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MINERAL RESOURCES AND RESOURCE POTENTIAL OF THE OWLSHEAD MOUNTAINS WILDERNESS STUDY AREA, SAN BERNARDINO 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 Owlshead Mountains Wilderness Study Area, (CDCA-156), California Desert Conservation Area, San Bernardino County, California.

SUMMARY

Metallic mineral deposits in and adjacent to the Owlshead Mountains Wilderness Study Area are of two main types: 1) iron and(or) manganese replacement and void-filling deposits in carbonate rocks and fanglomerate, and 2) precious- and base-metal vein deposits in granitoid rocks. Reserves, marginal reserves, and subeconomic resources of iron and manganese exist within the study area at two mines (pl. 1, sites M10 and M12), and at four sites adjacent to the area (pl. 1, sites M12, M16, M19, M22). Small, subeconomic resources and possible marginal reserves of gold, silver, lead, zinc, and copper exist at five localities within the area. Only iron has been mined in recent years, and the last iron operation (Ellie Iron Mine) closed in May 1982. Manganese ore was produced from the Black Magic Mine, and from deposits to the southeast, adjacent to the study area. Shipments of ore containing gold, silver, and copper from the Hidden Spring area were recorded between 1928 and 1934. There is no recorded production from the vicinity of Quail Spring, but the extent of the workings and the ruins of a stamp mill suggest unrecorded production from the gold-silver claims there.

Deposits of several types of non-metallic resources occur within and adjacent to the wilderness study area. Epsom salt (epsomite) was mined briefly during the 1920's from a locality at the western edge of the study area. Small agate occurrences have been prospected within the study area. Deposits of bentonitic clay, gypsum, and strontium (celestite) occur directly south of the study area, not far from Owl Hole Springs. Stone, sand, and gravel deposits are abundant and suitable for many construction uses, but the cost of production and of transportation to market would exceed the commercial value of these materials.

Zones of strong hydrothermal alteration and patterns of anomalous geochemical values mark areas with low resource potential for undiscovered disseminated, vein and(or) porphyry-type mineral deposits.

INTRODUCTION

Area Description

The Owlshead Mountains Wilderness Study Area encompasses about 165 square miles (about 105,000 acres) at the northern edge of San Bernardino County, California (fig. 1). The area lies within the Confidence Hills, Leach Lake, Quail Mountains, and Wingate Wash 15-minute quadrangles and is about 43 mi northwest of Baker and about 26 mi east of Searles Lake, California. The area is bounded on the north and east by Death Valley National Monument, on the west by Mojave Range B of China Lake Naval Weapons Center, and on the south by Fort Irwin Military Reservation.

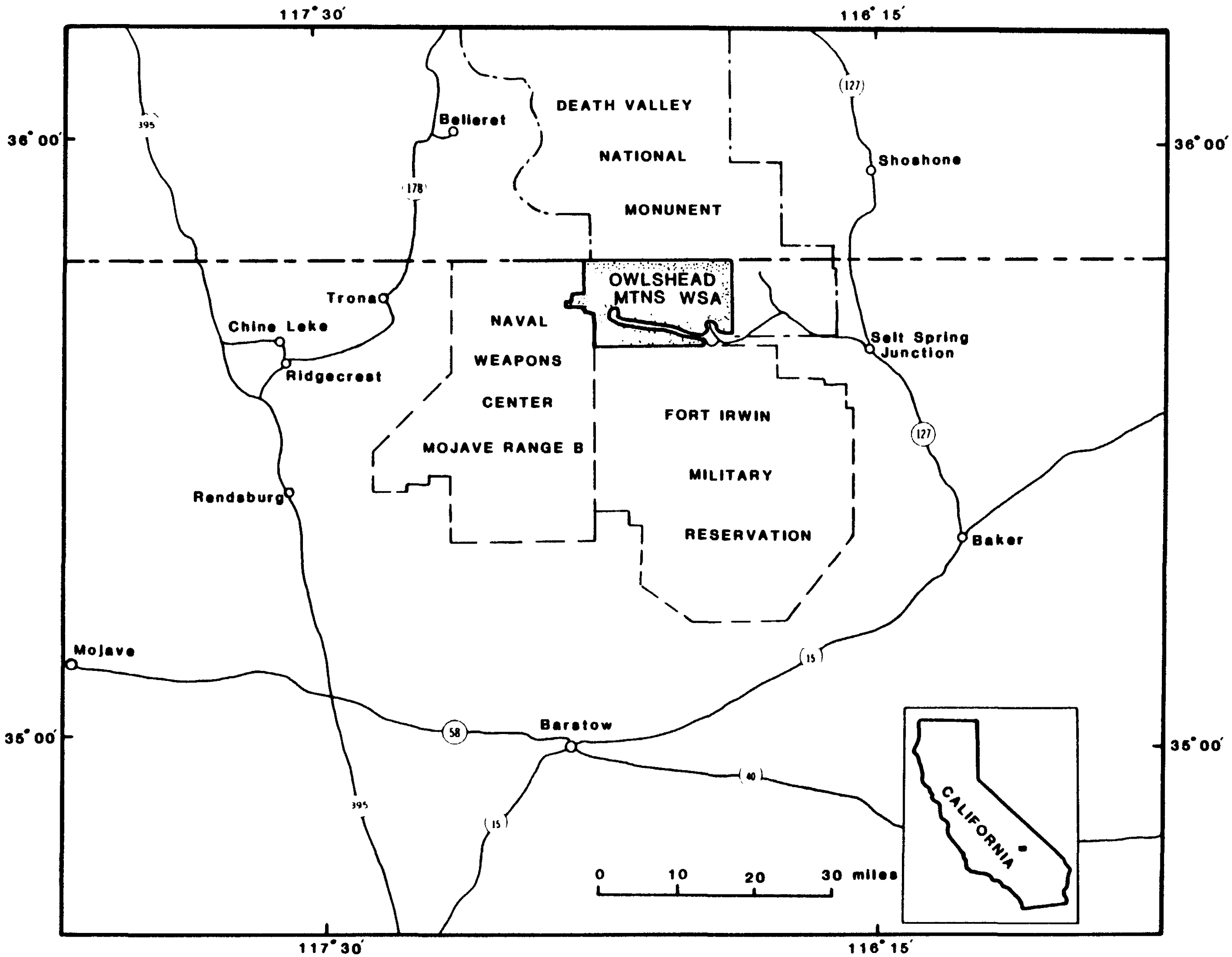

Figure 1. -- Index map showing location of Owlshead Mountains Wilderness Study Area, (CDCA-156), San Bernardino County, California.

