum, but no significant silver.
21	Montague "mine" (silver, gold)	Most development is in a northeast-striking, quartz breccia vein which is up to 50 ft thick. Country rock and apparently much of the breccia is rhyolite tuff. All rock types are pyritized. Andesite and andesitic lahar are abundant in the canyon south of the prospect. Quartz monzonite is exposed in the northern part of the prospect.	A 290-ft adit near the north end of the area, 17 pits and trenches up to 200 ft long in the central part of the area, 6 pits and trenches up to 40 ft long in the west-central part, and 25 pits and trenches up to 450 ft long and 2 caved adits at and near the Montague "Mine."	Twelve chip samples of the quartz breccia vein and minor veinlets were taken; the highest content was 1.6 oz silver per ton. The others contained only background to trace amounts of silver. Twenty-four random samples were taken. The highest content was 0.8 oz silver per ton. One grab sample contained 0.06 percent molybdenum, and most samples contained trace amounts of molybdenum. Seven contained a trace of gold. The deposit has low potential for silver-gold resources.
22	California Comstock prospect (silver, gold)	Mineralized quartz veins up to 3 ft thick are in a 20- to 40-ft-thick silicified shear zone in rhyolite and rhyolite tuff-breccia. The silicified zone trends north, dips steeply to the east, and can be trace for 800 ft on the surface with a possible 300-ft extension to the south. Silver-bearing quartz veins contain finely disseminated argentite(?) occurring as gray to black patches and veinlets in milky quartz, and rhyolite quartz breccia.	Two caved adits; one adit blocked by ice; a caved shaft; exploratory bulldozer cuts totalling about 3,800 ft in length; ten short trenches; two open cuts about 30 ft in diameter; 13 prospect pits.	Forty-two samples were taken. Twenty-two chip samples across quartz veins contained a weighted average of 1.25 oz silver per ton. Twenty grab and select samples had silver values ranging from trace to 5.7 oz per ton. Samples contained up to 0.11 percent molybdenum. One shear zone contains an occurrence of 4,500 tons of argentiferous quartz averaging 7.8 oz silver per ton and 0.06 oz gold per ton. High potential for silver-gold resources is in silicified shear zones.
23	Unnamed prospect (silver)	Clear to milky quartz vein 9 in. thick in rhyolite. Vein strikes N. 5° W. and dips 33° NE.	One adit 5 ft long.	One chip sample across the quartz vein had a minor amount of silver.
24	Unnamed prospect (silver)	Rhyolite tuff breccia which is highly argillized and silicified and contains disseminated pyrite.	Nine exploratory bulldozer cuts totalling 950 ft in length.	Nine samples were taken. One select sample of silicified breccia contained 0.11 oz silver per ton. Eight grab samples had only minor amounts of silver.

25	Sweetwater Rose prospect (silver)	Alluvium, colluvium and glacial drift of silicified rhyolite tuff, tuff breccia, and some vein quartz breccia with a light gray matrix.	Five pits and trenches as long as 200 ft.	Two grab samples and one chip sample contained no significant metal values.
26	Unnamed prospect (silver, gold)	Silicified rhyolite breccia containing veinlets of gray quartz. Abundant vugs in the breccia filled with drusy quartz. Minor pyrite and heavy iron oxide staining are present.	Two caved adits estimated to be 150 ft and 50 ft long.	Five samples were taken of silicified rhyolite. One chip sample contained 1.18 oz silver per ton. Three select samples had 0.09, 0.19, and 1.6 oz silver per ton. One grab sample had 0.09 oz silver per ton. This occurrence has low potential for silver resources.
27	Unnamed prospect (silver)	Breccia dike striking north with a steep easterly dip is about 6 ft thick and traceable for 200 ft. It has angular fragments of silicified rhyolite and andesite in a siliceous, gray to black aphanitic matrix.	One small pit and one trench.	Two select samples: one contained 0.8 oz silver per ton and trace amounts of molybdenum. The other contained 0.2 oz silver per ton, 0.023 percent molybdenum and a trace of gold.
