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Mineral resources and resource potential of the Hunter Mountain Wilderness Study Area, Inyo County, California

by

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This report is preliminary and has
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STUDIES RELATED TO WILDERNESS

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 the Congress. This report presents the results of a mineral survey of the Hunter Mountain Wilderness Study Area (CDCA-123), California Desert Conservation Area, Inyo County, California.

SUMMARY

No mineral resources were identified in the Hunter Mountain Wilderness Study Area. The principal metallic mineral resource potential in the WSA is in lead, zinc, and silver vein and replacement bodies in carbonate rocks and tungsten, molybdenum, and copper bearing skarn deposits. There is low mineral resource potential for these metals in both types of deposits in metamorphic rocks adjacent to large granitic plutons that form the principal rock type of the study area. North of the wilderness study area at the Lippincott mine there is a small amount of lead, zinc, and silver ore and adjacent to the mine, including the Lead King mine, there is high to moderate mineral resource potential for these metals. The Monarch mine on the eastern edge of the wilderness study area and areas adjacent to this mine are judged to have low resource potential for gold, silver, copper, and tungsten.

Silica in the Ordovician Eureka Quartzite, tourmaline in small, local pegmatite pods, and wollastonite in calc-silicate rocks occur in or near the wilderness area.

INTRODUCTION

The Hunter Mountain Wilderness Study Area encompasses 20,600 acres in Inyo County, California. It is about 55 mi east of Lone Pine, California, and adjoins the western boundary of Death Valley National Monument. The area is bordered by the Lower Saline Wilderness Study Area on the northwest and the Panamint Dunes Wilderness Study Area on the south. The terrain is moderately to extremely rugged with total relief of about 5,500 ft from the highest part of Hunter Mountain (7,454 ft above sea level) to the floor of Saline Valley. The climate is arid with a wide range in temperatures. Vegetation is sparse with creosote bush, desert holly, burroweed, and encelia on the flanks of Saline Valley; Joshua tree, sage, and rabbit brush at middle elevations and pinion pine and juniper at higher elevations. Perennial vegetation near springs includes willow, and wild rose; lush grasses and many varieties of wild flowers are present also.

Access to the area is by dirt road. The northern part of the WSA is reached from Death Valley via Racetrack Valley within Death Valley National Monument. This road, which crosses the Panamint Range to Saline Valley, is the northern boundary of the wilderness study area. Other roads that form the southern edge of the wilderness study area run along Grapevine and Jackass Canyons and ultimately join California Highway 190 south of the Inyo Mountains.

Previous and present studies

The Hunter Mountain Wilderness Study Area lies mostly within the Ubehebe Peak 15' quadrangle, a geologic map of which was published by McAllister (1956). A study of mineral deposits in the quadrangle was published by McAllister (1955). A composite geologic map compiled for this study encompasses the Hunter Mountain, Panamint Dunes, and Wildrose Canyon Wilderness Study Areas (Conrad and McKee, 1984).

Fieldwork for this report was done in 1981 and 1982 by the U.S. Bureau of Mines and in 1982 and 1983 by the U.S. Geological Survey. The studies included examination and evaluation of individual mines, prospects and mineralized zones by the Bureau of Mines, and reconnaissance geologic mapping, and geochemical sampling of drainage basins by the Geological Survey.

In addition, the Bureau of Mines searched literature for data pertaining to mineral resources and deposits in the region, as well as Inyo County and U.S. Bureau of Land Management claim records. Attempts were made to contact all known claimants and to obtain pertinent scientific or historical information.

All known mines, prospects and mineralized zones were examined and sampled; 181 rock samples were taken from mineralized zones and mine dumps. Most of the samples were analyzed for gold and silver using a combination of fire-assay and atomic-absorption methods. Quantitative values of visible or anomalous elements were determined by atomic-absorption, colorimetric, or X-ray fluorescent methods. At least one sample from each locality was analyzed by semiquantitative spectrographic methods. Complete analytical data, a detailed property map, and an open file summary report are on file at the U.S. Bureau of Mines Western Field Operations Center, Spokane, Washington (Causey and others, 1983).