The Owlshead and Quail Mountains together form a roughly circular pattern with the Quail Mountains being the southern edge and the Owlshead Mountains being the east, north, and west sections. One narrow, elongate, and two broad, nearly north-south trending, valleys divide the study area portion of the Owlshead Mountains into four nearly separate ranges which also trend nearly north-south. It is convenient to refer to these ranges informally as, (from west to east) the western range, the Lost Lake range, the Owl Lake range, and the eastern range.

The terrain in the study area ranges from flat playas and gently sloping alluvial fans and pediments to moderately steep hills, ravines, and escarpments. Elevations range from 600 ft at the northeast corner of the study area to 5103 ft near the area's southwestern corner. Drainage in most of the study area discharges onto Lost Lake and Owl Lake playas. The climate in the study area is arid, with a wide range of temperatures, and variable but commonly strong winds. Water is extremely scarce. There are no year-round streams in or near the area and only three year-round springs, each of very low volume (Owl Hole Springs, Quail Spring, and Hidden Spring). Vegetation is sparse, consisting mostly of scattered creosote bush, incienso, burroweed, desert holly, some small cacti and other small plants, with Joshua Trees in the highest parts of the Quail Mountains.

The wilderness study area can be reached from Salt Spring Junction on California Highway 127 by following an improved dirt road for about 13 mi toward the southern end of Death Valley National Monument, then turning southwest for about 10 mi to Owl Hole Springs on a graded dirt road. The road continues west about 16 mi beyond Owl Hole Springs to a microwave repeater site near the western edge of the study area. Connecting dirt roads to Wingate Wash and Hidden Springs via Long Valley, and south to Leach Lake from Owl Hole Springs, enter restricted military reservations and are blocked by locked gates at the reservation boundaries.

Previous Studies

Early geologic reports which discussed the Owlshead Mountains were concerned with manganese mining activity (Jenkins and others, 1943; Trask and others, 1950). Areal geology was summarized by Noble and Wright (1954) and later on the Trona sheet (scale 1:250,000) of the Geologic Map of California (Jennings and others, 1962). Gastil and others (1967) studied the effects of intrusion of Mesozoic adamellite into Precambrian gneiss, and the area's structural position at the intersection of the Death Valley and Garlock fault zones was discussed by Wright and Troxel (1967). The igneous rocks in the southeastern Owlshead Mountains near the New Deal and Black Magic mines were studied in detail by Calzea (1974).

Present Study

Fieldwork for this study was conducted by the U.S. Bureau of Mines in 1982 and by the U.S. Geological Survey in 1982 and 1983. The studies included reconnaissance geologic mapping and geochemical sampling of stream-sediments and bedrock by the Geological Survey, and examination and evaluation of individual mines, prospects, and mineralized zones by the Bureau of Mines. Mining claim records of San Bernardino County and of the U.S. Bureau of Land Management were searched for mining claims located in and adjacent to the study area. All known mines, prospects, and mineralized areas in and adjacent to the area were examined, sampled, and mapped, as necessary.

Sampling by the Bureau of Mines consisted of 140 grab and chip samples of rock. All were checked for radioactivity and fluorescent minerals. At least one sample from each locality was analyzed by semiquantitative spectrographic methods. Samples with anomalous concentrations of certain elements and those with visible metallic minerals were analyzed by quantitative atomic-absorption, colorimetric, or X-ray fluorescent methods. Massive quartz deposits with potential for industrial silica resources were analyzed for silica, aluminum, and iron content. Clay deposits were sampled and tested for ceramic properties. Analytical data for the samples collected by the Bureau, and a summary report (McMahan and others, 1984) are on file at the U.S. Bureau of Mines Western Field Operations Center, Spokane, Washington.

Geochemical samples collected by the Geological Survey consisted of bedrock grab-samples, stream-sediment samples, and heavy-mineral concentrate samples of stream sediment.

GEOLOGY

The oldest rocks in the Owlshead Mountains are Precambrian schist and gneiss, which crop out along the northeastern and eastern edges of these mountains, north of and at the eastern boundary of the wilderness study area. Gray, tan, and white calcitic and dolomitic marble is exposed mainly in the southeast corner of the area, but also in one small area west of Lost Lake. The depositional age of this unfossiliferous marble is uncertain. Noble and Wright (1954) considered the marble to be Precambrian in age, but it is assigned only a pre-Mesozoic age in this report, following questions raised by Calzea (1974).

A diverse assemblage of Mesozoic plutonic rocks includes fine-grained quartz diorite, mildly altered medium-grained hornblende biotite quartz diorite and diorite, fine-grained hornblende biotite granodiorite and adamellite, medium-grained biotite granite, and coarse-grained leucocratic biotite adamellite. The strikingly uniform coarse-grained leucocratic biotite adamellite underlies most of the eastern range, and much of the Owl Lake and western ranges of the Owlshead Mountains. Other granitoid lithologies (granodiorite, quartz diorite, and diorite) crop out in the western and eastern ranges and in the Quail Mountains, but are volumetrically minor. Small bodies of medium-grained quartz diorite near Quail Spring and Hidden Spring are associated with mineralized veins.

Volcanic and volcaniclastic rocks of Miocene age (Davis and Fleck, 1977) underlie much of the Quail Mountains and the Lost Lake, Owl Lake, and western ranges of the Owlshead Mountains. The volcanic rocks are mostly agglomerate, lava flows, and pyroclastic rocks but some, including most of the volcanic rocks in the western range of the Owlshead Mountains, were emplaced as hypabyssal intrusions. Compositionally, the volcanic rocks are mostly andesite, but also include basaltic andesite, basalt, dacite, and very minor rhyolite. The unconformity that separates the volcanic and volcaniclastic rocks from the underlying granitoid rocks exhibits considerable local relief.

Large portions of the study area are covered by alluvial deposits. Tertiary and(or) Quaternary fanglomerate is composed largely of Tertiary volcanic rock but locally contains granitoid debris, schist, quartzite, and rare coarse-grained gneiss. Some fanglomerate deposits contain granitoid blocks to 30 ft across. Uplifted and tilted Tertiary and(or) Quaternary bentonitic lacustrine deposits occur south and southeast of Owl Hole Springs. Active sedimentation is building broad fans and bajadas of sand and gravel, and is depositing silt and clay on Lost and Owl Lakes (dry) and a few minor playas.

Mild to intense hydrothermal alteration has affected rocks in some areas. Andesite, dacite, and adamellite in most of the southern half of the western range is strongly altered. Alteration is so intense in the eastern part of the Crystal Hills (pl. 1, area A1) that some of the andesite bedrock has been transformed into multicolored mounds of mud.

