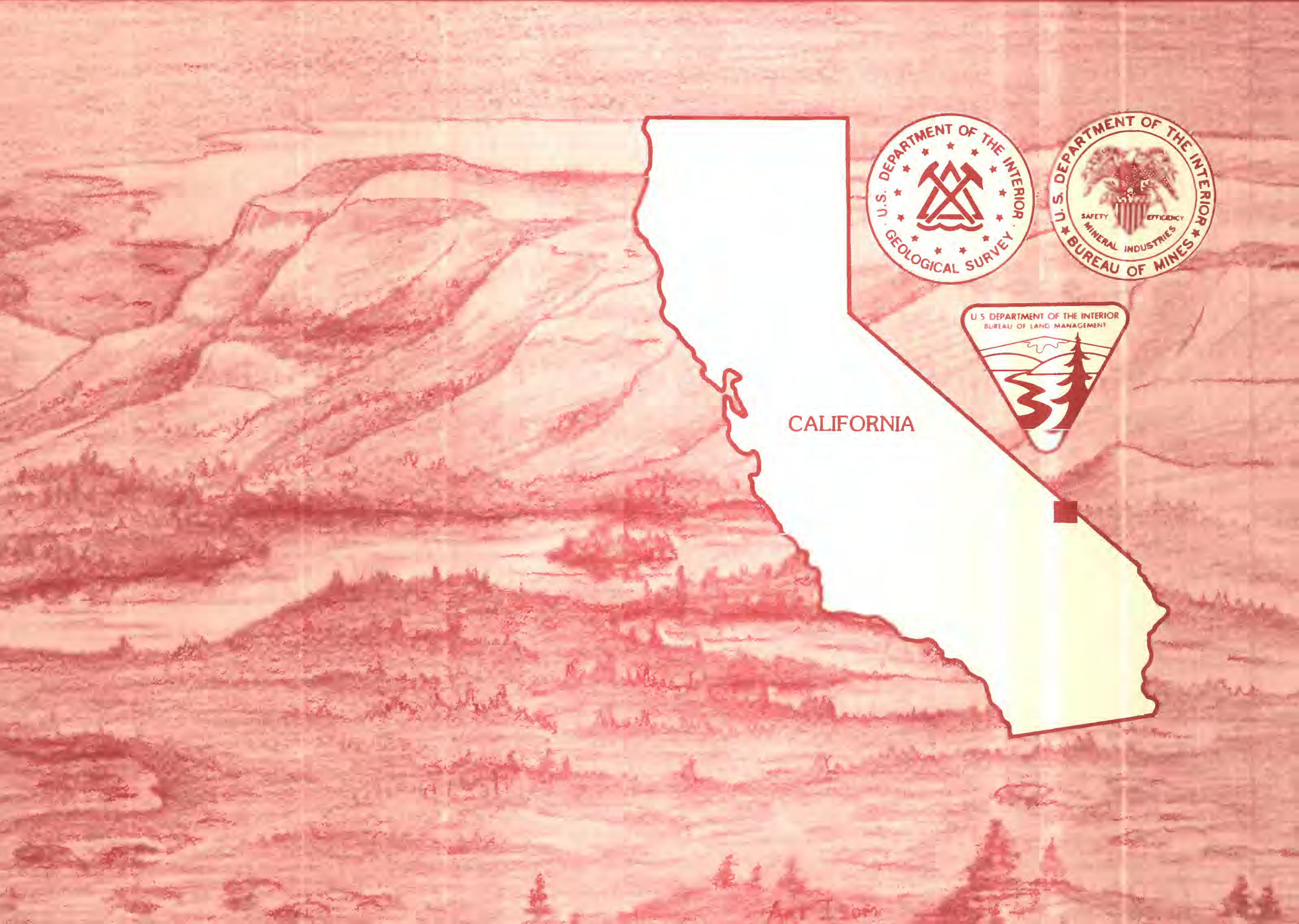
Mineral Resources of the Greenwater Valley Wilderness Study Area, Inyo County, California

U.S. GEOLOGICAL SURVEY BULLETIN 1709–B



Chapter B

Mineral Resources of the Greenwater Valley Wilderness Study Area, Inyo County, California

By AUGUSTUS K. ARMSTRONG, MICHAEL T. GARRISON, JAMES G. FRISKEN, and ROBERT C. JACHENS
U.S. Geological Survey

RICHARD L. RAINS
U.S. Bureau of Mines

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MINERAL RESOURCES OF WILDERNESS STUDY AREAS:
NORTHEASTERN CALIFORNIA DESERT CONSERVATION AREA

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Area

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and Congress. This report presents the results of a mineral survey of the Greenwater Valley Wilderness Study Area (CDCA-148), Inyo County, California.

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Mineral Resources of the Greenwater Valley Wilderness Study Area, Inyo County, California

By Augustus K. Armstrong, Michael T. Garrison, James G. Frisken, *and* Robert C. Jachens
U.S. Geological Survey

Richard L. Rains
U.S. Bureau of Mines

SUMMARY

Abstract

The Greenwater Valley Wilderness Study Area (CDCA-148) contains about 55,000 acres located at the southern end of the Black Mountains of southeastern California. Field work for this report was conducted from 1983 to 1985. The Quartz prospect, Graham Jem mine, and Jewell Quartz prospect within the study area have identified resources of gold and silver. The area west of Salsberry Peak has low resource potential for gold, silver, copper, lead, and zinc. An area south of Salsberry Peak in the southeast part of the study area has a low resource potential for zinc. The Calico Peaks locality northeast of Epaulet Peak in the north central part of the study area has a low resource potential for lead and copper. The locality northwest of Epaulet Peak has low potential for gold, lead, and zinc. An area of low potential for lead was delineated north of Epaulet Peak. The resource potential for nonmetallic boron-bearing minerals is low in the study area despite their presence 25 mi to the north in Greenwater Valley. The resource potential for oil, natural gas, and geothermal energy is also low in the study area.