Geochemical sampling by the Geological Survey included 35 stream-sediment samples, and 35 panned heavy-mineral concentrates. Chemical analyses of these samples are in Detra and others (1984).

GEOLOGY

The rocks in the study area can be divided into four major groups: (1) Paleozoic marine sedimentary rocks; (2) Jurassic intrusive rocks; (3) upper Tertiary basalt flows; and (4) Quaternary surficial deposits.

The Paleozoic marine sedimentary rocks include strata of Late Cambrian to Mississippian age and have a composite stratigraphic thickness of more than 6,000 ft. At no place within the area, however, is more than a fraction of this thickness exposed. The rocks are predominantly dolomite and limestone with some interbedded quartzite units. In the Hunter Mountain area these carbonate strata have been variously metamorphosed to marble or calc-silicate hornfels and the quartzose units are hornfelsic or phyllitic. A detailed description of the Paleozoic formations is given in McAllister (1956) and Conrad and McKee (1984).

The Jurassic plutonic rocks are part of the Hunter Mountain pluton, a composite granitoid body considered to be comagmatic with the Sierra Nevada batholith (Bateman and others, 1963; McKee and Nash, 1967; Ross, 1969). These granitic rocks intrude and have metamorphosed the Paleozoic sedimentary rocks of the area. The pluton generally has sharp and steep contacts with the surrounding country rock, and contact metamorphic effects extend as far as 2 mi from the contact. The Hunter Mountain pluton is mostly quartz monzonite in composition, but along border zones it may be composed of monzonite, syenodiorite, diorite, and hornblende gabbro, caused by reaction with the country rock (Hall, 1971). Locally, small intrusive bodies of aplite, leucogranite, pegmatite, and andesite porphyry cut the Hunter Mountain pluton and older stratified rocks.

A few outcrops of olivine basalt occur in the southern part of the area. These lavas are remnants of flows that have been offset by basin and range faulting and subsequently isolated by erosion. Widespread and voluminous basalt flows comprise most of the Saline Range a few miles north of the study area and outliers of basalt are found throughout the northern Death Valley region. The basalts are late Miocene and Pliocene in age (Elliott and others, 1984).

Paleozoic strata in the study area are strongly folded and faulted. The intrusion of the Hunter Mountain pluton further complicated the structure by creating widespread, pervasive metamorphic features such as foliation, lineation, and recrystallization. Three major periods of deformation are recognized: (1) faulting and folding that took place prior to emplacement of the granitic rocks. These structures are recognized by regional geologic studies; (2) deformation associated with emplacement of plutonic rocks; and (3) basin and range high-angle normal faulting that is responsible for most of the physiography of the region.

GEOCHEMICAL STUDIES

The geochemical samples consist of stream sediments, heavy-mineral concentrates from stream sediments, and rock samples. The stream-sediment samples contain material derived from major rock units of the drainage basin as well as scavenged materials such as amorphous iron-manganese oxides, clays, and organic matter. The drainage basins cover areas ranging from a fraction to several square miles.

The stream sediment was sieved and wet panned to remove most of the quartz, feldspar, and clay-sized minerals. The less dense grains that remained were removed by heavy-liquid mineral separation techniques; magnetite was removed with a magnet. The remaining concentrate was divided into two parts based on magnetic susceptibility. The nonmagnetic concentrates contain most of the sulfide minerals, their oxidation products, and other minerals that contain most of the elements related to ore deposits (Lovering and McCarthy, 1978). The amount of elements commonly associated with ore deposits is thus enhanced to the point where they can be measured by spectrographic methods and the variation in dilution by sedimentary processes is reduced.