GEOCHEMICAL STUDIES

Sampling

The geochemical samples collected by the Geological Survey consist of 157 stream-sediment grab samples, 157 heavy-mineral concentrates from stream sediments, and 236 rock samples. The sediments contain material derived from bedrock units and surficial deposits. In arid environments such as that of the study area, scavenging by organic material is minimal. Sediment sample sites were selected to test bedrock areas. Large alluvial areas were not sampled. The drainage basins sampled cover areas ranging from a fraction of a square mile to several square miles. All rock and sediment samples were analyzed for 31 elements by a semiquantitative emission spectrographic method (Grimes and Marrinzino, 1968). Many rock samples were also analyzed for antimony, arsenic, bismuth, cadmium, gold, and zinc by atomic-absorption spectrophotometry (Ward and others, 1969), for mercury by a flameless atomic-absorption technique (Vaughn and McCarthy, 1964), and for tungsten by a colorimetric method (Welsch, 1983). Probably because of the high determination limit (10 ppm) for gold determined by the semiquantative spectrographic technique, gold was not detected in any stream-sediment grab or concentrate samples.

To obtain heavy-mineral concentrate samples, stream sediment was sieved, and then wet-panned to remove most of the quartz, feldspar, and clay-sized minerals. The less dense grains which 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 and ore-related elements (Lovering and McCarthy, 1978). This procedure lessens the effect of variation in sedimentary dilution and effectively enhances analytical sensitivity for some elements to the point where their concentrations can be measured by semiquantative spectrographic methods, even if they occur in only small amounts.

A sample is considered to be geochemically anomalous when concentrations of one or more ore-related elements are greater 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) 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, percentile scores, and enrichment relative to general crustal abundances.

Geochemical Data

The most pronounced pattern of anomalous values in sediment samples occurs in the western range of the Owlshead Mountains. These anomalies occur in an area east of the range crest, and from about one mi south to about two mi north of the Kennedy Boys Mine (pl. 1, area A2). Sediment grab sample from all twelve of the sites sampled in this area have detectable silver, ten sites have anomalous lead, nine have anomalous molybdenum, seven have anomalous manganese, and six have anomalous zinc. Heavy-mineral concentrate samples from the same sites show a similar pattern with anomalous lead at nine sites, anomalous molybdenum at six sites, tin at six sites (all in the southern half of area A2), and silver at two sites. Rock samples from fifteen sites within this area were analyzed. Most samples were for background determination on rock with no visible mineralization, but two sites were at workings of the Kennedy Boys Mine. Seven rock-sample sites had no anomalous values. Anomalous values occurred at five sites for molybdenum, at five for silver, at four for lead, at three for cadmium and copper, and at two for manganese, gold, tin, and mercury. Multi-element anomalies occurred at almost all sites for all three sample media. The highest values and highest numbers of anomalous elements per site were found at the Kennedy Boys Mine and in the immediate vicinity.

A second distinctive pattern of geochemical anomalies in sediment samples occurs in a roughly elliptical area in the Quail Mountains (pl. 1, area A5). Sediment was sampled at twenty sites within this area. Sediment grab samples yielded anomalies for barium at eleven sites, for manganese at nine sites, for mercury at 8 sites, for zinc at four sites, and for copper, lead, and silver at one site each. Sediment concentrate samples from these same sites yielded barium anomalies at sixteen sites, tin at six sites, lead at four sites, and molybdenum and silver at one site each. Gold was not observed during visual inspection of mineral concentrates from this area. Background rock samples of andesite from several sites within this area contained anomalous antimony,arsenic, and(or) mercury. Rock samples from workings at the Burro Lake and Quail Spring properties contained anomalous gold, silver, copper, lead, mercury, and molybdenum.

Sediment samples from several closely-spaced sites along the southern border and 1.5 mi west of the southeast corner of the study area, showed mild to pronounced multi-element anomalies. Grab samples from three sites contained moderately anomalous values for lead (3 sites), tin (2 sites), zinc (2 sites), and mercury (1 site). Concentrate samples showed anomalies at all five sites sampled in this area, including lead (5 sites), molybdenum (4 sites), tin (4 sites), tungsten (2 sites), barium (1 site), and manganese (1 site).

The sediment data have no other pronounced, clustered, multi-element anomalies. Barium values in concentrate samples are marginally anomalous at most sites west of the crest of the western range, in the Quail Mountains, and at three sites in volcanic rocks south of the Owl Lake Fault. Concentrate sample data also indicate that the leucocratic adamellite (Mzad) in the Owl Lake and eastern ranges has a thorium background generally above that of the rest of the study area. Both of these patterns probably reflect relative background levels in bedrock, rather than potentially economic mineral enrichment. No uranium analyses are available, but scintillometer readings made throughout the area failed to detect appreciable variation from the consistent and very low background level of gamma-ray radiation. Weakly anomalous values for mercury and molybdenum in sediment grab samples occurred at several sites in the Crystal Hills and the western range. Some of the rock background samples from these two areas contain anomalous concentrations of arsenic, cadmium, molybdenum, and(or) silver. These areas have uneven but locally strong hydrothermal alteration.

Five scattered sites have multi-element anomalies in sediment grab samples. High values occur for cobalt, copper, lead, manganese, mercury, molybdenum, tin, and zinc. Two of these sites are near mine workings (pl. 1, sites M15, M19); one is in the central part of the Owl Lake range, and the other two are south of the Owl Lake Fault, about five mi west of Owl Hole Springs. Sediment was analyzed from three sites near the Hidden Spring workings (pl. 1, site M30). No elements were anomalous in the grab samples and only barium and tin had high values in concentrate samples from this area. Rock samples from the dump and workings at site M30 (pl. 1) were anomalous in gold (28-280 ppm), silver (20-100 ppm), copper, lead, mercury, bismuth, and molybdenum.

The iron-manganese ores exposed near the southeastern corner of the study area (pl. 1, area A6) are geochemically complex. Besides iron and manganese, samples of these ores are commonly weakly to moderately anomalous in four to twelve other elements from the group antimony, arsenic, beryllium, cadmium, copper, gold, lead, mercury, silver, tin, tungsten, and zinc.

MINES AND MINING HISTORY

Most mining and prospecting activity in and near the study area has focused on two types of deposits: base- and precious-metal deposits, and iron-manganese deposits. Claims for both types of sites had already been established by 1890. Between 1886 and 1970, 926 mining claims (825 lode and 101 placer claims) were recorded for locations in or adjoining the Owlshead Mountains Wilderness Study Area. Many of these claims are relocations or over-stakings of older claims. According to Bureau of Land Management records, eight mining claims adjacent to the study area and one claim within the area (the Golden Betty "pumicite" prospect at Quail Spring) were classified as active in 1982, when the Bureau's search of records was conducted. Recent work at the Golden Betty prospect has probably consisted only of minimal assessment work. Active re-evaluation of other properties in the Quail Spring area began in 1983 under new ownership. The mineral target there is gold, and plans for bulk sampling and(or) drilling were being made in early 1984. Iron was extracted and shipped from the Ellie Iron Mine, just outside the study area boundary, until May 1982.

