DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP-MF-1196-C

MINERAL RESOURCE POTENTIAL OF THE KING RANGE AND CHEMISE MOUNTAIN INSTANT STUDY AREAS HUMBOLDT AND MENDOCINO COUNTIES, CALIFORNIA

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Mineral Surveys
Related to Bureau of Land Management
Instant Study Areas

In accordance with the provisions of the Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976), the Geological Survey and the Bureau of Mines have conducted mineral surveys on certain areas, which formerly had been identified as "natural" and "primitive" areas prior to November 1, 1975. This report discusses the results of a mineral survey of the King Range and Chemise Mountain Instant Study Areas, Humboldt and Mendocino Counties, California.

Summary

The potential for economic development of energy-related or metallic mineral resources in the King Range and Chemise Mountain Instant Study Areas is low to moderate as indicated by geologic, geophysical, and geochemical investigations.

No oil or gas seeps or coal seams were detected within the King Range or Chemise Mountain Study Area. The low porosity and permeability of the Franciscan sandstones that underlie these areas indicate a very low potential for oil or gas. The geothermal resource potential of these areas also is low.

Minor manganese resources occur adjacent to the southeast corner of the King Range Instant Study Area near Queen Peak. The manganese forms small stratabound deposits associated with radiolarian chert and pillow basalt. The known deposits are too small and the manganese too low in concentration for further economic exploitation. Similar manganese mineralization may be within the belt of melange in the southeast corner of the King Range area and within the Chemise Mountain Instant Study Area, but economic deposits are unlikely.

Although there has been historical base- and precious-metal exploration activity north of the King Range in the Mattole River drainage, our geologic and geochemical field data indicate almost no gold potential and low potentials for lead, zinc, copper, and silver. During this investigation, one high-grade vein and several minor veins containing lead, zinc, copper, and silver were discovered at Point Delgada immediately south of the King Range Instant Study Area. The vein mineralization is Miocene and cuts Cretaceous basalt flows, dikes, flow breccia, and younger overlying sedimentary rocks of the King Range. The vein mineralization at Point Delgada could be remobilized from more extensive unexposed stratabound base-metal mineralization at depth. Traces of lead and zinc detected within the King Range Instant Study Area may have similar stratabound or vein origins, but no resource potential is indicated. Minor copper mineralization with associated lead, zinc, and manganese anomalies within the Chemise Mountain Instant Study Area is of low economic potential because of the shearing, isolation, and lenticularity of the basaltic and cherty rocks within the melange that hosts this mineralization.

INTRODUCTION

Purpose and scope

This report summarizes the mineral resource potential of the King Range and Chemise Mountain Instant Study Areas in northwestern California, based on field investigations conducted by the U. S. Geological Survey and the U. S. Bureau of Mines for the U. S. Bureau of Land Management. Detailed geologic, geochemical, and geophysical field data on which the conclusions presented here are based have been published as MF 1196-A (Beutner and others, 1980), Open File Report 80-815 (Dellinger, D. A., 1980), and MF 1196-B (Griscom, Andrew, 1980). The illustrations included here summarize critical data from these publications that are pertinent to the mineral resource potential of these two study areas.

Location and Geographic Setting

The King Range and Chemise Mountain areas (Fig. 1) lie within a 300-km^2 (116-mi^2) area along the northwest California coast designated by the Bureau of Land Management as the "King Range National Conservation Area". The Chemise Mountain Instant Study Area encompasses about 13 km^2 (5 mi^2) in the southern part of the conservation area, and the King Range Instant Study Area approximately 220 km^2 (85 mi^2) in the northwestern part (fig. 1). The area of this investigation extends from the coast approximately 11 km (7mi) inland, and for about 35 km (22 mi) along the coast south of the mouth of the Mattole River. The King Range and Chemise Mountain areas are unusually rugged and deeply dissected: the King Range rises to an elevation of 1227 m (4,047 ft) within 5 km (3 mi) of the coast, and Chemise Mountain attains an elevation of 779 m (2598 ft) within 3 km (2 mi) of the coast.

Acknowledgements

We thank Mr. Gene J. Plessala, vice president of Shelter Cove-Brooktrails Properties, Inc., for allowing us to examine the geology of the Point Delgada area and June L. Etter, president of the Queen Peak Mining Co., who permitted investigation of manganese resources near Queen Peak. Her husband, Leo J. Etter, graciously showed us the property.

Paleontologic support was provided by S. A. Kling, K. McDougall, and R. Z. Poore (U. S. Geological Survey), W. R. Evitt (Stanford University), and B. J. Welton (Los Angeles County Museum of Natural History).