28	Unnamed prospect (silver)	Tertiary rhyolite quartz porphyry "neck" penetrating older granitic intrusive rock. The rhyolite is iron and manganese oxide stained and the contact is flooded with quartz veinlets.	One small trench.	One select sample of rhyolite contained trace amounts of silver and molybdenum.
29	Unnamed prospect (silver, gold)	Country rock is rhyolite tuff breccia and rhyolite dikes; rhyolite float with pyritic siliceous matrix is present. Chalcedony-filled fractures are common.	One small pit.	One select and one grab sample each contained no significant amounts of metals.
30	Silverado Extension No. 3 prospect (silver, gold)	A poorly exposed shear zone striking N. 44° E., dipping nearly vertical, is in rhyolite tuff breccia; this structure is probably a northerly extension of the Silverado vein. The 20- to 30-ft-thick zone is composed of quartz veins at least 2 ft thick and breccia with a gray aphanitic matrix. Very fine argentite/acanthite with pyrite occurs locally. Pyrite is disseminated in the country rock.	Three caved adits, the longest estimated to be 70 ft; eight pits, as much as 20 ft in diameter and 6 ft deep; five trenches as long as 40 ft.	Seven select samples of vein and breccia were taken. Six contained 0.5 to 1.0 oz silver per ton. Some contained minor traces of gold. The deposit has moderate potential for silver and gold resources.

Table 1.--Mines and prospects--Continued

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
31	Unnamed prospect (silver)	Country rock is rhyolite tuff; some andesite float is present. No obvious structure. Prospect may be part of Silverado Extension No.3.	One small pit.	One select and one grab sample of float contained traces of silver.
32	Cottonwood Canyon prospect (silver)	Silicified zones are in rhyolite to andesite breccia. Sparse silicified rhyolite breccia (found mostly as float) contains finely disseminated sulfides in gray to black silicic matrix. This prospect is on the projected trend of the Silverado vein system.	Exploratory bulldozer cuts totalling 3,400 ft, and 28 prospect pits.	Ten select samples of silicic rock and 30 grab samples contained up to 0.05 oz silver per ton. Four grab samples have silver values between 0.1 and 0.25 oz per ton.
33	Unnamed prospect 1/ (silver)	Workings are in bedrock and rubble of rhyolite tuff and tuff-breccia with traces of disseminated pyrite. Area is in vicinity of rhyolite intrusive dikes and adularia veins. A 1-ft-thick siliceous vertical shear zone in rhyolite strikes N. 50° E.	Two 80-ft-long trenches and one small pit in rubble and one 30-ft trench in bedrock.	Two select samples of rhyolite rubble with only normal background metal contents. One chip sample of siliceous shear contained minor amounts of silver.
34	Red Dog prospect 1/ (silver, gold)	Workings in bedrock and talus of silicified and pyritized rhyolite tuff and tuff breccia in shear zones with adularia veins and rhyolite dikes. The adularia veins are a few inches thick, vertical, and strike northeast. Shear zones are up to 3 ft thick, and the silicified fractures contain light gray argentite (?) lenses.	Five small pits, a 30 ft trench, two 100-ft trenches, and two short, caved adits in talus.	One chip sample of a shear zone at the portal of a caved adit contained 9.0 oz silver per ton; one select dump sample contained 8.0 oz silver per ton and 0.03 oz gold per ton; eight other select samples ranged from 0.1 to 1.1 oz silver per ton. Most samples contained a trace of molybdenum. The deposit has moderate potential for silver and gold resources.