Historical Production Within the Study Area

Intermittent production from deposits in and adjacent to the wilderness study area was recorded from about 1908 until 1982. A small stamp mill (the Lone Star Mill) already existed one-half mi north of Quail Spring in 1907 suggesting that mineral production may have begun before this time, although no production has been recorded from the Quail Spring area.

Base- and(or) precious-metal claims have been staked in several areas in the western range of the Owlshead Mountains and in the Quail Mountains. Numerous prospect pits, some sizable underground workings, and the ruins of the Lone Star Mill attest to past activity, although little base- or precious-metal production was recorded for lode or placer deposits in the study area. Based on examination of the workings at the Kennedy Boys claims, it is estimated that 40 to 50 tons of material were removed, containing about 0.5 to 1.0 percent copper, 4 to 6 percent lead, 6 to 10 percent zinc, and 1.5 oz per ton silver. Combined production from other nearby prospects was probably less than 10 tons of ore containing minor amounts of gold and silver. Production of 117 short tons of ore containing 70.57 oz of gold, 20.75 oz of silver, and 118 lbs of copper, was recorded between 1928 and 1934 from workings in the vicinity of Hidden Spring (pl. 1, area A4). Some of the production from the Hidden Spring area may have been from sites outside the study area. There is no record of production from the Quail Spring-Burro Lake area (pl. 1, sites M27, M28), but measurement and sampling of 8 of the 25 workings there indicates probable production of about 430 tons of ore averaging 0.3 oz gold per ton and 0.09 oz silver per ton. Copper is also present. With the exception of one 90-ft shaft sunk in a dry wash near Quail Spring, no placer workings were found within the study area.

Manganese and iron lode claims in the area north of Owl Hole Springs (pl. 1, area A6) were located (and periodically relocated or restaked) during times of favorable metals prices and during World War II and post-Korean War stockpiling programs of the Federal Government. The Black Magic group (pl. 1, site M10), which lies within the wilderness study area, recorded a production of over 300 short tons of manganese ore in 1942. Small shipments were also made in 1953, 1954, and 1957. An air concentrator, now removed, was installed at the mine in 1958, although it is unlikely that concentrates were shipped. No other sites within the study area are known to have produced iron or manganese ore. Most manganese and iron production in the Owlshead Mountains was from workings just south of the study area.

A deposit in the Crystal Hills (pl. 1, area A1), at the western edge of the study area, contains magnesium sulfate (epsomite) and magnesium carbonate. These salts occur in surface efflorescences on outcrops of clay formed by intense alteration of Tertiary volcanic rocks. From 1922 to 1926, American Magnesium Co. attempted to develop the deposit, known as the Epsom Salt Works. The company mined epsomite from shallow surface workings, and shipped some material over a 30-mi-long monorail which extended westerly from the deposits to a station on the Trona Railroad south of Searles Lake. The operation proved unsuccessful, and the installations were dismantled about 1928.

One claim within the study area (Golden Betty prospect at Quail Spring, pl. 1, site M28) was classified as active in 1982. The claim is for "pumicite" but there is no evidence of production or significant development at this site. At least three quartz-rich pegmatite veins, intruding leucocratic adamellite in the western range of the Owlshead Mountains and in the Owl Lake range, between Lost and Owl dry lakes, were staked and prospected; presumably for industrial silica. No production is known from these claims and they could not be found for examination during this study. An area 4.5 mi west of Owl Hole Springs (pl. 1, site M24) contains elongate, gray to milky-white and orange-stained cavity fillings of chalcedony in altered andesite. These siliceous nodules have been energetically extracted by amateur mineral collectors as pedestrian-quality geodes and agate ("sagenite").

Mineralization and Production Adjacent to the Study Area

Metallic-mineral occurrences and resources adjacent to the Owlshead Mountains Wilderness Study Area include manganese, iron, and base- and precious-metal deposits. The most important of these, in terms of past production, are iron and manganese deposits northwest of Owl Hole Springs.

The Ellie Iron Mine (pl.1, site M12) is located just outside the study area's southern boundary, 2.5 mi northwest of Owl Hole Springs. The property, leased and operated by Jebco Inc. of Riverside, California, produced about 7,000 tons of ore at a rate between 500 and 1500 short tons per month between November 1981 and April 1982. Hematite ore was trucked to Victorville, California, for use in portland cement manufacture. Operations ended in May 1982 due to decreasing demand for cement, although the company had hopes of reopening the mine at an increased rate of production. Reserves at the Ellie Iron claims are estimated at 10 million short tons containing 54.3 percent iron. An additional 10 million short tons of ore can be inferred to extend into the study area.

The largest manganese producer in the vicinity of the study area was the New Deal Mine (pl. 1, site M19). Production from this mine between 1915 and 1956 amounted to about 4,000 long tons of ore containing 19 to 43 percent manganese. About 850 long tons containing around 27 percent manganese have been produced from the nearby Owl Hole Mine. Identified resources at the New Deal Mine are estimated at 130,000 long tons, containing 19 percent manganese.

Lode claims, presumably staked for base or precious metals, were located a few miles south and southeast of the study area in what is now the Fort Irwin Military Reservation. Other claims and claim groups were located near Hidden Spring (pl. 1, area A4). Some of the recorded 117 short tons of ore from the Hidden Spring area may have come from workings just outside the study area. This is the only recorded production that may have come from base- or precious-metal deposits that adjoin the study area.

Nonmetallic-mineral occurrences and deposits near the study area contain gypsum, bentonitic clay, and celestite. Interbedded gypsum and bentonitic clay occur northwest of Owl Hole Springs. Secondary gypsum (selenite) is widespread as crusts and precipitates within mudstone and in fan deposits in the vicinity of exposures of primary gypsum. Numerous lode and placer claims were staked on these occurrences, beginning in 1899 and continuing intermittently through 1954. There is no record of, or evidence of, production from these deposits, except for small pits dug for exploration and by mineral collectors seeking gypsum specimens.

In 1938 and 1939, claims for celestite (SrSO4) were staked northwest of Owl Hole Springs. The celestite occurs as concentrations and nodules in gypsiferous mud and fan deposits. There is no record of production.

Description and Classification of Individual Mineralized Sites

Locations of mines, prospects, and mineral occurrences in or near the Owlshead Mountains Wilderness Study Area are shown on plate 1 and information describing individual sites is summarized in table 1. More detailed information about individual sites, with maps of some workings, is included in a Bureau of Mines Open-File report (McMahan and others, 1984), available from the Bureau's Western Field Operations Center, Spokane, Washington.