Character and Setting

The Greenwater Valley Wilderness Study Area is located on the eastern flank of the southern end of the Black Mountains and includes part of the western side of Greenwater Valley. The study area is situated about 8 mi west of Shoshone, Calif. and 15 mi northwest of Tecopa (fig. 1). Relief is as great as 2,600 ft, with several tall peaks cut by narrow, steep-sided canyons and broad, sandy washes. The southern Black Mountains are composed of Proterozoic (570 to 2,500 million years before present (Ma): see geologic time chart on last page of report) and Paleozoic (about 240-570 Ma) metasedimentary and marine sedimentary rocks intruded by Tertiary (about 1.7-66 Ma) andesitic to rhyolitic intrusive and volcanic rocks, and overlain by Pliocene (1.7-5 Ma) and Pleistocene (0.010-1.7 Ma) igneous (andesitic to basaltic) and sedimentary rocks. The remainder of the study area is covered by Quaternary (1.7 Ma to the present) sand and gravel deposits.

Identified Resources

There has been very little production from mines in the study area. However, two of the five mines and prospects have had past production: the Salsberry prospect (fig. 2, No. 5) and the Graham Jem mine (fig. 2, No. 2). Although no production figures were available for the Salsberry prospect, this property has estimated reserves of 20,000 tons of ore assayed at 0.13 oz/ton gold, 0.26 oz/ton silver, 1 percent lead, and 2 percent zinc.

In 1908, the Graham Jem mine produced less than one ton of high-grade ore containing gold valued at $25,000 per ton. Recent work indicates that this mine contains reserves of about 9,000 tons of gold-bearing vein quartz averaging 0.073 oz/ton gold.

Mineral Resource Potential

The resource potential for additional gold and silver in the area adjacent to the Salsberry prospect and Graham Jem mine is low. Gneissic country rock adjacent to the Graham Jem mine contains no gold or silver.

Scattered oxidized veins within the study area contain localized occurrences of gold, silver, copper, lead, and zinc, which have, at times, been mined on a small scale. However, geochemical analysis of samples collected from these veins contain low concentrations of these elements, which suggests that their resource potential is low. An area west of Epaulet Peak has a low resource potential for gold, lead, and zinc. West of Salsberry Peak is an area with a low resource potential for gold, silver, lead, zinc, and copper, and to the south is an area with low potential for zinc. One locality northeast of Epaulet Peak has a

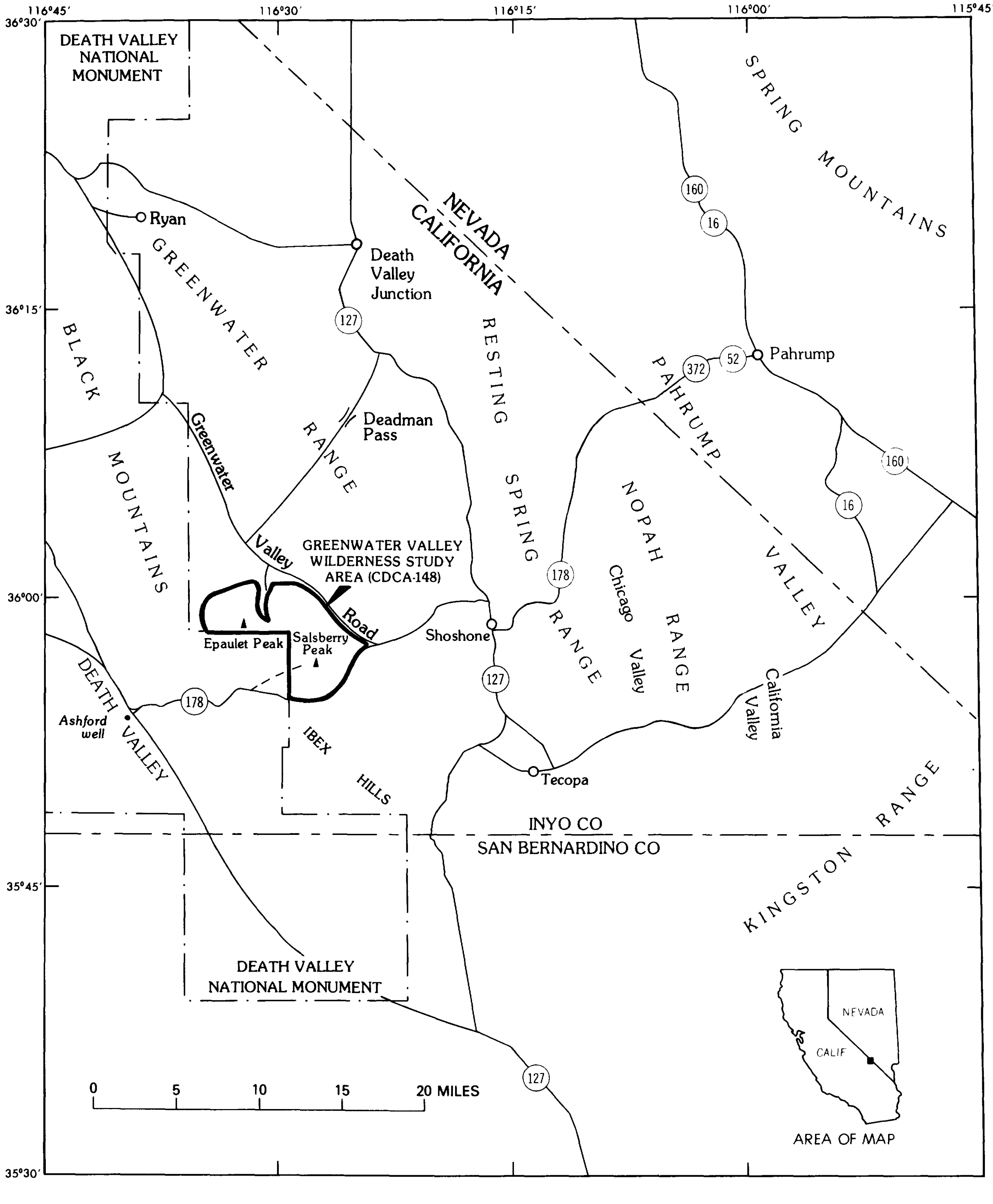

Figure 1. Index map showing location of the Greenwater Valley Wilderness Study Area, Inyo County, California.

low potential for lead. A small area having low resource potential for copper and lead was delineated southwest of Calico Peaks.