CHAPTER A

Geologic, Geophysical, and Geochemical Evaluation of Mineral Resources

By

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Geology and Structure

Rocks in the project area, ranging from Late Cretaceous to Miocene in age, are assigned to the Franciscan assemblage and grouped into three tectonostratigraphic units. (1) A steeply east dipping igneous complex of Late Cretaceous (Coniacian-Campanian) age, exposed along the coast at Point Delgada, is composed of basaltic pillow flows, flow breccia, and tuff that are cut by diabase sills and are overlain by, and interbedded with sheared argillite, sandstone, and conglomerate. (2) A structural unit of broken and sheared argillite and interbedded sandstone (Fig. 2), which locally contains a large percentage of volcanic detritus of andesitic composition (the sedimentary rocks of the King Range of Beutner and others, 1980), overlies the igneous complex of Point Delgada. In the King Range, this structural unit is complexly folded and penetratively sheared. Hemipelagic and pelagic thin-bedded limestone and chert prominent in some areas (Fig. 2), contain radiolarians and foraminifers. (3) A prominent melange of more complexly sheared argillite and sandstone containing a few sporadic blocks of basalt, chert, and high-grade blueschist bounds the sedimentary rocks of the King Range on the north and east. This melange is believed to delineate a post-middle Miocene suture (McLaughlin and others, 1979a). The area north and east of the melange terrane, including areas between Punta Gorda, Honeydew, and Ettersburg, consists of broken formations and melanges of older Franciscan rocks that are similar in composition and degree of deformation to those exposed within the King Range. These rocks were not studied in detail during this investigation.

Major faults in the study are delineated on the geologic map (Fig. 2). The San Andreas fault zone is the most prominent fault in the map area, although our investigations (McLaughlin and others, 1979b; Beutner and others, 1980) suggest that its main trace lies offshore. Surface ruptures that occurred at Point Delgada at the time of the 1906 earthquake have previously been attributed to the San Andreas fault, but probably either occurred along subsidiary splays of the fault zone or resulted from landslide reactivation. The Bear Harbor fault zone follows the coastline in the southern part of the map area but bifurcates at the mouth of Whale Gulch (Fig. 2); one branch trends north along Whale Gulch, and the other branch extends northwestward (Fig. 2).

A major northwest-trending fault in bedrock along the coast at Point Delgada (Figs. 2, 4), previously considered a branch of the San Andreas fault zone (McLaughlin and others, 1979b, c), is intersected and crossed by minor northeast-trending faults along which base- and precious-metal vein mineralization has occurred. K-Ar dating of adularia in the veins indicates that the mineralization occurred 13.8 ± 0.4 m.y. B. P. and that right-lateral offset of the veins by the northwest-trending fault has been insignificant since Miocene time.

Aeromagnetic Survey

An aeromagnetic survey was flown to determine whether the distribution of magnetic anomalies can be specifically associated with exposed or near-surface sites of metallic mineralization in the study area. The results of this survey (Griscom, 1980) delineate numerous shallow magnetic highs either near or at the surface that envelop the King Range on the north and east. Numerous oceanic-basement magnetic anomalies are present along or west of the San Andreas fault zone in the offshore area. The central block of the King Range is conspicuously non-magnetic. The trend of the magnetic anomalies along the north and east sides of the King Range mimics the strike of the melange bounding the sedimentary rocks of the King Range (Fig. 2). These anomalies probably are associated with unexposed lenticular bodies of mafic igneous rock, such as the blocks of altered pillow lava that are sporadically distributed throughout the melange. Unexposed ultramafic rocks or relatively young mafic intrusive rocks possibly account for some of these anomalies. Metallic mineralization cannot be directly correlated with any of the anomalies.

A prominent northwest-trending magnetic anomaly underlies the drainage basin of Sholes Creek north of Jewett Ridge, outside the northeast boundary of the study areas (Fig. 2-4). A ground investigation of the anomaly with a hand-held magnetometer confirmed its presence, but the magnetic source rocks were not exposed. An interpretive magnetic profile constructed by Griscom (1980) indicates that the Sholes Creek anomaly (and, by implication, the enclosing melange) dips steeply southwest toward the San Andreas fault. Another prominent magnetic anomaly, centered offshore immediately west of Point Delgada, is partly associated with pillow basalt and pillow breccia exposed along the shoreline beneath marine and fluvial terrace deposits. In the offshore area, the magnetic anomaly may be associated with gabbro or serpentinite.