All samples were analyzed for 31 elements by a six-step semiquantitative emission spectrographic method (Grimes and Marranzino, 1968). The analytical data are given in Detra and others (1984). These analyses show drainages with anomalous concentrations of metals or ore-related elements. Most often these anomalies reflect mining activity or mineralization, but in some instances they indicate areas of concealed mineralization. An anomalous area is a locality where ore-related elements in the sample deviate sufficiently from the upper limit of normal background values to suggest that concentrations of these metals may occur in the rocks. Anomalous values were determined by inspection of histograms, percentiles, and enrichment relative to crustal abundance.

The mineralization detected by evaluation of the trace elements is mostly related to lead-zinc-silver hydrothermal processes. The geologic setting and the presence of certain heavy minerals in concentrates suggest that mineralized skarns may be present as well.

MINING HISTORY AND MINING ACTIVITY

The Hunter Mountain Wilderness Study Area lies within the Ubehebe mining district, which also extends some 10 mi north of the wilderness study area boundary. Production of 5,625,501 lbs lead, 347,649 lbs zinc, 31,000 lbs copper, 84,837 tr oz silver and 303.4 tr oz gold is reported from the district. However, no production has been reported from within the wilderness study area. All of the recorded production came from four mines north of the area, the most important of which was the Lippincott mine.

Two other mining districts are in the vicinity of the study area. The Goldbelt Springs district (asbestos, talc, and tungsten) is east of and adjacent to the WSA in Death Valley National Monument but has had no reported production. The Lee district (copper, silver, and lead) about 4 mi west of the wilderness study area has produced 82,000 lbs copper, 1,079 lbs lead, and 471 tr oz of silver.

More than 350 mining claims have been located in the WSA since the late 1870's. In 1982, Bureau of Land Management records showed five actively held claim groups. About 600 ft of underground workings are evenly divided between the Shirley Ann-Sal and Navajo Chief claims; additional workings are at the Monarch mine. The J.O. mine northeast of the WSA contains a wollastonite deposit and has been described by Clark (1980).

No mineral resources were identified in the WSA. Mines, prospects, and mineral occurrences in or near the Hunter Mountain Wilderness Study Area are shown on plate 1. The workings, geologic setting, sampling, and sample assays are described in table 1.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The assessment of mineral resource potential in the Hunter Mountain Wilderness Study Area is expressed by a dual favorability-certainty classification (plate 1). The terms high, moderate and low resource potential are defined as follows: high indicates that the nature of the geologic environment and the geologic processes that have acted on the area suggests a high degree of likelihood that a stated mineral resource is present. The data define a geologic environment favorable for the presence of mineral resources, and support the interpretation that resources are present; moderate indicates that the nature of the geologic environment and the geologic processes that have acted in the area suggests a reasonable chance for the presence of mineral resources; low indicates the data define a geologic environment permissive for the presence of mineral resources but that there is no evidence of resource accumulation.

The certainty factor used in the assessment has five levels. The lowest level, A, indicates that available data are not adequate for determination of occurrence of mineral resources. The second level, B, infers that available data are adequate to suggest a degree of potential (high, moderate, or low), but evidence is insufficient to define the potential of geologic environments or activity of resource-forming processes. The third level of certainty, C, exists when available data provide a good indication of the level of potential, but are minimal in terms of definition of degree of activity of possible resource-forming processes, and type of geologic environments. The fourth level of certainty, D, is where data clearly define the level of potential, the geologic environment, and the degree of activity of possible resource-forming processes. The highest level, E, exists when available information verifies that resources or reserves have been identified and specifies the kinds of valuable materials.

General: geologic studies, geochemical sampling and review of mine production indicate that the Hunter Mountain area lies within a province characterized by the presence of lead, zinc, and silver hydrothermal-type deposits. The lead-zinc-silver deposits are mainly metalliferous vein and replacement bodies in carbonate rocks close to the margins of granitic plutons.