The Furnace Creek Formation, which includes the sedimentary rocks that host boron-bearing mineral deposits that are extensively mined in the Ryan area (25 mi north of the study area), is exposed in the study area. However, boron-bearing minerals are not known to occur in these exposures, so the resource potential is low.

Extensive faulting and the lithologic characteristics of the rocks in the study area preclude the accumulation of oil and natural gas resources, so the potential for these resources is low.

There is no geological or geophysical evidence for the existence of geothermal resources within the study area, despite the fact that it is located only 5 mi west of warm springs at Shoshone and 14 mi northwest of Tecopa Hot Springs; therefore, the potential for geothermal resources is low.

INTRODUCTION

Location and Physiography

The Greenwater Valley Wilderness Study Area (CDCA-148) comprises 55,044 acres located about 8 mi west of Shoshone, Calif., on the eastern flank of the southern end of the Black Mountains (fig. 1). It includes part of the west side of the Greenwater Valley, the Calico Peaks, and the northwest flanks of the Ibex Hills. The study area is accessible from a jeep trail leading up Rhodes Wash from Highway 178 and from a jeep trail running southwest from Greenwater Valley Road. Elevations range from 4,766 ft at Epaulet Peak to about 2,100 ft at the intersection of Highway 178 and Greenwater Valley Road. The study area is dominated by a line of steep-sided, deeply incised peaks composed of volcanic and sedimentary rocks of Tertiary age.

Sources of Data

The initial geologic studies of the region including the study area were unpublished geologic maps by L.A. Wright and B.E. Troxel, and maps and reports by Noble (1941), Drewes (1963), and Wright and Troxel (1984). U.S. Geological Survey personnel conducted geologic and geochemical investigations in the study area from 1983 to 1985.

The U.S. Bureau of Mines searched for information concerning mines and prospects within the study area; this information was obtained from U.S. Geological Survey publications, U.S. Bureau of Mines files, claim owners, and Inyo County and U.S. Bureau of Land Management claim records. In 1983, U.S. Bureau of Mines personnel collected 140 rock samples from 50 sites in the study area. These samples were analyzed by petrographic, fire-assay, colorimetric, atomic-absorption, radiometric, and x-ray-fluorescence methods.

Acknowledgments

B. E. Troxel of the U.S. Geological Survey provided unpublished geologic maps of the Calico Peaks area by L. A. Wright and himself. T. R. Neumann and M.S. Miller of the U.S. Bureau of Mines Western Field Operations Center helped with fieldwork. F. C. Johnson, a geologist with the American Borate Company, provided valuable information concerning access to the study area and local geology.

APPRAISAL OF IDENTIFIED RESOURCES

By Richard L. Rains, U.S. Bureau of Mines

History and Production

Greenwater Valley was the site of the most spectacular of the assorted booms in Death Valley mining history. In May of 1886, A.G. Rhodes reported silver shows in deposits about 2 mi northwest of Rhodes Spring (2 mi southwest of the study area); 1,200 lb of silver ore produced from one mine was valued at $800 (Latschar, 1981). However, when Rhodes and his partners perished in the desert, most information concerning the property and its mine was lost with them (Latschar, 1981).

In 1905, three prospectors relocated the mine at Rhodes Spring, and by the end of 1906, several new mines were opened nearby. By December of 1906, there were five working mines around the original site, the largest of which was owned by the Bonanza Greenwater Copper Company. While there were shows of gold, silver, copper, and lead, none of the mines reported any production (Latschar, 1981). According to Latschar (1981), surface evidence of copper mineralization was found in 1905 about 13 mi north of the study area. By 1907, four towns in the Greenwater district were home to 2,000 inhabitants, and 73 incorporated mining companies had invested $140 million in mining capital. However, most exploration (including shafts sunk more than 1,499 ft deep) failed to reveal sufficient ore. Within three years, the district was virtually abandoned after producing only a few tons of ore. Smaller rushes in and around the study area for gold, silver, copper, lead, and zinc accompanied the Greenwater boom, but activity had ceased by the end of 1910.

The Bonanza Greenwater Copper Company announced in May of 1907 that one of its mines at Rhodes Spring had estimated reserves valued at $100,000. The gold-bearing rock being stripped from the edge of an intrusive dike was assayed at $90 to $100 per ton. By June, 20 tons of ore had netted $1,400 profit, which resulted in a rash of claims being filed all around the site. By the end of 1907, the Bonanza Greenwater Copper Company operations had ceased because most of the easily recoverable ore had been removed.

