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MINERAL RESOURCES AND RESOURCE POTENTIAL OF THE SLATE RANGE WILDERNESS STUDY AREA, INYO COUNTY, CALIFORNIA

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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 of the United States. This report presents the results of a mineral survey of the Slate Range Wilderness Study Area (CDCA-142), California Desert Conservation Area, Inyo County, California.

SUMMARY

There is no recorded mineral production from the Slate Range Wilderness Study Area and the only evidence of mineral development consists of inactive workings in one small area near the northern border of the study area. Gold, silver, and lead have been produced from the Lotus Mine and the Crescent Mines area, both about one mile west of the study area. The Crescent deposits have a low probability of extending into the study area. Data from most stream-sediment geochemical samples does not indicate unusually high concentrations of elements of economic interest. Silver was detected at very low levels in twelve grab samples, seven of which are from adjacent sites, and this may reflect hydrothermal mineralization. The silver-bearing samples do not contain anomalously high values of other elements however, and heavy-mineral concentrate samples from the same sites contained no detectable gold or silver. One heavy-mineral concentrate sample from another area yielded anomalous values for several elements, including a very high concentration of thorium. The source of these high values is unknown. Tertiary volcanic rocks are extensively hydrothermally altered in several areas but, except at the Cliff Springs Claim, there is no physical or geochemical evidence of mineralization associated with the alteration. There is low mineral resource potential for undiscovered porphyry-type and(or) hydrothermal vein deposits at depth. The study area contains abundant sand and gravel deposits, but limited access and the considerable distance from major markets preclude their economic exploitation.

INTRODUCTION

Area Description

The Slate Range Wilderness Study Area encompasses about 70 square miles (about 45,000 acres) at the southern end of the Panamint Range, in southern Inyo County, California (fig. 1). The study area is located in the Wingate Wash and Manly Peak 15' quadrangles. It is about 16 mi east of Trona and about 15 mi south of Ballarat, California. The area is bounded on the north and east by Death Valley National Monument, and on the south by Mojave Range B of China Lake Naval Weapons Center. The terrain includes gently-sloping alluvial fans and rugged peaks and ravines. Elevations range from 1230 ft in Panamint Valley on the west, to 5809 ft at Needle Peak on the study area's northern boundary. The climate is arid, with a wide range of temperature and variable but commonly strong winds. All streams in the area are ephemeral. Vegetation is sparse, consisting mostly of scattered creosote bush, incienso, burroweed, desert holly, some small cacti, and other small plants.

The wilderness study area can be reached from California Highway 178 via 23 miles of unimproved dirt road and jeep trail up Goler Canyon. This road continues across Mengel Pass to the north, connecting with California Highway 190 in Death Valley via Butte Valley and Warm Spring Canyon. A jeep trail runs east from Meyers Ranch and