35	Unnamed prospect 1/ (molybdenum)	Quartz vein contains coarse molybdenite, tourmaline, and pyrite in monzonitic intrusive rock and aplite. The vein trends northeast and dips steeply northwest. A sericite envelope surrounds the vein. Some molybdenite occurs in the country rock.	One 6-ft adit.	Two select samples and 3 chip samples were taken. All contained a trace of molybdenum and one select sample contained 0.18 percent molybdenum and 0.002 percent tin.

36	Silverado mine 1/ (silver, gold)	Workings are in faults within highly altered and pyritized silicified rhyolite tuff, tuff breccia, quartz porphyry dikes, and coarse feldspar porphyry rhyolite dikes. Productive workings were in high-grade ore "shoots" in a fault which strikes approximately N. 15° E. and dips 40° to 70° NW. Nearby exploratory workings are in north-northwest striking, steeply west-dipping silicified shear zones. Mine depth may have been controlled by dewatering problems rather than lack of ore. Primary ore minerals are acanthite, hessite, and a trace of galena and chalcopyrite in a highly siliceous matrix. The structure is probably the same as that at the Kentuck mine and perhaps the Frederick mine. Twenty-four claims have been patented.	The Silverado mine contains 1,840 ft of haulage drift and 9 levels with 13,780 ft of development and production drifts excluding raises and stopes. Only portions of the haulage drifts were open. Total production from approximately 1885 to 1938 was about 3,000,000 oz silver, 3,000 oz gold, and 35,000 lb copper. Ancillary nonproducing workings are four adits ranging from 15 ft to 75 ft; two 150-ft trenches, several small pits, and two drill holes.	In the Silverado Mine most workings are caved and the large ore "shoots" could not be sampled. Seventy-six samples were taken. Sixty-one chip samples of nonsilicified zones in the faults contained background or slightly higher amounts of silver. One chip sample in a small open stope contained 56 oz silver per ton. Two select and two grab samples contained only trace amounts of metals. In the ancillary workings, two of three chip samples of silicified shear zones contained, 3 oz silver per ton and 9.0 oz silver per ton; five select samples of dump material contained no significant metal values; and two select dump samples of vein material contained 6.5 oz silver and 0.34 oz gold per ton and 12.4 oz silver and 0.02 oz gold per ton. Based on the analyses of 680 chip samples illustrated on old mine maps, the mine contains 120,000 tons of indicated and inferred subeconomic resources with an average grade of 11 oz silver per ton.
			Several mills have been constructed in this vicinity; most were at the mine mouth and destroyed by avalanches. The most recent mill at the mouth of Silverado Canyon operated from 1925 to 1926 and 1934 to 1938. Originally a cyanide process for silver recovery was used. The mill was converted to a flotation process in 1935.	Eight grab samples of mill tailings contained 1.04 to 1.65 oz silver per ton and from 0.01 to 0.16 percent tellurium. The mill tailings contain 35,000 tons with of average grade of 1.3 oz silver per ton. Based on sample analyses on old production maps and production history this mine has high potential for silver and gold resources.

Table 1.--Mines and prospects--Continued

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
37	Unnamed prospect 1/ (silver, gold)	Two trenches in breccia rhyolite and one in andesite landslide rubble.	Three trenches 80 ft to 150 ft long.	A chip sample and a select sample contained no significant amounts of metals.
38	Kentuck mine 1/ (silver, gold)	Brecciated and silicified shear zones in rhyolite, rhyolite porphyry, and volcaniclastic rhyolite contain finely disseminated argentite(?) and hessite(?) which appear as gray to black patches and veinlets in the matrix of quartz veins; pyrite locally is present. Mineralized zones are poorly exposed, but tend to be oriented approximately north with moderate to steep dips to the west. Iron and manganese oxide staining is common along mineralized zones.	There are more than 1,600 ft of underground workings in caved adits and a 150 ft winze. Development was on three levels (Whiting, 1888) with a stope to the surface above the highest level. Ancillary workings include four adits less than 25 ft long; a caved adit estimated to be 150 ft long; four caved adits; a caved shaft; a bulldozer cut 250 ft long; and 13 prospect pits. Production from the Kentuck mine is reported to have been 250,000 oz of silver (Eakle and McLaughlin, 1917).	Thirty-six samples were taken. Two 0.5-ft chip samples across quartz veins contained 14.8 and 2.51 oz silver per ton. Thirteen chip samples had silver values ranging from 0.02 to 1.44 oz per ton. Two select samples of quartz vein dump material had 28.9 and 5.8 oz silver per ton. Eleven other select samples contained silver values ranging from 0.01 to 1.28 oz per ton. Eight grab samples contained from a trace to 37.7 oz silver per ton. High silver-gold potential in silicified shear zones is identified.