In March of 1908, gold was discovered at the

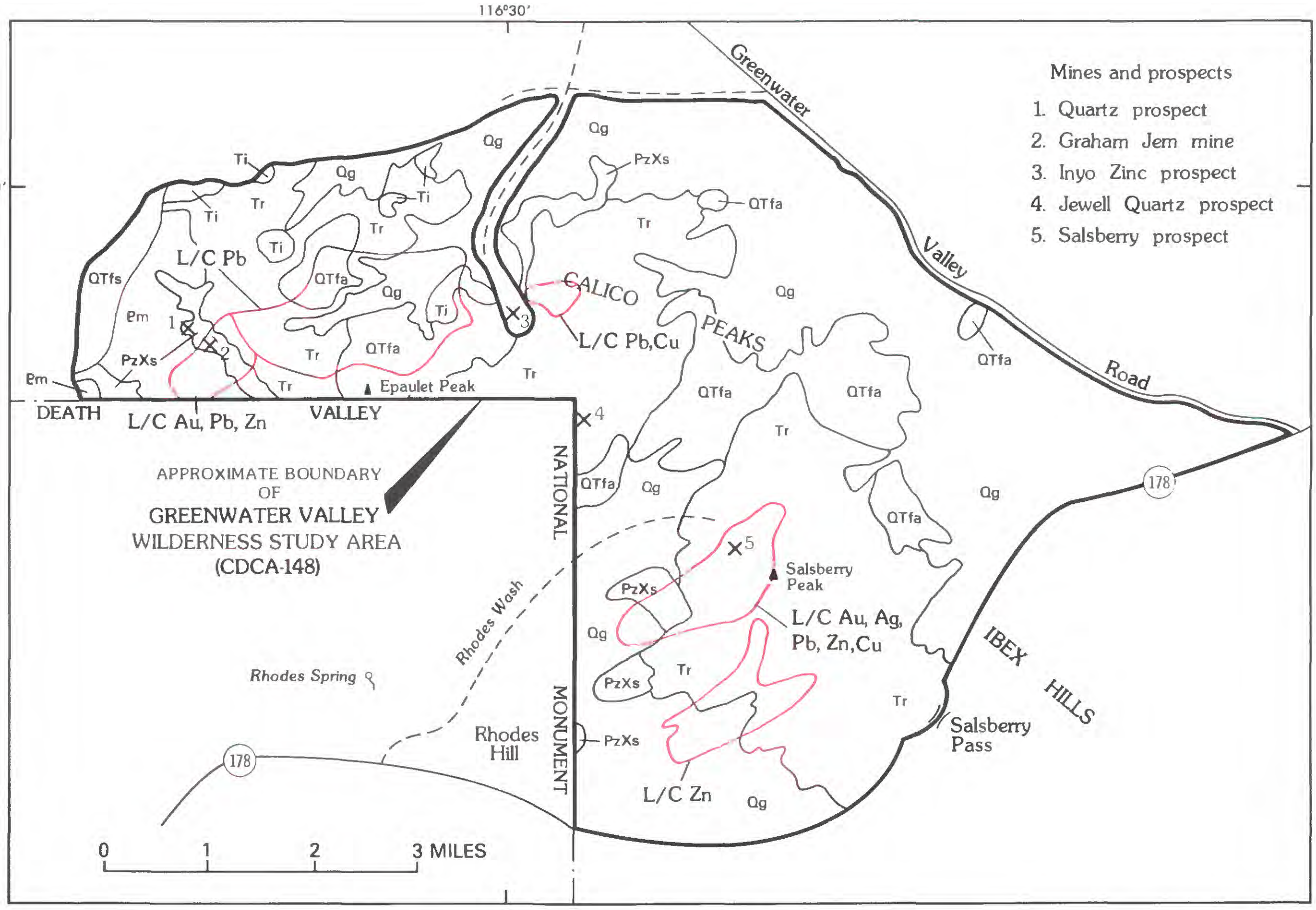

Figure 2. Map showing geology and mineral resource potential of the Greenwater Valley Wilderness Study Area, Inyo County, California.

EXPLANATION

Area with low mineral or geothermal resource potential, certainty level C. See appendix 1 and figure 4 for definition of levels of mineral resource potential and certainty of assessment

COMMODITIES

Au Gold
Ag Silver
B Boron
Cu Copper
Pb Lead
Zn Zinc

CORRELATION OF MAP UNITS

Qg — Holocene
QTfs, QTfa — Pleistocene(?) and Pliocene
(Holocene; Pleistocene(?) and Pliocene) — QUATERNARY

Ti, Tr — Miocene
TERTIARY

PzXs — PALEOZOIC AND LATE PROTEROZOIC

Pm — PROTEROZOIC

GEOLOGIC MAP UNITS

Qg Gravel deposits (Holocene and Pleistocene)

FUNERAL FORMATION (Pleistocene and Pliocene) divided into:

- QTfs Sedimentary rocks unit
- QTfa Andesitic-basaltic rocks unit

Tr Rhodes Tuff (Miocene)
Ti Andesitic and rhyolitic intrusive rocks (Tertiary)
PzXs Sedimentary rocks (Paleozoic and Late Proterozoic)
Pm Metasedimentary rocks (Proterozoic)

MAP SYMBOLS

——— CONTACT
------ JEEP TRAIL
⚒ MINE--Number refers to list of mines and prospects
× PROSPECT--Number refers to list of mines and prospects

Figure 2. Continued.

Graham Jem mine (fig. 2, No. 2; table 1). However, this occurrence turned out to be only an isolated pocket of high-grade ore valued at $25,000 per ton (Latschar, 1981). The rush ended by June of that year.

There has been little mining activity in the study area since the early 1900's. Despite there being 14 lode-mining claims and one millsite claim active within the study area at the time fieldwork for this report was done, there has been only minor recorded production as described above.

Mines and Prospects

At the Graham Jem mine (fig. 2, No. 2), four quartz veins are exposed intermittently for at least 1,000 ft in undifferentiated augen gneiss and granitic rock. The veins generally strike N. 30° to 35° W.; in most places, they dip nearly vertically and are as much as 5 ft thick, but average about 2.5 ft. Vein segments have been offset about 50 ft by faults. The quartz veins are massive and milky; iron-oxide staining ranges from sparse to heavy. Malachite, azurite, and other secondary copper minerals lightly stain the quartz veins. The veins are fractured and sheared and, in one place, are healed with magnetite. No primary sulfides were observed. Three adits (totaling 290 ft), 4 shafts, 2 trenches, and 12 prospect pits are located on the property. About 9,000 tons of ore (quartz and sheared gneiss) averaging 0.073 oz per ton gold were identified.