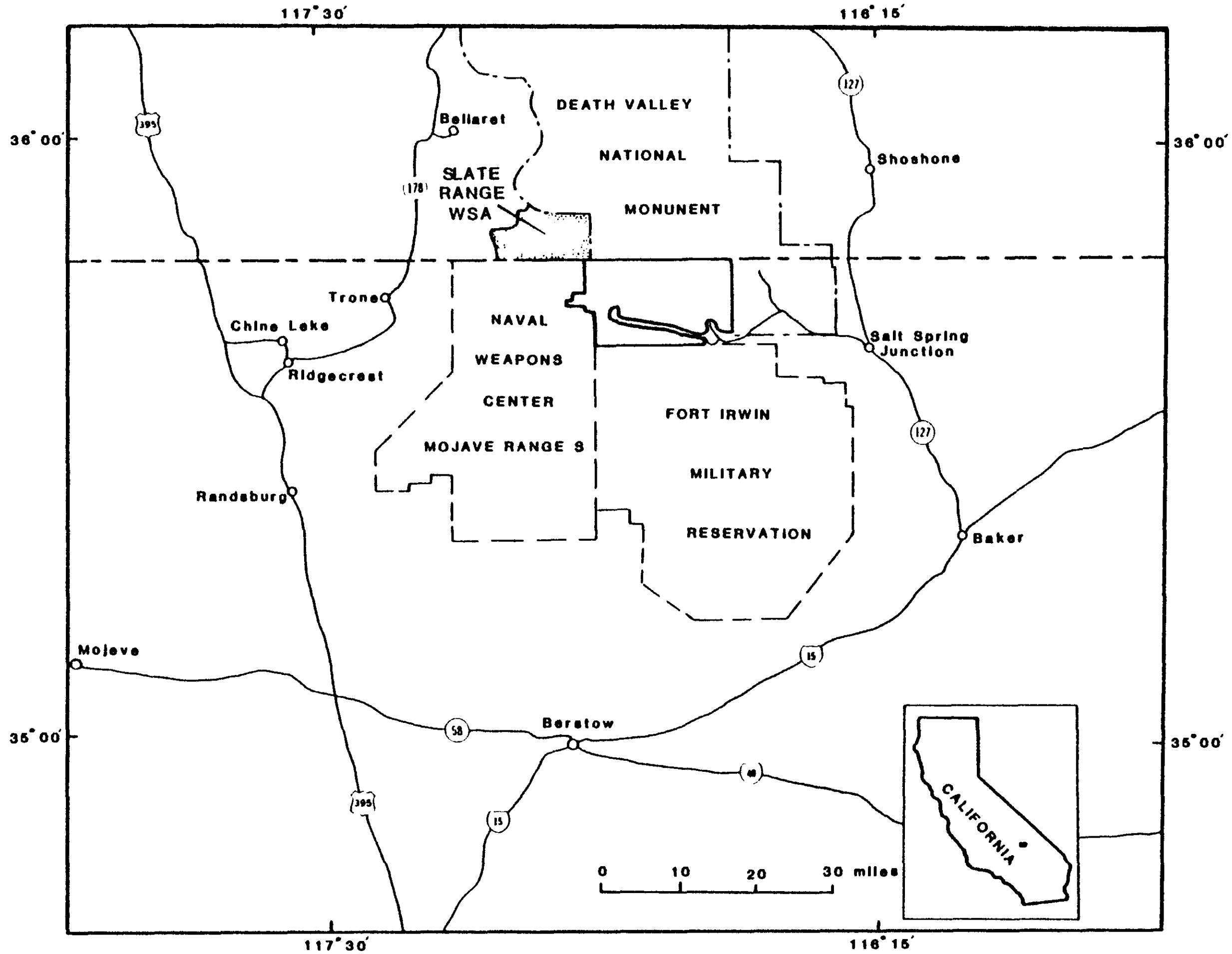

Figure 1. -- Index map showing location of Slate Range Wilderness Study Area,(CDCA-142), Inyo County, California.

then south to the southern boundary of the study area, where it enters the restricted area of Naval Reserve Mojave Range B.

Previous and Present Studies

Detailed geologic mapping by Johnson (1957) concentrated on the metamorphic and sedimentary rocks west and north of the wilderness study area but included some work along the western and northern portions of this area. Fieldwork for the present study was done by the U.S. Bureau of Mines in 1982 and by the U.S. Geological Survey in 1982 and 1983. The studies include examination and evaluation of individual mines, prospects, and mineralized zones by the Bureau of Mines, and reconnaissance geologic mapping and geochemical sampling of stream sediments and bedrock by the Geological Survey. The Bureau of Mines also conducted a literature search for data on mineral resources and deposits in the region, and searched Inyo County and U.S. Bureau of Land Management claim records.

Geochemical sampling by the Geological Survey included collecting stream-sediment grab samples, heavy-mineral concentrate samples of stream sediment, and bedrock samples. Special attention was given to sampling of altered zones within the Tertiary volcanic rocks. Analytical data for the samples of stream sediment are reported in Detra and others (1984). Sampling by the Bureau of Mines included grab and chip samples from the Cliff Springs area, within the study area, and from the Crescent Mines area, just west of the study area. Analytical data for the samples collected by the Bureau of Mines, and an Open-File Report summarizing the Bureau's findings, (Sokaski and others, 1983) can be obtained from the U.S. Bureau of Mines, Western Field Operations Center, Spokane, Washington.

GEOLOGY

About two-thirds of the wilderness study area is underlain by Tertiary volcanic and volcaniclastic rocks. Along the western edge of the study area the Tertiary rocks overlie, and are probably faulted against, Mesozoic granitic rocks and pre-Cambrian to Cambrian sedimentary rocks. The southeastern third of the study area is covered mostly by Quaternary alluvial fans and gently tilted Tertiary fanglomerate composed predominantly of Tertiary volcanic material. The western boundary of the study area approximately follows the contact between Tertiary rocks and the pre-Tertiary rocks that underlie most of the area to the west. Within the study area, pre-Tertiary rocks crop out only in small patches near this western boundary.