Energy-Resource Potential

No oil or gas seeps or coal seams were detected within the King Range of Chemise Mountain Instant Study Area, although small amounts of paraffin-base oil have been produced from Franciscan rocks along the Mattole River near Petrolia, north of the King Range Instant Study Area (MacGinitie, 1943; California Division of Oil and Gas, 1973). Clasts of clinker in the alluvium of several drainages of the King Range could be indicative of undetected coal, or of gas or oil seeps. However, Franciscan sandstone of the King Range and Chemise Mountain areas is pervasively sheared and zeolitized and consequently has an inherently low porosity and permeability. Small amounts of oil or gas could be associated with structural traps with permeabilities produced by localized crushing or fracturing along faults and shear zones, but this possibility is remote. The absence of any Tertiary or older nonmarine rocks in the study areas further indicates a low potential for coal.

The geothermal resource potential of these areas also is low. No evidence of geologically young heat sources or presently high heat flow, as would be indicated by active hot springs, fumaroles, or volcanism of Pleistocene or younger age was observed.

Metallic-Mineral Potential

Geochemical evaluation

We have evaluated the ferrous-, base-, and precious-metal resource potential of the study areas, using conventional geochemical sampling and analytical techniques. Stream sediment, beach sediment, and bedrock sample populations were collected (Dellinger, 1980) (Fig. 3). Splits from each suite of samples were analyzed for major-, minor-, and trace-element contents, and replicate splits were analyzed from the stream- and beach-sediment populations. Sampling of bedrock and stream sediment was limited to the mouths and major forks of principal drainages and to coastal bedrock exposures owing to the steepness, ruggedness, and locally thick vegetation cover.

Because of the friability of most sulfide, carbonate, and oxide minerals of the base metals, their geochemical detection in panned heavy-mineral concentrates from sediment is most reliable and sensitive in the -60-mesh (-0.025 mm) grain-size fraction. We found that sediment in virtually every stream draining the King Range and Chemise Mountain areas, in addition to the coastal beaches, is composed of lithic debris that contains no significant monominerallic heavy minerals in the -60-mesh (-0.025 mm) size fraction. The near absence of monomineralic heavy-mineral grains is largely due to extremely high rates of erosion and downcutting that continually dilute stream bedloads with coarse lithic detritus. The continuing rapid uplift and geologic youthfulness of the area are probably the major factors contributing to this erosion and downcutting (Sorg and others, 1979). The absence of heavy-mineral concentrates severely limits the sensitivity and reliability of data from our sediment samples.

We used standard six-step semiquantitative and quantitative emission spectrographic, colorimetric, and atomic-absorption techniques to analyze the samples. The analytical data were computer processed using programs for the U. S. Geological Survey's STATPAC system (Van Trump and Miesch, 1977) for determining the presence of significant quantities of any metallic elements. Table 1 lists the sample localities for each sample population that yielded anomalous concentrations of various elements, along with the lowest values considered anomalous (threshold values) for each element. The thresholds for anomalous values were assigned from log-probability plots according to the conventions established by Lepeltier (1969). By this method, values of a given element greater by two standard deviations (uppermost 2.5 percent of the population) are considered anomalous for log-normal populations. Where inflection points from log-probability plots indicate the presence of more than one statistical population, more than the upper 2.5 percent of the sample population may be considered anomalous. Any detected value for gold is considered anomalous. The distribution of the resulting geochemical anomalies (Figs. 4 and 5) illustrates areas of known or possible mineral potential.

In many sample localities, anomalous values were obtained for a metal in only one replicate stream- or beach-sediment sample split. We attribute these inconsistent values mainly to the textural immaturity and lithic character of the sediments, although minor contamination or analytical error is also possible. Elimination of these samples from the map (Fig. 4) as unreliable drastically reduces the number of anomalous localities in the study areas. Gold is considered significant where detected in only one sample split because of its unique physical properties and low natural concentrations; these localities are queried on the map (Fig. 4).

Metallic Anomalies

Sediment samples from several small drainage basins in the northern and central parts of the King Range contain slightly high metallic anomalies (Fig. 4). Three drainages yielded gold, one an anomalous value of lead and two anomalous values of zinc. The anomalous values for these drainage basins are based on single localities with only slightly high metallic values. Mineralization was not detected in those basins, and the anomalies are not considered significant.

Barely detectable gold values (less than 0.05 to as much as 0.2 ppm) were found in beach sediment in three localities; mercury was a minor constitutent at one of these localities. The source of the gold in the beach sediment is unknown but could be rock debris from the King Range and Chemise Mountain areas. No signfiicant placer-gold resource is indicated.