At the Salsberry prospect (fig. 2, No. 5), a shear zone in and along a rhyolite dike cutting gneissic and granitic rocks is exposed for about 600 ft and averages 2.2 ft thick. The shear zone strikes N. 60° W. and dips 65° to 80° NE. It is offset more than 5 ft inside the adit where the zone cannot be traced beyond 95 ft from the portal. The offsetting fault was not observed on the surface. Sheared material consists mostly of fine, rounded particles and clasts of rhyolite, augen gneiss, pods of argentiferous galena, and secondary copper minerals. Workings consist of one adit 115 ft long, 2 shafts, and 8 prospect pits. About 20,000 tons of ore with an average grade of 0.13 oz per ton gold, 0.26 oz per ton silver, 1 percent lead, and 2 percent zinc was identified.

Conclusions

The identified mineralized bodies at the Graham Jem mine and the Salsberry prospect are not considered resources because they are too small to mine. Considerable planning and development would be needed to produce ore from either of these mines because of poor access, rugged terrain, and harsh climate. Transportation and power costs would be very high because of the remote location.

The gold concentrations at the Graham Jem mine and the Salsberry prospect are high enough to be amenable to large-tonnage heap-leaching recovery methods. Additional mapping, sampling, and drilling programs may identify sufficient tonnage to classify these concentrations as mineral resources.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

By Augustus K. Armstrong, Michael T. Garrison
James G. Friskin, and Robert C. Jachens
U.S. Geological Survey

Geology

The Greenwater Valley Wilderness Study Area is underlain by an Early Proterozoic metamorphic complex of sedimentary and igneous origin and a thick sequence of Late Proterozoic and lower Paleozoic marine sedimentary rocks. These are overlain by volcanic and sedimentary rocks of Cenozoic age; Mesozoic rocks are absent in the study area. This entire sequence of rocks has been distorted and displaced by several episodes of faulting and folding, most extensively during the Mesozoic and Cenozoic eras. This deformation makes it impossible to interpret the composite cross section of all the stratigraphic units present in the Black Mountains.

Early Proterozoic rocks in the study area (fig. 2) are predominantly quartz-feldspar augen gneiss and grade into poorly defined bodies of quartz-feldspar-mica schist. Quartz veins are found within the gneiss terrane.

The most conspicuous units of the 10,500-ft thick Late Proterozoic and lower Paleozoic sedimentary succession are the Noonday Dolomite and the Johnnie Formation, which are exposed locally in the study area west of the Calico Peaks (fig. 2). In the study area, this sequence also includes limestone, shale, and quartzite of early Paleozoic age.

The Tertiary stratigraphy of the study area is composed of andesitic to rhyolitic intrusive rocks, the Rhodes Tuff of Wright and others (1984), and andesitic, basaltic, and sedimentary rocks of the Funeral Formation. The andesitic to rhyolitic intrusive rocks crop out in scattered exposures about 3 mi north and east of Epaulet Peak. Andesitic and rhyolitic dikes and irregularly shaped bodies locally include rhyolitic flows and were probably emplaced at various times during Tertiary volcanism.

The Rhodes Tuff is composed of Miocene rhyolitic and rhyodacitic volcanic flows and agglomerates, sedimentary rocks, and intrusive bodies. These rocks cover less than half of the study area, but are the thickest of the rock units within its boundaries. The rocks are cut by numerous shear zones.

The nearest reported outcrops of the Furnace Creek Formation are 15 mi north of the study area. The formation may be covered by alluvium in Greenwater Valley. The Furnace Creek Formation is composed of tuffaceous clastic rocks with subordinate evaporite and borate deposits (Drewes, 1963).

The andesitic to basaltic rocks of the Pleistocene(?) Funeral Formation occur as flows, dikes, and agglomerates. They crop out along the northeast flank of Epaulet Peak and on the slopes east and southeast of Calico Peaks. The sedimentary rocks of the Funeral Formation, composed of sandstone, conglomerate, and a siltstone breccia containing coarse conglomerate, crop out over a small area in the westernmost part of the study area.

Geochemistry

The reconnaissance geochemical study was based on analysis and evaluation of stream-sediment samples, heavy-mineral concentrates from stream sediments, and rock samples. Stream-sediment and concentrate samples contain material derived from major rock units of the drainage basin being studied. Sampled drainage basins range in area from less than one to several square miles.

All samples were analyzed for 31 elements by a six-step semiquantitative emission-spectrographic method (Grimes and Marranzino, 1968). These analyses were used to identify drainages containing anomalous concentrations of metallic and metal-related elements. Anomalous values were determined by inspection of histograms, percentiles, and enrichment relative to crustal abundance. These anomalies usually reflect known mining activity, but in some instances they indicate areas of undiscovered or previously unrecognized mineralization.

All rock and heavy-mineral concentrate samples containing anomalous concentrations of metals were collected at three mines or prospects and from nearby drainage basins. Mineralized rock samples from the Salsberry prospect (fig. 2, No. 5) contain a maximum of 200 parts per million (ppm) silver, 3,000 ppm copper, 7,000 ppm zinc, and 1 percent lead. A concentrate sample collected about 1 mi downslope to the southwest contains 700 ppm arsenic, more than 10,000 ppm barium, 10,000 ppm lead, and 5,000 ppm zinc. Another concentrate, collected downslope 1.5 mi west of another Salsberry adit, contains 1,000 ppm lead. Two concentrates from streams draining the southwest side of the ridge from Salsberry Peak to Salsberry Pass contain 100 and 300 ppm lead, indicating that some related mineralized rocks are present along the ridge southeast of the Salsberry prospect. A concentrate sample collected outside the study area (0.75 mi south-southeast of Rhodes Hill) contains 1,000 ppm zinc and more than 10,000 ppm barium, indicating the presence of mineralized rock from either Rhodes Hill or the ridge near the Salsberry prospect.