Skarns that contain tungsten, molybdenum, and copper are present at other localities in the region where large granitic plutons have metamorphosed carbonate rocks. Indications of both lead-zinc-silver hydrothermal vein, and tungsten-molybdenum-copper skarn mineralization are found in the Hunter Mountain Wilderness Study Area but at widely separated localities and at low elemental concentrations.

Spectrographic analyses of heavy-mineral concentrates show lead, zinc, silver, bismuth, and barium anomalies in one drainage in the northern part of the study area. One strong base-metal (Pb-Zn-Cu) anomaly is found on the southern edge of the study area. Analysis of the stream sediments revealed anomalous bismuth and barium values at two places in the central part of the area. Numerous prospects in this area suggest mineralization as well.

The anomalous concentrations of base metals and the ore minerals identified in samples from the drainage in the northern part of the study area probably originated at the Lippincott mine or areas adjacent to it. The trace-element signature and the observed mineral assemblage is indicative of both hydrothermal and metasomatic processes. The anomalous elements present include lead, zinc, silver, bizmuth, barium, and molybdenum. Microscopic examination of the concentrates disclosed a mixed assemblage of base-metal and skarn-type minerals. The assemblage includes galena, barite, oxidized pyrite, scheelite, powellite, and unidentified sulfides. The Lippincott mine (outside the wilderness study area), the Lead King mine, and adjacent areas, are judged to have high to moderate potential for additional resources of lead, zinc and silver in carbonate hosted veins and possibly tungsten in small skarn bodies.

The anomalous sample in the southern part of the area is from the east side of Grapevine Canyon, which forms the boundary of the wilderness study area. The heavy-mineral concentrates contain a trace-element signature often associated with base-metal sulfide deposits. The suite of anomalous elements includes lead, zinc, silver, antimony, and barium. The sample was collected from older alluvium, containing a variety of rock types, in an unmineralized area. The stream drains an area of predominantly granitic rock with no carbonate rock exposed. Mineralization may be related to faults that cut the granitic rocks and which acted as channels for hydrothermal solutions. Areas adjacent to, and upsteam from, the anomalous sample site are assigned a low resource potential for lead, zinc, and silver solely on the basis of this anomaly.

A solitary bismuth anomaly was detected in a stream-sediment sample collected from a drainage in metamorphosed carbonate rock in the vicinity of Little Dodd Springs; anomalous barium was detected in the drainage south of Little Dodd Springs. The bismuth may reflect skarn-type mineralization, the barium (probably barite) came from the quartz-monzonite pluton where it could occur as small veins or as a constituent of potash feldspar. In the area of Little Dodd Springs, the Shirley Ann group and other prospects in metamorphosed carbonate rocks encompass small skarns. This area, which lies along the extension of the Racetrack Valley road, locally called the Ubehebe trail, is judged to have low mineral resource potential for tungsten and possibly silver, lead, zinc, and copper in skarns.

The Monarch mine on the eastern edge of the wilderness near the boundary with Death Valley National Monument, yielded samples from its dump with small amounts of gold, silver, copper, and tungsten. The potential for additional resources of these metals at this mine is low.

Other minerals that are found in or near the Hunter Mountain Wilderness Study Area and which might be of value are: (1) silica (quartz) in the Ordovician Eureka Quartzite; (2) tourmaline in small, local pegmatite pods; and (3) wollastonite in contact metamorphosed calc-silicate rocks. Wollastonite has been mined from the J.O. mine just east of the study area. None of these materials is considered to have significant resource potential within the wilderness area.

No radioactive minerals, fossil fuels, or geothermal resources were found in the Hunter Mountain Wilderness Study Area during this study.