Widespread manganese mineralization is indicated by numerous anomalous manganese and cobalt values in the Point Delgada area, and within and adjacent to melanges that bound the north and east sides of the King Range and envelop the Chemise Mountain area (Fig. 4). The prominent north-northwest-trending zone of high (greater than 387 ppm) manganese values is delineated by stream-sediment and sheared bedrock samples of sandstone, argillite, chert and altered basaltic volcanic rocks. Most of these anomalous values are distributed about Point Delgada and Queen Peak, where cherty rocks associated with pillow basalt are the principal host rocks for manganese mineralization. Sporadic isolated masses of these manganese-bearing rocks are present in a 5- to 7-km- (4-mi) wide belt that includes Point Delgada and the area underlain by melange (Fig. 2) from the coast southeast of Queen Peak, northward to the latitude of Ettersburg (see Fig. 5). The geochemical data suggest that manganese occurrences similar to those at the Queen Peak manganese mine are likely to be present within the north-trending belt delineated on the map (Fig. 5).

Copper occurrences also coincide with rocks of the Point Delgada area (Fig. 2) and the northwest-trending melange that is associated with manganese mineralization (Fig. 2). At Point Delgada, the copper is associated with lead, zinc, and silver in mineralized veins that cut basaltic pillow flows, flow breccia, sandstone, and argillite. The copper within the melange occurs in association with the same basaltic and cherty rocks that are associated with manganese distribution. One example of this occurence within the melange is near the mouth of McKee Creek (Loc. 7, Fig. 4), where a large boulder of chert-cemented basalt pillow breccia derived from melange in the immediate landslide-covered drainage area contains conspicuous native copper. Similar minor occurrences of relatively high grade copper mineralization may be present within the study areas. Extensive copper mineralization, however, is unlikely, owing to the lenticularity and isolation of the basalt and chert rocks that host copper mineralization in the melange.

Queen Peak Area

Investigations by T. J. Peters at the Queen Peak manganese mine showed that the manganese occurs in two large open pits and several exploratory trenches as stratiform concentrations within complexly folded and faulted zones of chert that overlie basalt pillow flows. The bedded cherts contain concentrations of manganese mineralization in their lower parts that are in turn overlain by tuffaceous red to green radiolarian chert, cherty argillite, or sandstone. The manganese mineralization consists largely of hausmannite, pyrolusite, psilomelane, probable rhodochrosite, neotocite, and bementite (M. B. Norman, II, oral commun., 1979).

The stratiform nature of the manganese mineralization and its association with the contact between submarine basaltic pillow flows and overlying pelagic chert suggest that primary manganese mineralization occured shortly after volcanism and before, or possibly in conjunction with, chert deposition. Manganese mineralization associated with submarine basalt and pelagic ooze described from the modern sea floor is commonly associated with subsea hydrothermal systems along spreading axes of oceanic ridges (for example, see Moore and Vogt, 1976; Snyder, 1978). Kuypers and Denyer (1979) have described manganese occurrences with paragenetic relations like those in the Queen Peak mine locality and argued that such mineralization probaby occurs in the deep ocean in conjunction with hydrothermal activity, close to a spreading-ridge axis or similar area of volcanism.

Later hydrothermal activity may have remobilized and redistributed the manganese locally. Evidence for this later or continued activity is the prominent hydrothermal alteration along some northeast-trending cross faults that offset the basalt flows, manganiferous chert, and overlying sandstone. Hydrothermal alteration in all these rocks indicates that the hydrothermal system at least in part post-dates initial manganese deposition.

The massive manganese oxide and carbonate mineralization locally contains chalcopyrite, calcite and quartz crystal-lined vugs thinner than a centimeter (0.4 in.) in diameter, filled with black hydrocarbon residues. Similar occurrences of hydrocarbon-filled vugs were reported to be associated with mercury deposits in the Coast Ranges by Bailey (1946) and Yates and Hilpert (1946). The hydrocarbon deposition at Queen Peak probably accompanied or closely followed initial manganese mineralization.