About 3 mi northwest of the Salsberry prospect on the southwest side of the Calico Peaks is another prospect (fig. 2, No. 4) that contains minor copper mineralization. A concentrate sample collected downstream and to the north of this prospect contains 2,000 ppm lead and more than 10,000 ppm barium. A concentrate sample collected 2.5 mi south and downstream of the prospect contains 500 ppm lead and more than 10,000 ppm barium. Two concentrates from tributaries draining the south and east flanks of the hill 0.5 mi east of the prospect contain more than 10,000 ppm barium and 100 ppm lead, respectively.

The remaining anomalous concentrate samples are associated with the Graham Jem mine (fig. 2, No. 2). A concentrate sample collected 0.5 mi south of the mine contains 1,500 ppm lead, 1,000 ppm zinc, and more than 10,000 ppm barium. A concentrate sample collected from a tributary east of the Graham Jem mine that contains more than 1,500 ppm lead and more than 10,000 ppm barium indicates that the mineralized rocks may extend to the east.

Geophysics

An aeromagnetic survey of an area including the study area (fig. 3) was flown in 1981 and compiled under contract to the U.S. Geological Survey (U.S. Geological Survey, 1983). Total-field magnetic data were collected along east-west flight lines spaced approximately 0.5 mi apart and at a height of 1,000 ft above terrain. Because of the rugged topography in the survey area, actual terrain clearance varied about 300 to 3,000 ft. Corrections applied to the data compensated for diurnal variations of the Earth's magnetic field, and subtraction of the International Geomagnetic Reference Field (the update of the month the data were collected) yielded a residual magnetic field.

The study area lies on the flank of a large northwest-trending magnetic high that is located over the Black Mountains and occupies most of the southwest half of the map (fig. 3). The main source of this anomaly is the crystalline basement of the Black Mountains and, where the basement is exposed, the anomaly correlates with Proterozoic metadiorite, Mesozoic(?) diorite, and Tertiary granitic rocks of Smith Mountain (7 mi northwest of Epaulet Peak) (Drewes, 1963; Wright and Troxel, 1984). The anomaly is bounded on the northeast and southwest by linear, northwest-trending zones of steep magnetic gradients that parallel major fault zones in the region (the Death Valley, Furnace Creek, and Sheephead fault zones) (Stewart, 1983).

The linearity of the zones of steep magnetic gradients on the northeast side of the Black Mountains anomaly, their parallelism with fault zones in the region, and the inferred steep attitude of the contacts indicate that the magnetic source in the Black Mountains is bounded on the northeast by a major fault (or fault zone) concealed beneath sedimentary and volcanic rocks. The inferred location of the boundary passes beneath the northeastern part of the study area. Although this structural boundary is only associated with two known mineralized zones (Salsberry and Inyo zinc prospects) within the study area, many occurrences of copper minerals and barite (a barium mineral) to the northwest (Drewes, 1963) cluster around the structural boundary, indicating that they may have been deposited by hydrothermal fluids migrating along the fault zone. Similar mineralized zones may be present beneath the study area.

Mineral and Energy Resources

Geologic, geochemical, and geophysical data indicate that the Greenwater Valley Wilderness Study Area contains mineral resource potential for epithermal base- and precious-metal deposits and boron-bearing sediments (fig. 2). See appendix 1 and figure 4 for definitions of mineral resource potential and certainty of assessment. The gold, silver, zinc, lead, and copper-bearing deposits in the Black Mountains west of the study area typically occur in veins, stockworks, or bedding-replacement bodies along faults, usually in Proterozoic or Paleozoic