Resources identified at mines, prospects, and mineral occurrences were classified in table 1 according to their potential for development. In an attempt to indicate relative resource potential, resources were categorized by estimating the return on investment for hypothetical production plans. Reserves are expected to provide enough positive cash flow to yield a reasonable profit. Marginal reserves would require no more than a 50 percent increase in commodity price, or equivalent technological change, to become reserves. Subeconomic resources would return at least 20 percent of the expenditure needed to produce them. Volumes of mineralized rock not expected to return at least 20 percent of anticipated production expenditure are classified as occurrences rather than as resources.

For mineralized sites where sufficient information is available to allow an estimate of mineral resource potential, the degree of favorability is indicated in table 1 as follows:

High potential — A mine or prospect for which there is a high favorability for existence of economic or subeconomic mineral resources of the commodities specified. High favorability, or potential, for existence of resources is based on the nature of known mineralization and on consistently favorable sample results and presence of geological conditions that favor resource accumulation. In some cases, identified resources of the specified commodities have been estimated, and(or) production of these minerals had been recorded.

Moderate potential — A mine or prospect for which moderate favorability for economic or subeconomic mineral resources of specified commodities is based on favorable sample results and the presence of geological conditions that favor resource accumulations.

Low potential — A locality for which samples yielded only partly or weakly favorable results, and geological conditions are permissive for accumulation of mineral resources. The term low is not synonymous with no potential. To the contrary, low potential signifies a favorablity for the specified commodities, although it is considered to be less than for localities having a moderate or high potential.

Mines, prospects, and mineral occurrences not classified as having high, moderate, or low potential have no recognized mineral resource potential on the basis of data gathered during this study. At many of these properties, data are insufficient to determine potential for mineral resources.

Table 1.--Mines, prospects, and mineralized occurrences in and adjacent to the Owlshead Mountain Wilderness Study Area
[*, outside study area; underlined site names indicates identified mineral resources or portential]

Map no. (fig.)	Name (commodity)	Workings	Resource data
M1	<u>Kennedy Boys Lead Mine</u> (zinc, lead, silver, copper)	Two sdits, 4 shafts, 8 pits and one bulldozer trench. The most extensive working is a 115-ft adit with 30 ft of drift snd a 33-ft shaft.	The area around these workings is underlain by leucocratic biotite adamellite, intruded by fine-grained aplite, quartz-porphyritic felsite, and minor mafic dikes. Most of the rocks show mild to moderate degrees of hydrothermal alteration. Thick veins of brown calcite cut the intrusive rocks, along with small quartz fisaure veins. Mineralization is partly in quartz veins but mainly in the brown carbonate which locally contains zones of concentrated galena and sphalerite, with minor pyrite, malachite, and azurite. An inferred subeconomic resource at the 115-ft-long adit contains 19,000 tons, averaging 2.6 percent zinc, 2.3 percent lead, 0.29 percent copper, 0.3 oz silver per ton, and containing a trace of gold. The mine area has moderate potential for additional zinc-lead-copper-silver resources.
M2	Unknown name prospect	One bulldozer trench 10 to 20 ft wide and 175 ft long, and three prospect pits.	A bleached, silicified, iron-oxide-stained zone in leucocratic biotite adamellite trends N. 60 E. and contains secondary quartz. The zone is 30 ft thick, 350 ft long and is exposed 50 ft vertically. A 20-ft chip sample collected across the altered zone contained trace amounts of gold and silver.
M3	Unknown name prospect	Bulldozer scrapings and claim monuments.	Two massive quartz-rich pegmatite zones 50 ft and 70 ft long, 30 ft and 20 ft wide, exposed as much as 16 ft vertically, cut leucocratic biotite adamellite. Fifty linear ft of chip sample contained trace amounts of gold and silver.
M4	Unknown name prospect	Claim monuments.	A silicified, blesched, and iron-oxide-stained zone 65 ft long and 10 ft wide, which includes quartz stringers, occurs in leucocratic biotite adamellite. A 10-ft chip sample across the altered zone contained trace amounts of gold and silver.
M5	Unknown name prospect	Claim monuments.	Three quartz-rich pegmatite lenses, the largest 8 ft acrosa, are in leucocratic adamellite. A composit grab sample from the three lenses contained trace amounts of gold and silver.
M6	Unknown name prospect	One pit 3 ft long, 2 ft wide, and 2 ft deep.	A quartz-rich pod 8 ft across is in leucocratic adamellite. A 3 ft chip sample contained trace amounts of gold and silver.
M7	Mineralized outcrop	None.	Silicified, bleached, iron-oxide-stained andesite is exposed as a mound 20 ft across. One random chip sample contained trace amounts of gold and silver.
M8	Mineralized outcrop	None.	A quartz pod occurs in dark green andesite with green and blue amygdule fillings. A grab sample of quartz contained trace amounts of gold and silver, and 0.5 percent tantalum.
M9	<u>Mineralized outcrop</u> (iron, manganese)	None.	Silicified marble has visible manganese and iron oxides. A grab sample contained 13.5 percent iron, 3.45 percent manganese, 17 percent silicon and 0.72 percent aluminum. This occurrence has low potential for additional iron-manganese resources.

Table 1.--Mines, prospects and mineralized occurrences in and adjacent to the Owlshead Mountain Wilderness Study Area--(continued)