39	Tiger I "mine" 1/ (silver, gold)	Poorly defined quartz veins occur in granite, rhyolite, and rhyolite volcaniclastics. Veins of clear to milky quartz with accessory fluorite are up to 8 in. wide. Argentite(?) occurs as finely disseminated gray to black patches and veinlets; gold and huebnerite are visible in vein rock on the dump. Limonite staining is present on quartz-vein fractures.	Four caved adits, each with estimated lengths over 100 ft, two adits, two trenches, each 130 ft long, and eight prospect pits.	Eight samples were taken. Four select samples from the dumps had from 0.40 to 1.54 oz silver per ton; and two select samples from the dumps had 0.01 and 0.014 oz gold per ton. Low potential exists for silver and gold resources in quartz veins.
40	Tiger II "mine" 1/ (molybdenum)	Coarse molybdenite in quartz in altered quartz monzonite. Some molybdite is present.	One 85-ft adit in landslide rubble, and one caved adit estimated to have 500 ft of workings.	A select sample from a stockpile contained 0.3 percent molybdenum and minor silver. The occurrence has low potential for molybdenum resources.
41	Unnamed prospect 1/ (molybdenum)	Very fine molybdenite(?) and pyrite occur in a poorly defined silicified shear zone in highly altered quartz monzonite(?).	One 6-ft-long adit.	One shear zone and one chip sample contained 0.025 and 0.03 percent molybdenum and trace amounts of silver. The occurrence has low potential for molybdenum resources in the shear zone.

42	Unnamed prospect (silver, gold)	A series of adits on a talus slope follow a quartz vein striking N. 10° W., dipping 45° SW., in pyritized rhyolite porphyry country rock. The vein, which is up to 2.5 ft thick, contains a gray matrix.	One 75-ft-long adit, two caved adits, each estimated to be less than 50 ft long, and the remains of a mill.	One of five chip samples of the vein in the open adit contained 15 oz silver per ton and 0.09 oz gold per ton; the remaining samples contained no gold or silver. Grab samples of vein and float contained 0.4 and 0.3 oz silver per ton, respectively. The occurrence has moderate potential for silver and gold resources in the quartz vein.
43	Frederick "mine" 1/ (silver, gold)	Silicified shear zones in rhyolite and rhyolite porphyry contain argentite(?) in clear to milky quartz veins up to 3 ft thick. Brecciated rhyolite is cemented by quartz along margins of veins. Argentite(?) is finely disseminated and occurs as gray-black veinlets, patches, and breccia fragments in quartz veins. The main mineralized vein strikes N. 28° W. and dips 48° NE. Iron and manganese oxide staining along the shear zones. Talus covers the main structure on the surface.	Underground workings include 1,280 ft of drifts, stopes, and crosscuts. Ancillary workings include a 30-ft adit; an inaccessible adit estimated to be 200 ft long; and four prospect pits. In 1980, a 1,100-ft-deep hole was drilled near the main adit portal by Molycorp.	Twenty-four samples were taken. Two 0.5-ft chip samples across the main Frederick vein had 31.6 and 162 oz silver per ton with 0.96 and 0.24 oz gold per ton, respectively. Eighteen chip samples ranged from 0.06 to 2.1 oz silver per ton. Four select samples from dumps ranged from 0.41 to 1.49 oz silver per ton. High potential for silver and gold resources exists in silicified shear zones.