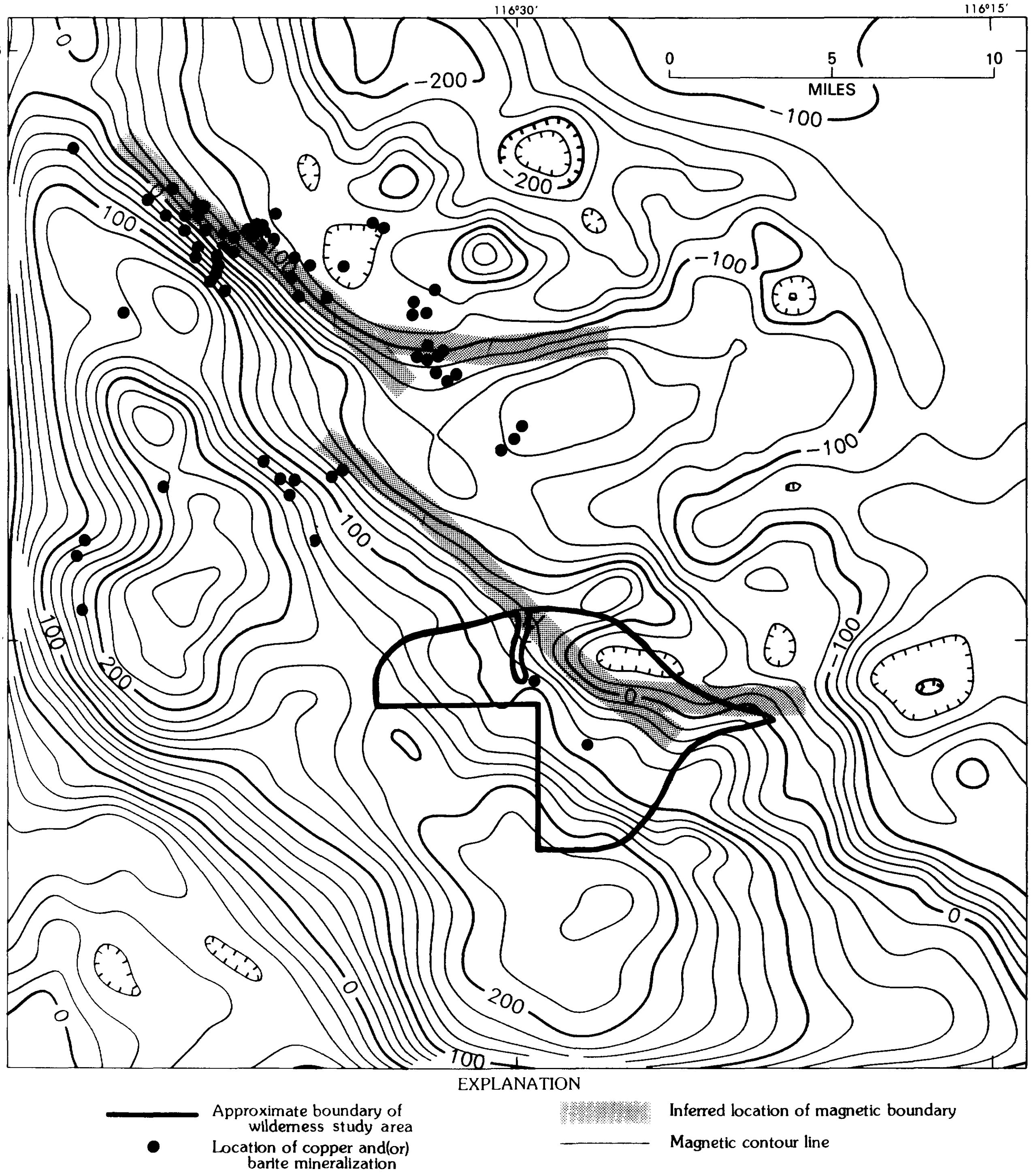

Figure 3. Residual aeromagnetic map of the Greenwater Valley Wilderness Study Area and vicinity. Contour interval is 20 nanoteslas. Hachures indicate direction of decreasing magnetic intensity. Black dots indicate area of copper and (or) barite mineralization.

carbonate rocks (Norman and Stewart, 1951). However, only scattered low-grade occurrences of these metals are present in the study area.

Gold and silver, along with minor lead, copper, and zinc, are found in Tertiary volcanic rocks at the Salsberry prospect, and gold with minor copper is present in shear zones in granite at the Graham Jem mine. Berger (1983) reported that similar epithermal precious- and base-metal deposits are located near centers of volcanism, and that through-going anastomosing fracture systems are the ore controls. These deposits are characterized by the presence of pyrite, arsenopyrite, galena, sphalerite, and chalcopyrite, and by anomalous concentrations of gold, silver, lead, zinc, and copper. Salsberry prospect, along with small prospects (table 1) such as the Inyo Zinc, Quartz, and Jewell Quartz, belong to this type of deposit. Three areas on the west side of the Calico Peaks (fig. 2) have anomalous concentrations of metals in panned-concentrate samples that indicate the Tertiary volcanic rocks have low resource potential for gold, silver, lead, copper, and zinc deposits in polymetallic epithermal-vein deposits. A small area south of the Calico Peaks has low mineral resource potential for lead and copper with a certainty level of C. An area west of Salsberry Peak has a low mineral resource potential for gold, silver, copper, lead, and zinc with a certainty level C. An area south of Salsberry Peak has low resource potential for zinc with a certainty level of C.

An anomalous metal suite similar to that found in the previously noted volcanic terrane is found north of Epaulet Peak in the northwest part of the study area; there are indications of low resource potential for lead with a certainty level of C.

The Graham Jem mine and the Quartz prospect west of Epaulet Peak explore gold-bearing quartz veins in a sheared gneissic terrane with anomalous concentrations of gold, lead, and zinc. Little mineralization was observed immediately adjacent to these deposits. This part of the study area has a low resource potential for gold, lead, and zinc with a certainty level of C.

The geophysical, geochemical, and geologic data indicate that the mineralized areas shown on figure 2 are part of a northwest-trending magnetic high (fig. 3) associated with Precambrian igneous rocks along a possible fault zone. The mineralizaton is located on the northeast side of this magnetic anomaly.

Boron-bearing deposits in the subsurface may extend from the Ryan area into the northern part of Greenwater Valley, north of the study area. However, boron minerals have not been found in the study area. Exploration drilling would be needed to prove the existence of boron in the subsurface of the study area. With the data available, the resource potential for boron minerals is low with a B certainty level.

The study area lies within a part of the Great Basin that has a low potential for oil and natural gas (Scott, 1983). The absence of source rocks and the structural complexity of this region preclude the accumulation of oil and natural gas resources in the study area; therefore, the resource potential of oil and natural gas is low with a C certainty level.

Although the study area lies only 5 mi west of the warm springs of Shoshone and 14 mi northwest of Tecopa Hot Springs where water temperatures range from 80° to $118^{\circ}F$ (Sammel, 1979; Brook and others, 1979), there is no evidence of geothermal activity in the study area. The warm springs of Shoshone and Tecopa Hot Springs are associated with the deep range-front fault systems that provide migration paths for the geothermal (source) waters. As distance increases from the fault systems, geothermal resource potential should decrease rapidly. Within the study area, the geothermal resources potential is low with a C certainty level.

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Table 1. Miscellaneous prospects in the Greenwater Valley Wilderness Study Area