Map no. (fig.)	Name (commodity)	Workings	Resource data
M10	Black Magic Mine (manganese, iron)	Five pits, 2 bulldozer trenches and a 2,460-ft-long tram line. By 1942, 302 tons averaging 34.8 percent manganese had been produced. There was small production in 1953, 1954, and 1957.	Breccia along a faulted marble-adamellite contact contains manganese and iron oxides. Nineteen samples totalling 230 linear ft were taken from mineralized zones ranging from 3 to 30 ft in thickness. An inferred subeconomic resource of 160,000 tons averages 9.2 percent manganese, 15 percent iron, 15 percent silicon, and 1.5 percent aluminum. The mine area has high potential for additional manganese-iron resources.
M11	Mineralized outcrop	None.	An altered, bleached and iron-oxide-stained shear zone in leucocratic adamellite is exposed for 70 ft along a canyon wall. The exposure is 6 ft high and trends N. 30° W. Gouge occurs in the center of the zone. A two-foot channel sample across the gouge contained trace amounts of gold and silver.
M12*	Ellie Iron Mine (iron)	Production pit 200 ft long, 50 ft wide, and 20 ft deep; and 35 to 40 prospect pits and adits. In 1978, the Bureau of Mines estimated that 250,000 tons of ferruginous material had been mined. Production from November 1981 to April 1982 was about 7,000 tons.	Iron oxide minerals occur as veins and replacement pods in marble, and as fillings in adamellite breccia, within an area approximately 4,000 ft long and 1,000 ft wide. Six out of eight Bureau of Mines chip samples and one grab sample of ore contained from 13.5 to 62.0 percent iron, and averaged 50 percent iron and 1.2 percent manganese, 8.03 percent silicon, and 1.05 percent aluminum. Data from a private company report (L. H. Loidolt, 1975) indicates that the ore averages 54.3 percent iron. As calculated by the owners, a total of 10 million tons of reserves are in the Ellie Iron Claims, adjacent to the study area. An additional 10 million tons can be inferred in extensions of the Ellie Iron deposit, for a total of 20 million tons of iron resources. The iron-mineralized zone extends into the study area; however, resources were not identified in the study area from surface exposures. Potential for additional iron resources in the study area is high.
M13	Mineralized outcrop (iron)	None.	Two east-west trending zones of brecciated marble and leucocratic adamellite 8 ft and 100 ft thick, are bounded and separated by 100 ft of adamellite. Iron and manganese oxides, calcite, and quartz fill breccia voids and locally replace breccia matrix. A chip sample across the 100-ft zone contained 9.6 percent iron and 1.96 percent manganese. A sample across the 8-ft zone had 22.5 percent iron and 0.56 percent manganese. Both samples contained traces of gold, silver, copper, lead, molybdenum, chromium, and titanium.
M14	Mineralized outcrop (iron)	None.	A zone of brecciated marble and adamellite, 50 ft thick and trending east-west, is bounded on the south by adamellite and on the north by marble. The breccia is filled and partly replaced by iron and manganese oxides, calcite, and quartz. A chip sample across the 50-ft zone contained 9.9 percent iron, 0.15 percent manganese, 20 percent silicon, and trace amounts of gold and silver.

Table 1.--Mines, prospects and mineralized occurrences in and adjacent to the Owlshead Mountain Wilderness Study Area--(continued)

Map no. (fig.)	Name (commodity)	Workings	Resource data
M15	Mineralized outcrop	None.	A 20-ft-thick granite dike intrudes marble. The dike is bleached and iron-oxide-stained. A chip sample across the dike contained trace amounts of gold and silver.
M16*	Unknown name prospect (manganese, iron)	Four pits and 3 adits totalling 184 linear ft. Based on inspection of the workings, past production is estimated to have been 375 tons of hand-sorted ore containing about 30 percent mangsnese.	A marble pendant in adamellite contains iron and manganese oxides as open space fillings in breccia and as replacements in marble. Four samples were taken. Three chip samples contained from 6.35 to 11.1 percent manganese and from 31.0 to 40.5 percent iron; one sample of hand-sorted material contained 27.0 percent manganese and 1.7 percent iron. This subeconomic resource has sn estimated 4,000 tons containing an average of 7.2 percent manganese and 34 percent iron. The prospect has high potential for additional manganese-iron resources.
M17*	Unknown name prospect	One shallow pit 20 ft long and 3 ft wide.	A quartz vein in granite is 3 ft thick. A chip sample across the vein contained trace amounts of gold and silver.
M18*	Unknown name prospect	One pit 6 ft long, 3 ft wide, and 3 ft deep.	Granite 100 ft from a marble contact has a 3-ft-thick zone of gouge containing an aplite dike 1 ft thick. A chip sample across the dike and gouge zone contained a trace of gold and silver.
M19*	New Deal Mine (manganese, iron)	Two shafts 100 ft and 67 ft deep with a total of 280 ft of crosscut and drift; one pit 120 ft long, 40 ft wide and 20 ft deep. Total production from 1916 to 1956 was about 4,000 tons containing from 19 to 43 percent manganese.	Breccia along a faulted granite-marble contact contains manganese and iron oxides. Nine 5-ft chip samples across a 45-ft face contained an average of 19.0 percent manganese, 8.8 percent iron, 13.7 percent silicon, and 3.53 percent aluminum. A sample of the mineralized breccia 1,320 ft northwest of the main workings contained 15.3 percent manganese and 8.0 percent iron. This subeconomic resource contains an inferred 130,000 tons averaging 19 percent manganese. The mine srea has high potential for sdditional manganese resources.
M20*	Unknown name prospect (strontium sulfate)	Two prospect pits 3 ft across and 2 ft deep.	Celestite ($SrSO_4$) nodules up to 5 in across occur with manganese-encrusted gypsum crystals in a solution channel 40 ft long, 8 ft wide, and 3 ft deep in fanglomerate. The gypsum (selenite) is a secondary mineral which forms crusts within and on the surface of the fanglomerate snd which probably precipitated from ground water.
M21*	Unknown name prospect (gypsum)	Numeroue small pits, cuts and trenches dug by mineral collectors. No commercial production.	The occurrence contains 800,000 tons of bedded gypsum and 10 million tons of secondary gypsum (selenite). The commercial potential of this deposit is low because the selenite cleaves rather than breaking down finely during grinding, and is therefore not suitable for wallboard or plaster. The prospect has low potential for sdditional gypsum resources. It is a source of selenite (gypsum) crystals for mineral collectors.
M22*	Owl Hole Mine (manganese)	One shaft, 3 adits and 3 pits. Production from 1916 to 1918 and in 1929 totalled 852 tons containing 40 percent mangsnese.	Veins and pods of manganese oxide are in limestone and grsnite breccia along a granite-limestone fault contact. Five samples contained a weighted average of 27 percent manganese, 5.4 percent iron, 22 percent silicon, 2.0 percent aluminum and less than 0.02 percent phosphorus. This subeconomic resource is estimated at 79,000 tons containing 27 percent manganese. The mine area has a high potential for additional manganese resources.
M23*	Unknown name prospect (clay)	Two sdits and one sloughed pit.	Bentonitic clay in an area of weathered, indurated volcanic ash. Firing tests of 2 samples indicate thst the clay is not suitable for structural clay products because of high shrinkage.
M24	Unknown name prospect (agste)	Numeroue small, shallow pits and trenches totalling as much as 500 linear ft.	Weathered, amygdaloidal andesite with patchy, mild to intense alteration, contains milky-white and blueish chalcedony, calcite, and clays in fractures and as amygdules. The deposit is of significance only for agate specimens.