Point Delgada Area

Occurrences of lead, zinc, and copper sulfide mineralization at Point Delgada are important because they illustrate the likely mode of occurrence of any undetected minor lead or zinc mineralization within the King Range and Chemise Mountain Instant Study Areas (Figs. 4, 5). The mineralization at Point Delgada occurs in vein fillings along steeply dipping northeast-trending left-lateral and normal tension faults and fractures; these vein fillings are associated with a gangue mineralogy of quartz, carbonates, and adularia. The principal sulfide minerals are sphalerite, galena, and chalcopyrite. The galena contains significant amounts of silver (see Table 1), and the veins cut basaltic volcanic and sedimentary rocks of Late Cretaceous and Tertiary age belonging to the Franciscan assemblage. The age of mineralization has been determined by K-Ar dating methods to be 13.8±0.4 m.y. B. P. (McLaughlin and others, 1979a).

In an earlier report (McLaughlin and others, 1979c), we first described the base- and precious-metal vein occurrences at Point Delgada and noted their relation to the San Andreas fault and their potential economic significance. Most of these northeast-trending veins (Locs. 2-5, Fig. 4) are thin (3 - 10 cm wide) and contain only sparse sulfides. However, one vein system (Loc. 1, Fig. 4), traced for at least 210 m (700 ft) along strike, contains vein fillings of quartz-carbonate with sphalerite, argentiferous galena, and chalcopyrite, in veins that range from 2 cm (1 in.) to as much as a meter (3 ft.) in width. One of the veins at this locality crops out as a 60 cm (2-ft.) -wide zone of massive sphalerite and argentiferous galena. This massive sulfide mineralization maintains a vein width of 60 cm (2 ft.) for a vertical distance of about 3 m (10 ft.) above the surface and probably extends to at least an equal depth in the subsurface.

The sulfide minerals in veins at Point Delgada which contain lead, zinc, copper, and silver, are typical of the mineral assemblage associated with stratabound sulfide occurrences in argillitic rocks rich in organic materials, and with areas underlain by or adjacent to intermediate to acidic volcanic or plutonic rocks (Anderson, 1969, p. 130). A significant proportion of the detritus in sandstone and argillite of the Franciscan assemblage in this area is clearly derived from crystalline source terranes composed dominantly of andesitic volcanic and intermediate plutonic rocks. We believe that the base and precious metals could have been remobilized into veins from stratabound sulfide concentrations within this sandstone and argillite. This remobilization occured during the Miocene hydrothermal activity indicated by the age of vein mineralization. It is possible that additional stratabound sulfide concentrations are present at depth in association with the steeply dipping contact between basaltic igneous and sedimentary rocks of Point Delgada (Fig. 2) and the overlying sedimentary rocks of the King Range (Fig. 2).

King Range Instant Study Area

The likelihood of significant base- and precious-metal resources within the proposed King Range Instant Study Area is low. An area east and southeast of a north-south line drawn at the intersection of Gitchell Creek with the coastline contains local manganese and base-metal anomalies (Fig. 5). Any undiscovered manganese, or copper, lead and zinc occurrences in this area are probably associated with small fractured pods of basaltic volcanic rocks and chert within melange, and are unlikely to have economic potential. There is no geochemical evidence of mineralization northwest of Gitchell Creek (Figs. 4 and 5); however, rocks in this area are not within a melange and not as fractured. Mineral potential is low, but cannot be discounted because of the high-grade base-metal and silver mineralization at Point Delgada.

Chemise Mountain Instant Study Area

The mineral potential of the Chemise Mountain Instant Study Area is low, although the area yielded a somewhat higher incidence of metallic anomalies than the King Range. Trace amounts of gold detected in beach sand south of McKee Creek probably have no economic significance. Concentrations of manganese and native copper mineralization are associated with pods of basalt and chert from the north-trending melange that intersects the coast between the mouths of McKee Creek and Whale Gulch (Figs. 2, 4, 5). Undiscovered copper and manganese occurrences within this melange are likely to be small and discontinuous owing to intense deformation and shearing, and to low abundance of the basaltic and cherty host rocks in the melange.

CHAPTER B

Economic Apraisal of Mineral Resources

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Setting

Mining Districts and Divisions

There are no active claims or significant mineralized localities within the study areas; however, two mineralized localities, the Point Delgada base-metal and silver occurrence, and the Queen Peak manganese district (Fig. 5) are adjacent to the King Range Instant Study Area. The Point Delgada area is important because of newly discovered high-grade silver, zinc, and minor copper. The Queen Peak district contains minor manganese resources. No significant production resulted from pretroleum exploration north of the King Range in the Mattole River basin.

History of Mineral-Resource Development

In 1865, petroleum exploration began north of the King Range along the Mattole River. The town of Petrolia was settled near the mouth of the North Fork of the Mattole River. Its three-year "boom" was among the first in California, and many of the State's earliest oil and gas wells were drilled near natural oil and gas seeps common to the area. Production during this early period probably was less than 200 barrels of oil. More detailed accounts of this early activity are in the reports by California Mining Bureau (1884, p. 294), Weber (1888, p. 195-200) and Lowell (1915, p. 410-414).