44	Boulder Flat prospect (silver, gold)	Talus of silicified rhyolite, tuff, tuff breccia, and andesite covers the prospect area. Massive, iron oxide-stained white quartz float occurs in the talus near and in the sloughed workings.	Three caved adits, seven pits, and two trenches are obscured by talus debris. One caved adit is probably in excess of 400 ft long, based on the dump size.	Seventeen grab samples from dumps contained from 0.04 to 2.72 oz silver per ton. Potential is moderate for silver and gold resources in talus-covered quartz veins.
45	Wheeler Peak prospect (silver, gold)	Workings are in silicified rhyolite tuff and breccia along the same general structural trend as the Frederick "Mine". Weakly defined zones of 1-in-thick quartz veins with some gray quartz are in shear zones and in fractures. General strike of the shear zones is northerly, dip is 50° to 70° E. The collective width of the group of shear zones is approximately one-quarter mile.	Part of the workings are outside the study area; 33 small pits and trenches, a 15-ft-long adit, and five caved adits.	Forty-six samples were taken. Twelve chip samples of individual silicified shear zones contained from 0.005 to 0.09 oz gold per ton and 0.2 to 0.6 oz silver per ton. Of twenty-seven select samples of vein outcrops and float, nine contained from a trace to 0.16 oz gold per ton and a trace to 1.5 oz silver per ton. Only one select sample contained 0.12 oz gold and 11.5 oz silver per ton. Seven grab samples of country rock and vein float contained no significant metal contents. The deposit has moderate potential for silver and gold resources in the shear zones.

Table 1.--Mines and prospects--Continued

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
46	M and T prospect (silver)	Workings are in andesite lahar and rhyolite talus near a contact with older granitic rock.	Eleven small trenches and pits; two caved adits (one of which is possibly 100 ft long).	Eleven select and 9 grab samples of andesite and rhyolite contained no significant metal values.
47	Green Creek prospect 1/ (molybdenum)	Occurrence of coarse molybdenite and minor chalcopyrite is in north-northeast striking, southeast dipping quartz veins up to a few inches thick in argillized monzonitic and aplitic rock.	Three trenches, 100 to 250 ft long. On the south end of the prospect are three caved adits and 2,000 ft of road. There are four drill holes on the north end.	Six chip samples were taken: two across the quartz veins contained 1.26 percent and 0.01 percent molybdenum; four in altered intrusive rock and vertical, north-striking shears contained 0.01 to 0.03 percent molybdenum; and two dump samples of aplite from the dump contained no significant metal content. The deposit has low potential for molybdenum resources in the quartz veins.
48	Thoroughbrace prospect 1/ (gold, silver)	A 2-ft-thick iron oxide-stained massive white quartz vein strikes N. 65° W. and dips 45° SW. in iron oxide-stained silicified tuff and tuff-breccia. The quartz and tuff-breccia contain about 1 percent finely disseminated sulfides, mainly pyrite.	Three caved adits, two caved shafts, and two sloughed pits are on the prospect. In 1888, three adits totalling 725 ft and a 260 ft shaft were on the prospect (Whiting, 1888, p. 362).	Twenty-two samples were taken; one chip sample across the quartz vein contained no significant metal values; twenty-one grab samples from dumps contained from 0.2 to 0.85 oz silver per ton. Potential for gold and silver resources is low in the quartz vein.