Map Number	Name	Geology	Workings	Sample/Resource Data
1	Quartz prospect	Quartz veins 230 ft long strike N. 70 W., dip 40° NE-60° SW in gneiss and granite. Copper staining locally heavy.	Five pits.	Of 6 chip samples of quartz, 2 contained 0.0002 and 0.0005 oz/ton gold, 3 contained 0.01-0.04 oz/ton silver. One select sample of granite contained 0.24 oz/ton silver, 2.9 percent copper.
2	Graham Jem mine	Four quartz veins <1,000 ft long in gneiss and granite. Veins strike N. 30-35° W.; average 2.5 ft thick. Veins are iron and copper stained, with no primary sulfides.	Three adits, 2 trenches, and 12 pits.	One concentrate sample collected 0.5 mi south of the mine contained 1,500 ppm lead, 1,000 ppm zinc, and >10,000 ppm barium. One sample from west of the mine contained >1,500 ppm lead and 10,000 ppm barium. Prospect as a whole contains reserves of about 9,000 tons of vein quartz averaging 0.073 oz/ton gold.
3	Inyo Zinc prospect	Shear zones with iron minerals trend NW and are stained with copper minerals.	One shaft, 2 trenches, and 9 pits.	Two samples from shear zones contained 0.0008 and 0.0018 oz/ton gold. Six samples ranged from 0.015 to 0.17 oz/ton silver. One sample contained 21.4 percent copper. None contained more than 49 ppm zinc.
4	Jewell Quartz prospect	Siliceous, argillized rhyolite is iron and copper stained.	Two shafts, 1 pit.	One sample of rhyolite contained 0.0091 oz/ton gold and 0.057 oz/ton silver.
5	Salsberry prospect	Shear zone in rhyolite dike cutting gneiss and granite is exposed for about 600 ft and averages 2.2 ft in thickness. Shear zone strikes N.60°W., dips 65°-80° NE. Sheared material includes rhyolite, gneiss, pods of argentiferous galena, and secondary copper minerals.	One adit, 2 shafts, and 8 pits.	Samples contain 200 ppm silver, 3,000 ppm copper, 7,000 ppm zinc, and 1 percent lead. Prospect as a whole contains about 20,000 tons of ore averaging 0.13 oz/ton silver, 1 percent lead, and 2 percent zinc.

APPENDIX 1. Definition of levels of mineral resource potential and certainty assessment.

Mineral resource potential is defined as the likelihood of the presence of mineral resources in a defined area; it is not a measure of the amount of resources or their profitability.

Mineral resources are concentrations of naturally occurring solid, liquid, or gaseous materials in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Low mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment where the existence of resources is unlikely. This level of potential embraces areas of dispersed mineralized rock as well as areas having few or no indications of mineralization. Assignment of low potential requires specific positive knowledge; it is not used as a catchall for areas where adequate data are lacking.

Moderate mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable chance for resource accumulation, and where an application of genetic and (or) occurrence models indicates favorable ground.

High mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resources, where interpretations of data indicate a high likelihood for resource accumulation, where data support occurrence and (or) genetic models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential requires positive knowledge that resource-forming processes have been active in at least part of the area; it does not require that occurrences or deposits be identified.

Unknown mineral resource potential is assigned to areas where the level of knowledge is so inadequate that classification of the area as high, moderate, or type in a well-defined area. This phrase is not used if there is the slightest possibility of resource occurrence; it is not appropriate as the summary rating for any area.

Expression of the certainty of the mineral resource assessment incorporates a consideration of (1) the adequacy of the geologic, geochemical, geophysical, and resource data base available at the time of the assessment, (2) the adequacy of the occurrence or the genetic model used as the basis for a specific evaluation, and (3) an evaluation of the likelihood that the expected mineral endowment of the area is, or could be, economically extractable.

Levels of certainty of assessment are denoted by letters, A-D (fig. 4).

A. The available data are not adequate to determine the level of mineral resource potential. Level A is used with an assignment of unknown mineral resource potential.

B. The available data are adequate to suggest the geologic environment and the level of mineral resource potential, but either evidence is insufficient to establish precisely the likelihood of resource occurrence, or occurrence and (or) genetic models are not known well enough for predictive resource assessment.

C. The available data give a good indication of the geologic environment and the level of mineral resource potential, but additional evidence is needed to establish precisely the likelihood of resource occurrence, the activity of resource-forming processes, or available occurrence and (or) genetic models are minimal for predictive applications.

D. The available data clearly define the geologic environment and the level of mineral resource potential, and indicate the activity of resource-forming processes. Key evidence to interpret the presence or absence of specified types of resources is available, and occurrence and (or) genetic models are adequate for predictive resource assessment.

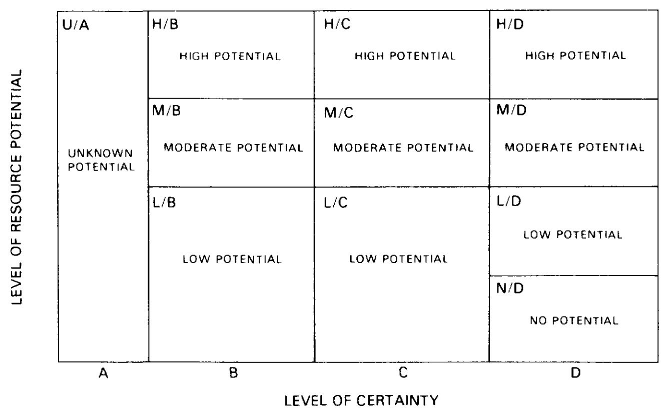

Figure 4. Major elements of mineral resource potential/certainty classification.

GEOLOGIC TIME CHART

Terms and boundary ages used by the U.S. Geological Survey in this report

EON	ERA	PERIOD		EPOCH	AGE ESTIMATES OF BOUNDARIES (in Ma)
Phanerozoic	Cenozoic	Quaternary		Holocene	0.010
				Pleistocene	1.7
		Tertiary	Neogene Subperiod	Pliocene	5
				Miocene	24
			Paleogene Subperiod	Oligocene	38
				Eocene	55
				Paleocene	66
	Mesozoic	Cretaceous		Late	96
				Early	138
		Jurassic		Late Middle Early	205
		Triassic		Late Middle Early	~240
	Paleozoic	Permian		Late Early	290
		Carboniferous Periods	Pennsylvanian	Late Middle Early	~330
			Mississippian	Late Early	360
		Devonian		Late Middle Early	410
		Silurian		Late Middle Early	435
		Ordovician		Late Middle Early	500
		Cambrian		Late Middle Early	~570[1]
Proterozoic	Late Proterozoic				900
	Middle Proterozoic				1600
	Early Proterozoic				2500
Archean	Late Archean				3000
	Middle Archean				3400
	Early Archean				(3800 ?)
pre Archean[2]					4550

[1]Rocks older than 570 Ma also called Precambrian, a time term without specific rank.

[2]Informal time term without specific rank.

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