Table 1.--Mines, prospects and mineralized occurrences in and adjacent to the Owlshead Mountain Wilderness Study Area--(continued)

Map no. (fig.)	Name (commodity)	Workings	Resource data
M25	Mineralized outcrop	None.	Altered volcanic breccia covers a 3.6-acre area. The breccia is bleached and in part opalized. Three chip samples collected across the altered zone contained no significant mineral values.
M26	Mineralized outcrop	None.	Dark gray andesite that is jointed, fractured and highly altered is exposed for 60 ft in a cliff. A sample across the zone contained trace gold and .01 oz silver per ton.
M27	Burro Lake Prospect (gold, silver, and copper)	Eleven pits, four trenches, three shafts, and three adits.	Gold and silver occur in gouge zones and quartz veins in hornblende biotite quartz diorite. Twenty-one chip and channel samples from mineralized zones contained a trace to 0.179 oz gold and a trace to 0.114 oz silver per ton. Three mineralized zones averaging 1.7 ft thick contained an average of 0.16 oz gold and 0.08 oz silver per ton. Four samples from stockpiles and mine dump contained from 0.003 to 0.417 oz gold and 0.003 to 0.144 oz silver per ton. Copper values in these samples range from 0.02 to 4.8 percent. This prospect has a high potential for gold, silver, and copper resources.
M28	Quail Spring Prospect includes Golden Betty prospect (gold, silver, copper)	Three pits, one trench and one shaft.	Gold and silver occur in gouge zones and quartz veins in hornblende biotite quartz diorite. Bentonitic clay occurs in an exposure of weathered volcanic ash (Golden Betty). Four chip samples representing 11.5 linear ft were taken across mineralized gouge and veined zones; one sample representing 20 linear ft was taken across the bentonitic clay occurrence. A placer shaft, 90 ft deep in alluvium, was not sampled. Samples from mineralized zones contained a trace to 0.072 oz gold and a trace to 0.032 oz silver per ton. Fire tests on the bentonitic clay proved that the material is unsuitable for structural clay products because of high shrinkage. This prospect has a moderate potential for additional gold and silver resources.
M29	Boundary Prospect (gold, silver)	Two shafts, two adits and two pits.	Gold and silver occur in gouge zones and quartz veins in hornblende biotite quartz diorite. Ten samples representing 38.8 linear ft were taken across mineralized zones; and three samples were taken from stockpiles. Nine samples from mineralized zones contained from trace to 0.397 oz gold per ton; ten samples contained 0.003 to 0.125 oz silver per ton. Stockpile samples contained from 0.007 to 0.017 oz silver per ton. This prospect has a high potential for additional gold and silver resources.
M30	Hidden Spring prospect (gold, silver, and copper)	One shaft 25 ft deep and 4 shallow pits.	Quartz veins and gouge zones in hornblende biotite quartz diorite were explored for copper, gold and silver. Two veins are exposed on the surface. A 3-ft chip sample across the vein in the shaft collar contained 0.17 oz gold per ton, 0.23 oz silver per ton, and 0.6 percent copper. A 2-ft chip sample across a vein in a shallow pit contained 0.03 oz gold per ton, 0.02 percent copper, and 0.01 oz silver per ton. A grab sample of a stockpile near the shaft contained 0.80 oz gold per ton, 0.95 percent copper, and 0.55 oz silver per ton. A select sample of mineralized quartz from the stockpile contained 1.56 oz gold per ton, 4.8 percent copper, and 2.13 oz silver per ton. This prospect has moderate potential for additional gold-silver-copper resources.
M31	Epson Salts Mine (epsomite)	Shallow surface workings and one water-filled shaft.	Magnesium sulfate (epsomite) and magnesium carbonate occur as efflorescences on the surface of clayey outcrops of highly altered Tertiary volcanic rocks. Site has moderate potential for additional subeconomic epsomite resources.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The assessment of mineral resource potential in the Owlshead Mountains 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 direct evidence of resource accumulation.

Six areas judged to have at least low mineral resource potential were identified on the basis of the nature and distribution of known mines, prospects, and occurrences, and on the results of reconnaissance geochemical sampling, and of field observations. These areas are outlined on plate 1 and are discussed below along with attributes which characterize them, potential commodities, types of permissible or suggested deposits, and resource-potential favorability factor (low, medium, or high).

Mineral Resource Potential Area A1

An area of low hills (the Crystal Hills) in the westernmost part of the study area (pl. 1, area A1) was mined for magnesium sulfate (epsomite) and magnesium carbonate between 1922 and 1926. The salts occur as efflorescences on clay derived by locally extreme alteration of Tertiary volcanic rocks, and were mined in shallow surface workings. Marginally anomalous barium concentrations are the only high values in sediment concentrate samples from area A1, but sediment grab samples contained low-level anomalies for mercury and molybdenum, and rock samples contained anomalous amounts of arsenic, cadmium, and molybdenum (one sample). The boundaries of area A1 enclose the areas of strongly altered bedrock and sites of anomalous geochemical samples.

Area A1 contains undetermined amounts of subeconomic magnesium salts deposits, and has low mineral resource potential for undiscovered deposits of magnesium salts. The strong hydrothermal alteration and geochemical anomalies, probably related to similar features just to the east, in the western range of the Owlshead Mountains, suggest a low mineral resource potential for buried, porphyry-type molybdenum deposits.

Mineral Resource Potential Area A2

Resource potential area A2 is located in the western range of the Owlshead Mountains (pl.1, area A2). It is underlain mainly by leucocratic biotite adamellite, with lesser granodiorite, andesite, dacite, and minor marble. The adamellite has been locally intruded by aplite, rhyolite, and quartz-porphyritic felsite. Hydrothermal alteration (mainly argillic and sericitic alteration) has affected the rocks locally, and is mild to strong throughout the southern half of the area. Minor amounts of lead, zinc, copper, and silver were produced from sulfide-bearing calcite veins at the Kennedy Boys Mine (pl. 1, site M1) in the early 1900's. The Kennedy Boys Mine has inferred subeconomic resources of at least 19,000 tons of ore containing zinc, lead, copper, silver, and traces of gold. Geochemical samples of rock from the workings also contain anomalous concentrations of antimony, cadmium, mercury, and tin.

Sediment grab samples from all sites and concentrate samples from all but one sediment sample site within area A2 contained anomalous levels of one to five of the elements lead, manganese, molybdenum, silver, tin, and zinc. Almost all sites had high values for three or more elements. Background rock geochemical samples contained scattered anomalous values of silver, molybdenum, beryllium, copper, and lead.

The boundary of resource area A2 outlines the area of anomalous geochemical sediment samples. There is moderate resource potential for additional lead, zinc, copper, and silver in carbonate vein deposits. The presence of extensive hydrothermal alteration and the persistence of geochemical anomalies, especially for molybdenum, suggests that the area has low mineral resource potential for molybdenum in buried porphyry deposits.