49	Monte Cristo mine (gold, silver)	Silicified rhyolite breccia and rhyolite porphyry in shear zones striking generally northeast and dipping moderately to steeply northwest contain finely disseminated sulfides. Silver minerals are associated with gray to black veinlets in silicified breccias. Green, gray, and black chalcedony is commonly present in silicified zones. Disseminated silver and gold may occur in extensive alteration zones. Talus covers main structures.	Main workings include an open cut at the surface, and more than 1,000 ft of inaccessible underground workings in 4 caved adits (Whiting, 1888, p. 362). Ancillary workings include a 20-ft-long adit; four adits, each with an estimated length over 100 ft; three caved adits, three caved shafts, and 34 exploratory pits and small trenches. According to U.S. Bureau of Mines production records 90 oz gold and 650 oz silver have been produced from the Monte Cristo mine, but production records are probably not complete.	Seventy-four samples were taken. Four chip samples across parallel shear zones in the open cut contained an average of 0.10 oz gold per ton and 0.52 oz silver per ton. Ten select samples of "in-situ" vein and dump material had values between 0.02 and 1.2 oz silver per ton and gold values from a trace to 0.28 oz per ton. Fifty-six grab samples ranged from a trace to 0.05 oz gold per ton, and three others contained 0.06 to 0.13 oz gold per ton. One grab sample of silicified rhyolite breccia had 0.28 oz silver per ton and 0.54 oz gold per ton. Potential is high for gold-silver resources in silicified shear zones, and disseminated in rhyolite.

50	AMAX prospect (molybdenum)	This large area is a consolidation of three large claims groups, many small claim groups, individual claims, and 28 patented claims; it overlies mines and prospects 18 through 28, 30, and 32 through 48 discussed elsewhere in this table. Most of the exposed rock is highly altered rhyolitic flows, dikes, tuffs, and tuff-breccias of the Sweetwater volcanic center. Alteration appears to be related to the epithermal deposits, but many features in the numerous prospects are characteristic of a Climax-type porphyry molybdenum system. These characteristics include: the presence of fluoride and tungstate minerals; an explosive rhyolite volcanic sequence with above normal amounts of contained molybdenum; numerous silver occurrences; and several breccia pipes and dikes.	Besides the workings mentioned in other prospect descriptions, approximately 20 mi of access roads have been constructed or improved.	During a geologic mapping and geochemical sampling program conducted by AMAX Exploration, Inc. several hundred rock chip samples were taken. Anomalous molybdenum ($\geq$ 24 ppm) was identified in a 1.5 mi wide, belt beginning on Wheeler Peak and extending for 3 mi to the north (part A1). The Montague (area A3) and Kentuck Mines (part of area A1) vicinity also had anomalous molybdenum values. Anomalous silver contents ($\geq$ 1ppm) corresponded closely with molybdenum anomalies. Moderate potential for molybdenum resources exists.
51	Pits prospect (molybdenum)	Occurrence of coarse molybdenite and pyrite in a quartz vein in Cretaceous monzonitic intrusive rock. Strike of the quartz vein is N. 20° W., dip is 55° NE.	One small pit.	A chip sample of the vein contained 0.081 percent molybdenum; two select samples from dumps contained as much as 0.15 percent molybdenum, 0.02 oz gold per ton and 0.34 oz of silver per ton. There is low potential for molybdenum resources in quartz veins.
52	Unnamed prospect 1/ (tungsten)	Calc-silicate rock containing epidote, garnet, and minor pyrite and pyrolusite is present at the pit. White rhyolitic welded ash with disseminated pyrite is in the trench.	One exploratory bulldozer cut 60 ft long; one pit 20 ft long, 15 ft wide, and 8 ft deep is 200 ft west of the bulldozer cut.	One select sample of calc-silicate rock contained 0.07 oz silver per ton and 0.005 percent WO_3. One grab sample of rhyolitic rock had 0.02 oz silver per ton.
53	Longstreet "mine" 1/ (tungsten)	Xenoliths up to 60 ft wide of silicified metasediments are in granite. Disseminated pyrite (up to 5 percent of rock) is in portions of the metasedimentary blocks, and sparse pyrite is in shear zones in the granite.	One adit 90 ft long.	One chip, one grab, and one select sample of siliceous, pyritic rock contained no significant metal values.