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Table 1.—Mines, prospects, and mineral occurrences, Hunter Mountain Wilderness Study Area

Map no.	Name	Workings	Summary
1	J. O. mine[1]	Several prospect pits, two test excavations, 18 drill holes	Clark (1980) estimated that 200 million tons of wollastonite-bearing rock are present in this vicinity; about 26 million tons are on land adjoining the Wilderness Study Area. An open-pit mine to produce wollastonite would extend into the study area, although no resources are identified there.
2	Palmer prospect	One prospect pit	Skarn as thick as 10 ft at contact between quartz monzonite and limestone-marble. Two samples assayed 0.004 and 0.11 oz gold and 0.003 and 0.12 oz silver per ton. One contained 1.00 percent copper.
3	Monarch mine	Three inaccessible shafts	Workings are on 6-ft-thick quartz vein in vertical shear zones striking N. 20°-57° W. in quartz monzonite. A chip sample across the shear zone on the surface contained no significant values. A select sample of vein quartz from a dump contained 0.07 oz gold and 101 oz silver per ton, 2.30 percent copper, 1.5 percent antimony, and 0.03 percent tungsten trioxide (WO_3); another had 13.7 oz silver per ton and 0.62 percent WO_3; the third had 11.2 oz silver per ton, 0.32 percent copper, and 0.06 percent WO_3. Potential is low for silver-copper-tungsten-gold resources in quartz vein.
4	Tourmaline #1-4 prospect	One prospect pit, five trenches	Tourmaline-quartz pods as large as 3 ft in diameter in quartz monzonite. Four samples: highest values were less than 0.002 oz gold and 0.1 oz silver per ton. One sample from copper-bearing pit had 0.27 percent copper. This prospect has been mined for specimen tourmaline. Potential is low for tourmaline resources.
5	Tungsaline prospect	Six prospect pits	Skarn and quartz vein as thick as 3 ft in sediments of a roof pendant about 1,500 ft long and 300 ft wide. Fourteen samples: eleven had traces of silver and one had 0.59 oz per ton; five of eight tested had 0.26 to 2.65 percent copper; and four of ten tested had 0.04 to 0.60 percent WO_3.
6	Jackrabbit prospect	One prospect pit	Small skarn pod about 140 ft long, 40 ft thick, and 25 ft wide. Two samples contained 0.29 and 0.134 percent copper and negligible gold, silver, zinc, and tungsten.
7	Navajo Chief prospect	Two adits (210 and 50 ft long), 7 prospect pits	Skarn zones as thick as 10 ft between quartz monzonite and carbonate rocks. Twenty-seven samples: ten samples analyzed for copper, five had 0.15 to 0.56 percent copper and two others had 0.93 and 2.90 percent. Fourteen were tested for tungsten, but WO_3 (0.01 percent) was detected in only one sample. Traces of lead (0.01 percent) were found in four of seven samples tested. Small amounts of gold (as much as 0.013 oz per ton in one sample) and silver (as much as 0.50 oz per ton in one sample) were found in seven and 21 samples, respectively.
8	Shirley Ann (Sal and June) group	Eight adits (110, 50, 35 (2), 20 (3), and 10 ft long) ten prospect pits, one shaft	Skarn zone about 400 ft long and up to 8 ft thick in marble near contact with quartz monzonite. Thirty-six samples taken: only one had detectable gold (0.0002 oz per ton), nine had 1.20 to 17.1 oz silver per ton, the rest had less than 0.67 oz silver per ton. Nineteen samples analyzed for copper: three had 0.46 to 1.50 percent. Twenty-six analyzed for lead: 13 had 0.50 to 7.80 percent. Seventeen analyzed for molybdenum: seven had 0.01 to 0.092 percent. Six analyzed for WO_3: one contained 0.01 percent. Four analyzed for antimony: values ranged from 0.0275 to 0.100 percent. Four analyzed for arsenic: two had significant values 0.46 and 1.90 percent. This prospect has moderate potential for silver-lead-copper resources with other by-products.
9	Sal (Bee Em Tee) group	Nine prospect pits	Scattered skarn pods near and along contact between monzonite-syenite and limestone-marble. Largest pod about 25 ft long, 15 ft wide, and at least 13 ft thick. A shear zone apparent in several prospect pits is oriented about N. 15° W. Thirteen samples: four had 0.001 to 0.018 oz gold per ton; three had 1.25, 25.8, and 34.0 oz silver per ton. Eight samples analyzed for copper: four had 0.42 to 2.20 percent. Three samples analyzed for WO_3, two detectable values: 0.59 and 0.01 percent. No significant lead or zinc values detected in any samples analyzed (lead less than 0.05 percent, zinc less than 0.19 percent). This prospect has low potential for silver and copper resources.
10	Sunshine prospect	Two prospect pits	Skarn as thick as 4 ft at contact between quartz monzonite and limestone-marble. Ten samples: nine contained detectable copper (three had 0.31 to 1.70 percent); highest values were 0.02 percent lead, 0.125 percent molybdenum, 0.01 percent WO_3, 0.54 oz silver per ton, and 0.034 oz gold per ton (gold was detected in three samples).
11	Cuprotungstite prospect	One trench	Lense of skarn 3 ft by 17 ft in marble; one sample contained 9.20 percent copper, 0.23 percent WO_3, and 1.55 oz silver and 0.115 oz gold per ton.
12	Windy Hill prospect	One prospect pit	Working in quartz monzonite. Two samples contained 0.009 and 0.015 oz silver per ton.