A second period of minor oil production in the Mattole area between 1930 and 1942 was detailed by MacGinitie (1943). Minor activity, which continued intermittently from 1949 to 1960, was reported by California Division of Oil and Gas (1960, p. 446, 447; 1964, p. 291). Peak annual production was 140 barrels in 1954. Only one 4-ha (10-acre) area 6 km (4 mi.) north of Petrolia (secs. 15-16, T. 1 S., R. 2 W.) has been productive. This productive zone averages 479 m (1,570 ft.) deep and is 27 m (90 ft.) thick (California Division of Oil and Gas, 1960, p. 447). Total oil production for the Mattole district since 1865 has been approximately 350 barrels (California Division of Oil and Gas, 1977, p. 49).

Oil wells visited by MacGinitie (1943) were all in steeply dipping extensively faulted Franciscan rocks; he concluded that the presence of large oil-bearing structures was doubtful. California Division of Oil and Gas (1960, p. 446) provided a geologic sketch of the productive area north of Petrolia that depicted petroleum accumulation along small stratigraphic traps formed by porous units pinching out updip. These traps, within alternately sandy and shaly thin-bedded units of the Franciscan, are not an economically promising source of petroelum using conventional recovery techniques. Bedding and fault-zone attitudes, including known petroleum-bearing structures, strike west-northwest and do not trend toward the King Range. Strata within the King Range and Chemise Mountain areas are broken by widespread faulting and have low potential for trapping accumulations of petroleum. Many Petrolia area wells were mapped by Munger (1977, p. 34).

Approximately 40 placer gold claims were located along the lower stretch of the Mattole River and its tributaries, including the north slope of the King Range, between 1899 and 1901, and in 1908 (Humboldt County mining records). The area was designed the "Mattole district"; no evidence of gold production, however, has been recorded. Long-time local residents report seeing traces of gold panned from tributary streams many years ago. Reconnaissance pan sampling of old placer claims by the U. S. Bureau of Mines along streams draining the northern end of the King Range study area did not produce free gold. Franciscan rocks of the northern Coast Ranges of California, which underlie the Mattole district, have not been a significant source of gold. The scarcity of gold is probably related to the absence of intrusive granitic rocks within the assemblage (Irwin, 1960, p. 64-67). Isolated traces of free gold from the Mattole drainage were possibly carried into the area from the Klamath Mountains mineral province (Irwin, 1960, p. 64-67) along ancient drainages that no longer exist. There is practically no potential for placer-gold production in the study area.

Two early copper prospects--the Rainbow Group (secs. 19, 30, 32, T. 1 S., R. 1 E.,; sec., 12, 19, T. 1 S., R. 1 W.) and the Crimson Group (sec. 8, T. 2 S., R. 1 E.)--are 13 km north of Honeydew. These prospects were not visited during the present study but were reported by California Mining Bureau (1908, p. 128-129) and were briefly described under the designation "Mattole mining district" by Lowell (1915, p. 399).

The Queen Peak manganese mine, that produced 1,498 metric tons (1,651 tons) of ore during 1958 and 1959, is the only mine with a history of production in the King Range National Conservation area. The mine is one of four open-pits that make up a small district within a kilometer (0.5 mi.) of the King Range Instant Study Area. The Franciscan assemblage in the district strikes toward the Chemise Mountain Instant Study Area (Fig. 5).

During the summer of 1978, the U. S. Geological Survey (McLaughlin and others, 1979c) discovered a high-grade mineralized northeast-striking fault zone near Point Delgada. It is exposed in the sea cliff between the mouths of Humboldt and Telegraph Creeks, 3 km (2 mi.) north of Shelter Cove (Fig. 6). The zone is approximately 120 km (400 ft.) south of the Instant Study Area and may extend into the King Range. Similar fault zones may exist within the Instant Study Area. The occurrence, to the extent explored, is not a significant resource; its full extent, however, is unknown.

Mining Claims and Oil Wells

No oil and gas wells have been drilled in the King Range or Chemise Mountain Instant Study Areas. However, between 50 and 70 wells have been drilled in the Petrolia area (Tps. 1, 3 S., Rs. 1 E., 1-3 W.), which includes the lower Mattole drainage and the vicinity of the village of Honeydew (Munger, 1977, p. 34).