54	Unnamed prospect (molybdenum)	Clear to smoky quartz lenses up to 5 ft long are in granite. Molybdenite, ferrimolybdite, and pyrite are in quartz lenses; empty cavities indicate much crystal weathering.	One shaft 10 ft deep, and one open cut 8 ft long.	Two select samples had 0.05 and 0.08 percent molybdenum and 0.08 and 0.22 oz silver per ton. Low potential for molybdenum resources exists in quartz lenses.
55	Black Horse prospect (manganese)	Botryoidal psilomelane and manganite(?) occur as 1- to 3-in. stringers in dacite and in a brecciated zone about 1 ft thick, which strikes N. 60° W. and dips 70° SW. Dacite fragments are cemented with psilomelane in the brecciated zone.	A caved adit about 15 ft long; an open cut 28 ft long, 4 ft wide, and 15 ft deep at the face.	A chip sample of psilomelane breccia contained 41 percent manganese. A chip sample of dacite contained 0.43 percent manganese. Low potential for manganese resources is in the breccia zones.

Map no. (fig. 1)	Name (commodity)	Summary	Workings and production	Sample and resource data
56	Sims prospect (silver)	The occurrence is a pyritized, 30-ft-thick shear zone in hornblende andesite. The zone strikes north, dips 50° E., and is about 1,500 ft long, silicified, iron-oxide stained, and vuggy. Selenite is common.	One 10-ft-long adit and two small pits.	One chip sample of the shear zone contained minor amounts of silver.
57	Unnamed prospect 1/ (quartz)	Two vertical (?) circular pegmatites--each approximately 300 ft in diameter--and several small pegmatites to the east-southeast trend N. 70° W. All are dominantly milky quartz with a thin feldspar shell. Host is a granitic intrusive rock.	None.	An estimated 600,000 tons of quartz occur on the prospect. No samples. The deposit has low potential for decorative stone or silica smelter-flux resources.
58	Quartz Hill No. 6 prospect 1/ (silver, gold)	Rhyolite dikes intruding quartz mozonite. Both rock types are cut by a poorly defined, vertical silicified easterly trending shear zone about 6 ft thick, and are altered and pyritized.	One 20-ft-long open cut.	Three samples taken: two grab samples of dump rock and one sample across the sheared rhyolite contained no significant metal values.
59	Fales Hot Springs 1/ (geothermal energy)	Several hot springs discharging into Hot Creek have formed extensive tufa deposits.	One well 416 ft deep; bathing and swimming facilities with overnight accommodations.	Several springs discharge at more than 260 gallons/minute at temperatures to 142°F. Reservoir temperature is estimated to be 241°F and reservoir volume is estimated to be 0.8 mi^3 (Muffler, 1979). The area has low potential for geothermal energy resources.
60	Red Gold prospect 1/ (mercury)	Pods of brecciated milky quartz in 40 ft thick shear zones are in granite. Red oxides of iron and manganese are in the shear zone and along fractures. Strike of the zone is N. 70° E.; dip is 65° N.	One 15-ft-deep shaft.	One select sample of quartz contained no significant metal values.
61	Unnamed prospect 1/ (silver)	Colluvium and residual grus of Cretaceous intrusive rock with minor amounts of quartz.	Four shallow 20-ft-long trenches.	Two select samples contained no anomalous metal contents.
62	Unnamed prospect (silver)	Two heavily iron oxide-stained shear zones are in granite. One 10-in.-thick zone strikes N. 36° W., and dips 46° SW., the other is 12 in thick, strikes N. 6° W., dips 37° SW. and can be traced by iron oxide-stained float for 500 ft along the surface.	Three trenches from 20 to 40 ft long; and one small prospect pit.	Two chip samples across the shear zones contained 0.04 oz silver per ton. One grab sample of iron oxide-stained granite contained 0.03 oz silver per ton.

1/ Outside the study area boundary