Pre-Cambrian and(or) Cambrian quartzite, quartzose sandstone, and shale of the Wood Canyon Formation, and dark-gray to light-gray limestone and dolomitic limestone of the Lotus Formation crop out south of Goler Canyon along the western edge of the Tertiary rocks. Massive, leucocratic biotite adamellite of probable Mesozoic age crops out in faulted and highly shattered exposures in Panamint Valley along the western edge of the study area, and massive, leucocratic, potassium-feldspar porphyritic biotite adamellite, also Mesozoic in age, forms a large pluton north of Goler Canyon and west of Mengel Pass.

Most of the bedrock within the study area consists of Tertiary lava flows, pyroclastic deposits, and agglomerate. These rocks are mainly of andesitic composition, with lesser dacitic rock. Small bodies of dacite and rhyolite have intruded the extrusive rocks. Some of these plugs occur in small clusters and their emplacement may have been controlled by faults. Areas of mild to intense hydrothermal alteration of Tertiary volcanic rocks are scattered across the northern part of the study area. Most of the alteration is argillic, with sericitic alteration present locally. Much of the southern and southeastern part of the study area is covered by uplifted and deeply dissected fanglomerate and by active alluvial fans.

GEOCHEMICAL STUDIES

Sampling

The geochemical samples collected by the Geological Survey during this study consist of 148 stream-sediment grab samples, 126 nonmagnetic heavy-mineral concentrates from stream sediments, and 102 rock samples. The sediments contain material derived from rock units and surficial deposits. The drainage basins sampled cover areas ranging from a fraction of a square mile to several square miles.

For heavy-mineral concentrate samples, the sediment was sieved, and then wet-panned to remove most of the quartz, feldspar, and clay-sized minerals. Low-density mineral grains that remained after panning were removed by floatation in undiluted bromoform. Magnetite was then removed with a magnet. The remaining concentrate was divided into two parts, based on magnetic susceptibility, using a Frantz Isodynamic magnetic separator. The relatively nonmagnetic concentrates contain most of the sulfide minerals, their oxidation products, and other minerals which contain most of the ore-related elements (Lovering and McCarthy, 1978). This procedure lessens the effects of variation in sedimentary dilution and effectively enhances analytical sensitivity for some elements to the point where their concentrations can be measured by spectrographic methods, even when they occur in very small concentrations.

All rock and sediment samples were analyzed for 31 elements by a semiquantitative method (Grimes and Marrinzino, 1965). The analytical results for the stream-sediment and heavy-mineral concentrate samples are presented by Detra and others (1984).

A sample is considered to be geochemically anomalous when the concentration of one or more ore-related elements is higher than the upper range of normal background values and(or) than normal crustal abundances. There is, however, no absolute "anomalous" level or fixed correlation between areas that yield anomalous geochemical values and economically viable mineral deposits. Because of site and analytical variability, values that are only marginally anomalous are given little weight unless supported by anomalous values for geochemically related elements in the same sample and(or) by complementary anomalous values in samples from the same site or from neighboring sites. Anomalous concentration levels were determined by inspection of analytical data, frequency distributions for these data, and the amount of enrichment relative to general crustal abundances.

Geochemical Data

Weakly anomalous concentrations of several elements occur in stream-sediment grab and heavy-mineral concentrate samples from sites scattered about the study area. Most of these anomalies are probably the upper end of normal geochemical "background noise" and do not reflect mineralization. Only a small number of heavy-mineral concentrate samples yielded anomalous element concentrations. Most of these anomalies are scattered, single-element values.

Data for the stream-sediment grab samples collected within the study area are characterized by unimodal frequency distributions for every element with a detection ratio greater than 0.5 ppm. Only chromium showed a logarithmic range greater than 1.0.