Approximately 60 placer claims were located in Humboldt County along the lower Mattole River and its tributaries. Of these, 12 claims are within or adjacent to the King Range Instant Study Area along Honeydew, Bear Trap, Woods, Squaw, and Fourmile Creeks.

Two placer claims were located for mineral spring water within the Chemise Mountain Instant Study Area in Mendocino County during 1970 (SW1/4 sec. 30, W1/2 sec. 31, T. 5 W., R. 2 E.). The claims are invalid according to the Supreme Court decision of May 31, 1978 (Charles Stone Products v. the United States), which notes that water is not a locatable mineral.

The Queen Peak manganese deposit is covered by 10 lode claims, the Bear Creek group. These claims belong to the Queen Peak Mining Co. and are filed in Humboldt County records. The group comprises known manganese deposits in the National Conservation Area (T. 4 S., R. 1 E.). There are no patented claims in the study areas.

Mineral Resource Estimates

Resources cannot be estimated for the Point Delgada area because of limited outcrops. However, a 1.2-m (4-ft.) - wide zone of silver-bearing massive base-metal sulfides contains 374 g/t (10.9 oz/ton) Ag, 0.56 weight percent Cu, 7.6 weight percent Pb, and 17.7 weight percent Zn (Loc. 2 of McLaughlin and others, 1979c, p. 3).

The Queen Peak manganese district contains a total of 2,880 t (3,180 T) of identified resources averaging 13 weight percent Mn. Of this, only 80 t (90 t) with an economic grade of 37 weight percent Mn, have been identified. There are 1,050 t (1,160 t) at a paramarginal grade of 21 weight percent Mn, and 1,750 t (1,980 t) at a submarginal grade of 7 weight percent Mn.

Point Delgada Area

Location and Access

The Point Delgada area (Fig. 5), which extends for 3 km (2 mi) along the coast (secs, 9, 16, T. 5 S., R. 1 E.), is in the residential development at Shelter Cove, Calif. Access from U. S. Highway 101, through Garberville and Redway, is by way of Shelter Cove Road (inset, Fig. 1). residential drives crisscross the area and provide easy access. Facilities are also available for landing small planes at Shelter Cove.

History and Production

The mineralized zones, which were discovered by the U. S. Geological Survey during the summer of 1978, have been described by McLaughlin, Sorg, Ohlin, and Heropoulos (1979c). The Point Delgada area has no history of production.

Geologic Setting

Zinc, lead, copper, and silver minerals occur in quartz-carbonate-adularia gangue along steeply dipping northeast-trending predominantly tensional faults and fractures. The principal sulfide minerals are sphalerite, argentiferous galena, and chalcopyrite. The mineralized faults occur within the Late Cretaceous Franciscan assemblage in the Point Delgada area.

Mineralized zones occur in eight localities; the zones are nearly vertical planar structures that strike in three main directions.

1. N. 30° - 40° E. Two high-grade sulfide veins occur along fault zones. One vein crops out within the sea cliff between the mouths of Humboldt and Telegraph Creeks. A second vein, 180 m (600 ft.) upstream from the mouth of Telegraph Creek, may be an extension of the first that has been displaced by later faulting. Axes of isoclinal folds in local strata appear to parallel these veins.

2. N. 15° - 30° W. Two weakly mineralized sulfide zones parallel the regional strike of strata and the San Andreas fault trend. One zone is within interpillow material overlying basalt flows, the second is made up of hairline veinlets that parallel argillite beds.

3. N. 60° - 70° E. Four weakly mineralized veins are perpendicular to bedding and to the San Andreas splays. The quartz-carbonate veins are thinner than 30 cm (1 ft.). Sparse sulfide minerals that fill open spaces in these apparently tensional features, may represent late sufide remobilization.

Mineralized zones parallel strata in some places and crosscut them elsewhere. Significant mineralized veins at Point Delgada may be remobilized from an underlying stratabound deposit.

Resource Potential

Resources cannot be estimated for the Point Delgada area because of limited exposures. The silver, copper, lead, and zinc content of one high-grade sulfide vein indicate that economic base-metal and silver resources may be present. A low to moderate potential exists for finding similar prospects in the Franciscan assemblage within the King Range and Chemise Mountain areas.