Table 1.—Mines, prospects, and minerel occurrences, Hunter Mountain Wilderness Study Area.—(continued)

Map no.	Name	Workings	Summary
13	Unidentified prospect	One prospect pit	Six-ft-thick skarn zone at contact between quartz monzonite and limestone-marble. One sample; contained 0.015 oz silver per ton.
14	Green Light prospect	One adit 28 ft long	Skarn zone 2 ft thick at contact between quartz monzonite and marble. Four samples contained from 0.015 to 0.02 oz silver per ton.
15	Unidentified prospect	One prospect pit	Manganiferous shear zone 2 ft thick along contact between quartzite and dolomitic limestone. One sample contained 3.10 percent manganese, and 0.0009 oz gold and 0.044 oz silver per ton.
16	Eureka Quartzite	None	White vitreous quartzite that may be as much as 100 ft thick. Random chip sample contained 99.5 percent silicon dioxide, 0.26 percent calcium, 0.03 percent magnesium, 0.19 percent total iron, 0.01 percent sodium, and less than 0.01 percent potassium. Low potential for silica resources.
17	Hidden Ledge prospect	One adit 8 ft long adit, two prospect pits	Shear zones, as thick as 3 ft but averaging less than 2 ft, with iron and copper minerals are in quartzite and dolomite. Out of ten samples, the maximum values were: 0.05 oz gold per ton, 0.16 oz silver per ton, 0.54 percent copper, and 0.02 percent lead. Five other samples had more than 0.01 oz silver per ton, and one had more than 0.1 percent copper.
18	Lead King group	Two adits (7 and 35 ft long), ten prospect pits	Only mineral occurrences south of Death Valley National Monument are included here. Twenty-six samples of skarn zone, generally less than 10 ft thick, and of adjoining quartz monzonite and marble. Best values were in skarn: 0.0335 oz gold per ton, 1.41 oz silver per ton, 5.15 percent copper, 4.40 percent zinc, 0.054 percent molybdenum, 0.02 percent WO_3. Only one sample had more than 0.004 oz gold per ton; eight had more than 0.1 oz silver per ton; nine had more than 0.50 percent copper; four had detectable zinc (three exceed 2 percent); four had detectable molybdenum; and three had detectable tungsten (one sample of altered quartz monzonite had 0.14 percent WO_3).
19	Bonanza group	None	There are workings in a skarn zone north of this study area in the Lower Saline Valley Wilderness Study Area described by Rumsey (1984). One sample of a 9-in-thick quartz vein with boxwork structure within the Hunter Mountain Wilderness Study Area contained 0.003 oz gold and 0.15 oz silver per ton.

[1]Outside wilderness study area.