Mineral Resource Potential Area A3

Mineral resource potential area A3 includes the southern end of the western range of the Owlshead Mountains, and the adjacent northern-most part of the Quail Mountains (pl. 1, area A3). Rocks in most of this area are mildly to strongly hydrothermally altered. Three small prospects (pl. 1, sites M2, M3, M4) comprise the only mineral workings in the area. Chip samples of altered rock and quartz from these sites yielded detectable gold and silver. Three of the eight stream-sediment sample sites in area A3 yielded multi-element anomalies in grab samples. A site just south of prospect M4 contained marginally anomalous mercury, molybdenum, and thorium. Two sites near the northern end of the area contained anomalous levels of barium, lead, manganese, and molybdenum, and of molybdenum and silver, respectively. Concentrate samples contained marginally anomalous levels of barium for sites along the western edge of area A3.

The hydrothermal alteration in area A3 is continuous with that in the southern part of area A2 but, because of the pronounced difference in geochemical expression, the areas have been outlined separately. The boundary of area A3 was drawn to include hydrothermally altered rock not part of area A2. The alteration in areas A1, A2, and A3 is probably related to the same hydrothermal system or systems.

Based on the extensive alteration, known weakly mineralized sites, and generally low geochemical background, area A3 has low potential for gold or silver in hydrothermal vein or disseminated deposits. Considered in conjunction with the evidence in adjacent areas A1 and A2, the broadly distributed alteration and few molybdenum anomalies suggest that there is low mineral resource potential for molybdenum in buried, porphyry-type deposits.

Mineral Resource Potential Area A4

A small body of hornblende-biotite quartz diorite is exposed in and just west of the southwestern corner of the study area, southeast of Hidden Spring (pl. 1, area A4). Most of the quartz diorite is only mildly altered but thin zones of fractured and sheared rock are more strongly altered. Quartz veins cut the quartz diorite, mainly following these shear zones. The quartz veins were not observed in adjacent volcanic rock. Samples of the quartz contain visible copper minerals and up to 1.56 oz per ton gold, 2.13 oz per ton silver, and 4.8 percent copper. Samples of mineralized quartz veins and altered gouge also yielded anomalous levels of bismuth, lead, mercury, and molybdenum. From 1928 to

1934, recorded production from this area totaled 117 short tons of ore containing 70.57 oz gold, 20.75 oz silver, and 118 lbs copper. Some of this production may have been from workings outside of the study area boundary. Stream-sediment grab samples from three sites in the vicinity did not contain anomalous levels of any elements. Heavy-mineral concentrate samples from the same sites were weakly anomalous in barium and contained 30 ppm tin. This area has moderate mineral resource potential for gold, silver, and copper in veins and disseminated in sheared and altered zones.

Mineral Resource Potential Area A5

Hornblende-biotite quartz diorite very similar to that near Hidden Spring, is exposed in several places in the Quail Mountains in the vicinity of Quail Spring (pl. 1, area A5, sites M27, M28, M29). The quartz diorite is cut by fault zones which were invaded by quartz and minor calcite veins containing gold, silver, and copper. Extensive prospecting and mining activity began before 1900 and probably continued into the 1930's. No production was ever recorded from this area but estimated production, based on examination of the size and grade of workings, is over 430 tons of ore with a weighted average of 0.3 oz gold and 0.09 oz silver per ton. Chip samples of veins, and of sheared and altered quartz diorite contained up to 0.4 oz per ton gold, 0.12 oz per ton silver, and 0.08 percent copper. Lead, manganese, mercury, and molybdenum occur in anomalous amounts in some samples of veins and sheared quartz diorite from the workings.

Grab and concentrate samples of stream sediment from the vicinity of the mine workings do not contain anomalous gold, silver, or copper and no free gold was observed during visual inspection of the heavy-mineral concentrates from this area. Data from sediment sample sites within several miles to the west, north, and east of the Burro Lake prospect do form a distinctive geochemical pattern, however. All but three of the twenty sediment-sample sites within area A5 contained anomalous levels of barium, manganese, or mercury, along with several anomalous values of silver, copper, lead, and zinc. Most sites are anomalous in two or three elements. Concentrate samples from most of these sites are anomalous in barium, with fewer anomalous values of tin, lead, and molybdenum. Background rock samples from throughout this area and away from the mine workings are anomalous in one or more of the elements antimony, arsenic, mercury, or silver. The outlines of mineral resource potential area A5 were drawn to include the area of anomalous geochemistry, as well as the known deposits.

Based on the nature of the prospected deposits and associated geochemical values, this area has moderate to high mineral resource potential for additional gold, silver, and copper in hydrothermal veins and disseminated in shear zones associated with quartz diorite bodies. The broader geochemical pattern suggests that there is low mineral resource potential for lead, silver, zinc, and possibly other base metals and(or) gold in buried hydrothermal deposits.

Mineral Resource Potential Area A6

Deposits of iron and manganese oxides occur in a belt running from the vicinity of Owl Hole Springs (pl. 1, site M22) to the area of the Black Magic Mine (pl. 1, site M10). These deposits are replacement veins and pods in marble, veins in breccia and fault zones, and replacement of Tertiary fanglomerate matrix. Most ore is found in the vicinity of contacts between leucocratic adamellite and marble. The ratio of iron to manganese varies markedly throughout the mineralized belt. In the Black Magic area alone, samples ranged from 40 percent manganese and 0.5 percent iron to 2.5 percent manganese and 54 percent iron.

About 4000 long tons of ore containing 19 to 43 percent manganese have been produced from the New Deal Mine, and about 850 long tons of ore containing about 27 percent manganese were produced from the Owl Hole Mine, both just outside the study area. Somewhere between 300 and 350 tons of ore containing about 33 percent manganese were produced from the Black Magic Mine, within the study area. Estimated subeconomic resources at the Owl Hole and New Deal Mines are 79,000 long tons containing 27 percent manganese and 130,000 long tons containing 19 percent manganese respectively. Inferred subeconomic reserves at the Black Magic Mine are 160,000 tons containing 9.2 percent manganese and 15 percent iron. At the Ellie Iron Mine, identified reserves are estimated to be 10 million short tons containing 54 percent iron. An additional 10 million tons of ore are inferred to lie in extensions of the deposit within the study area.

Based on the nature and distribution of known deposits, and on the distribution of suitable host-rock sites, this area has high mineral resource potential for additional buried iron-manganese resources in vein and replacement deposits, both inside and outside the study area.

Other Resources

There is no indication of the existence of economic mineral deposits, other than those discussed above, within the Owlshead Mountains Wilderness Study Area. The study area contains substantial amounts of sand and gravel, but the large distances to market precludes their development. No radioactive minerals, fossil fuels, or geothermal resources were found in the Owlshead Mountains Wilderness Study Area. Absence of recognizable indications of mineralization or of the effects of potentially mineralizing processes does not absolutely preclude the existence of such deposits. The probability of significant mineral deposits outside the six areas of potential outlined above, however, must be considered to be slight.

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