About 20 percent of the grab samples were weakly anomalous in one or, less frequently, two of the elements barium, copper, lead, molybdenum, or silver. Most of these anomalies are scattered sparsely and none are conspicuously above general background ranges. Thus the sediment data provides little evidence to support the presence of ore mineralization. The element with the most interesting sediment geochemical data is silver. Seven samples had concentrations of "0.5L" (detectable but less than the 0.5 ppm determination limit), three samples had values of 0.5 ppm, one had a value of 5 ppm, and one had 7 ppm silver. More importantly, the samples with detectable silver cluster in two areas. One cluster of seven adjacent samples (pl. 1, area A3) is in the west-central portion of the study area, and one diffuse "cluster" of three samples is at the eastern edge of the area. None of these 12 sediment samples are especially anomalous in any other elements, nor are concentrate samples from these sites anomalous in any elements. None of the corresponding heavy-mineral concentrates contain detectable silver or gold. This suggests that the silver present in the sediments was not associated with gold or sulfide mineralization.

The heavy-mineral concentrate samples collected within the study area contained no detectable antimony, arsenic, cadmium, gold, silver, or zinc. Most samples having anomalous concentrations of other elements came from sites scattered about the area and there are no large, conspicuous clusters of anomalies for ore-related elements. Two adjacent samples near the study area's eastern edge and two widely spaced samples contained from 100 to 700 ppm tin, and three other, widely-scattered samples yielded 1500 ppm lead. Only one of these concentrate samples was anomalous in other elements and none of the sediment grab samples from these sites was anomalous. The volcanic flows, tuffs, and agglomerate near these localities appear similar to those elsewhere in the study area. Since these localities are within a few miles of a U.S. Naval Bombing Range, the lead anomalies may reflect metal contamination. Bomb fragments were noted in a number of sites in the southern portion of the study area and bullets and shell casings are scattered throughout the study area. One heavy-mineral concentrate sample, collected near Mengel Pass, contained 150 ppm bismuth, 150 ppm lead, 100 ppm tin, 5000 ppm thorium, and 700 ppm tungsten. Proximity to a large adamellite pluton just beyond the wilderness boundary suggests that these high values could be derived from local skarn mineralization, although none was observed. One quarter of the heavy-mineral concentrate samples contained greater than 10,000 ppm barium. These samples all come from northeast of the jeep trail which bisects the study area. No correlation between these values and lithology or alteration was noted and the significance of them is not known.

MINES AND PROSPECTS

The only known mining or prospecting activity within the Slate Range Wilderness Study Area occurred in one small area on the northern border, about midway between Needle Peak and Sugerloaf Mountain (pl. 1, locality M1). This area is known as the Cliff Spring no. 5 claim. There is no evidence of recent prospecting activity at the site, and the most recent claim notice is dated November 1972. Development in this area consisted of an 83-ft long adit, several shorter workings, and a few small pits. Most workings follow zones of combined iron-oxide staining and quartz veins within altered volcanic rock. These zones range from 1 to 5 ft thick. Some workings are also cut into dark, silicified andesite country rock and into white to yellow clays (products of extreme alteration of the volcanic country rocks). Chip samples from the workings and grab samples from small stockpiles contained from less than 0.1 to 0.4 ppm silver and less than 0.003 to 0.09 ppm gold. A single, 3-ft thick, black iron-manganese oxide vein is exposed in one prospect pit and an analysis of one sample of it yielded 0.1 ppm silver, less than 0.003 ppm gold, 5.9% silicon, 39.5% iron, and 2.04% manganese. This is the only vein of its kind seen within the study area, though iron-oxide and iron-manganese oxide veins occur elsewhere in the region.

Alunite ($KAl_3(SO_4)_2(OH)_6$) claims are vaguely mentioned in claim records to occur just north of the Cliff Springs area; however, none were located in the field. Because of these reported claims, white clay from one of the Cliff Springs area prospect pits was analyzed. The clay contains 33% silicon and 9.3% aluminum.

The Crescent Mine group includes several small adits which were within the original wilderness study area. The study area boundary has been subsequently changed and these workings lie about 0.8 mi west of the new boundary. At the Crescent Mine, small irregular pods of limonitic material and iron-stained, silicified limestone in the Cambrian Lotus Formation, have been explored in 7 adits and 2 prospect pits. Mining in the 1920's by the open stope method resulted in recorded production of 235 tons of ore containing 20.58 oz gold, 1,186 oz silver, and 30,803 lbs of lead. Most of the pods exposed at the surface have been mined out; undiscovered and buried pods may be present in the area. Twelve continuous chip samples of pod material and one stockpile sample of limonitic material were collected from the adits and pits. The gold content of the twelve chip samples ranged from 0.0006 to 0.34 oz per ton, and averaged 0.18 oz per ton. The silver content of these samples ranged from 0.018 to 5.81 oz per ton and averaged 2.0 oz per ton. The samples contained from 0.02 to 9.2 ppm lead and less than 0.2 to 5 ppm zinc.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The assessment of mineral resource potential in the Slate Range Wilderness Study Area is presented in terms of favorability, expressed as high, moderate, and low resource potential. High favorability indicates that there is direct evidence of mineralization or that the nature of the geologic environment and the geologic processes that have acted on the area suggest a high degree of likelihood of the presence of a stated mineral resource. Available data for areas classified as highly favorable define a geologic environment conducive to the presence of mineral resources, and support the interpretation that resources are present. Moderate favorability indicates that the nature of the geologic environment and the geologic processes that have acted in the area suggest a reasonable chance for the presence of mineral resources. Low favorability indicates that the available data define a geologic environment permissive of the presence of mineral resources, but there is no evidence of resource accumulation.

Very small amounts of gold and silver occur in silicified andesite and in zones of quartz-veined and iron-oxide-stained, altered volcanic rock in the Cliff Springs area (pl. 1, locality M1), in the northern part of the study area. Clay derived from highly altered volcanic rocks in that area contains insufficient aluminum to be of economic interest, although there are records of claims for alunite in the Cliff Springs area. Scattered exposures of altered rock in the area contain no significant mineralized material but subsurface occurrences are possible. This area has low potential for precious-metal (gold, silver) resources in quartz-veined zones of iron-stained, altered rock.

Mild to intense hydrothermal alteration of the Tertiary volcanic rocks occurs in several broad areas (pl. 1, areas A2a, A2b). This alteration appears to be similar to acid alteration commonly associated with thick volcanic deposits and is not necessarily an indicator of concealed mineral deposits These altered areas yielded no encouraging geochemical results. The possibility exists, however, for supergene enrichment of base metals or a copper and(or) molybdenum porphyry-type deposit at depth. These areas have low potential for either type of deposit.

A cluster of seven adjacent stream-sediment grab samples in the south-central part of the wilderness study area all had detectable, and therefore anomalously high, silver (pl. 1, area A3). No other evidence of mineralization was observed in the field and there are no corroborating anomalies for heavy-mineral concentrate samples from the vicinity. This area has low potential for precious metal (silver) resources in hydrothermal veins.

One heavy-mineral concentrate sample from the northwest corner of the study area, near Mengel Pass (pl. 1, area A4), contained anomalous amounts of bismuth, lead, tin, thorium, and tungsten. A sediment grab sample from the same site had 100 ppm yttrium (slightly higher than background) but was otherwise not anomalous. The grab and concentrate samples from the only close-by sample site did not have anomalous values. No evidence of mineralization was observed in the field, but the anomalous values might be related to an unobserved skarn associated with the granitic pluton exposed west of Mengel Pass. The area near Mengel Pass has a low resource potential for bismuth, lead, tin, and tungsten in skarn deposits or veins.

Gold, silver, and lead have been produced from small pods of limonitic material at the Crescent Mines, located about 0.8 mi west of the study area. Most of the pods exposed on the surface have been mined out, although others may be present in the Crescent area (pl. 1, locality M2). Some pods may be covered by alluvium in the extreme southwestern part of the study area, but any resources, if present, would be minor. The portion of the study area directly adjacent to the Crescent Mines area (pl. 1, area A5) has low potential for precious-metal resources (gold, silver) in buried limonitic and silicified pods within limestone.

Two widely-separated heavy-mineral concentrate samples contained unusually high concentrations of thorium (2000 and 5000 ppm). The sample with 5000 ppm thorium also contained anomalous concentrations of bismuth, lead, tin, and tungsten, and was discussed above (area A4). The sample with 2000 ppm thorium did not yield anomalous values in any other elements. No uranium analyses were performed, but scintillometer readings were made from a helicopter parked at sites throughout the study area, including the vicinity of the sites which yielded high thorium values. The scintillometer data do not show any deviations from a very narrow range of background values. The rock types present in most of the study area are not those commonly associated with uranium deposits. The sources for these two geochemical anomalies are unknown but exploitable radioactive resources in the study area are unlikely.

There is no indication of the existence of any other economic mineral deposits in the Slate Range Wilderness Study Area. The study area contains substantial amounts of sand and gravel, but the large distances to markets precludes their development. No fossil fuels or evidence of geothermal resources were found in the Slate Range Wilderness Study Area during this study.

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