Queen Peak District

Location and Access

The Queen Peak manganese district is near the southeast corner of the King Range area, about half a kilometer (0.3 mi.) outside the Instant Study Area (Fig. 3). The district is directly east of the South Fork of Bear Creek, on the west slope of Queen Peak (E1/2 sec. 34 and W1/2 sec. 35, T. 4 S., R. 1 E.). Primary access from U. S. Highway 101, at Garberville and Redway, is by way of Shelter Cove Road to the Horse Mountain Road. Approximately a kilometer of private road connects the deposit with the Horse Mountain Road, but the private road is impassable to vehicles where it crosses Bear Creek.

History and production

Manganese at Queen Peak was discovered in May 1958 by Messrs. Carl Macela, Leroy Elliot, and Guy Westfall, all Garberville prospectors and miners. The discovery is more than 32 km (20 mi.) west of other manganese deposits within the Franciscan assemblage (California Division of Mines and Geology, 1959b). The Queen Peak Mining Co. produced 594 t (655 T) of ore containing 41 weight percent Mn during 1959. The U. S. General Services Administration bought most of the ore, 1,426 t (1,572 T). It was trucked 72 km (45 mi.) to Southfork, Calif., and then shipped by rail to Wenden and Fort Worth, Tex., for stockpiling. All production within the district was from the Queen Peak mine, now a partly flooded small open pit. A second open pit, the North pit, did not contain significant amounts of manganese of an economic grade. One of two other pits contained small manganese resources. Production ceased in August 1959 with the end of the Federal Government's domestic purchasing program (California Division of Mines and Geology, 1959a).

Geologic Setting

The Queen Peak district is underlain by an early and middle Tertiary deep-water marine sequence of sedimentary and volcanic rocks. Manganiferous beds have been mapped across an area that extends a kilometer (0.5 mi.) north and south and half a kilometer (0.3 mi.) east and west. The main rock types are argillite (shale), black, red, and green radiolarian chert, and graywacke interbedded with two greenstone units (pillow-basalt flows). The chert and argillite contain radiolarians of Miocene or younger age (McLaughlin and others, 1979a). Two discontinuous manganiferous beds, interbedded with red argillite, overlie the greenstone units. The upper manganiferous bed, which was the main zone of manganese production, is 1.8 to 3 m (6 to 10 ft.) thick and dips 50° SE. This ore zone appears to thin to approximately 0.3 to 0.6 m (1 to 2 ft.) in the overturned east limb of a synclinal fold.

The entire stratigraphic assemblage within the district has been deformed into two isoclinal folds: an anticline to the west, and a corresponding syncline to the east. The fold limbs extend northward and northwestward across the district and dip steeply east. Overturned basalt pillows are visible on the east flank of the syncline. The folded assemblage is cut by left-lateral northeast-striking, and right-lateral southeast-striking strike-slip faults. Rocks in the district are intensely deformed and sheared and slightly metamorphosed.

Manganese mineralization is exposed in many places along roadcuts and in prospect pits. The discontinuous manganiferous beds consist of a low-grade mixture of microcrystalline chert and manganese minerals containing high-grade pods of hausmannite (Mn_3O_4). The beds range from less than 0.3 to about 3 m (1 to 10 ft.) in thickness. Besides hausmannite, the manganese minerals include two black oxides, psilomelane and pyrolusite, and two silicates, bementite and neotocite (M. B. Norman II, oral commun., 1980). Rhodochrosite, a pink carbonate, fills small cavities and hairline veins.

A total of 57 samples were taken in the Queen Peak area; the average grade for 17 of these samples containing more than 5 weight percent Mn is 13 percent. The richest sample contained 48 weight percent Mn.

Hydrothermal activity associated with volcanism, and perhaps rapid cooling and palagonitization of the basalt, causing local enrichment of seawater with manganese, iron, and silica has been proposed as a mechanism of manganese mineralization (Taliaferro and Hudson, 1943, p. 273). Sorem and Gunn (1967, p. 26) suggested that manganese precipitated out of the seawater as oxide and silicate minerals. The stratabound structural relations of the manganese ore in the Queen Peak area suggest that primary manganese mineralization was syngenetic with volcanism and chert deposition (Snyder, 1978, p. 742). Additional manganese resources are likely to be found where similar pillow basalts occur.

Resource Potential

Greenstone units and overlying manganiferous beds at Queen Peak strike toward the Chemise Mountain area. At Chemise Mountain, the units are within a melange (Fig. 2) and are broken and discontinuous. A manganese deposit with a minable shape probably does not occur there. Although greenstone outcrops are uncommon within the King Range area, Queen Peak-type manganese deposits may exist in the subsurface.

The Queen Peak district contains approximately 2,900 t (3,200 T) of submarginal material averaging 13 weight percent Mn. This manganese resource is not economically significant, and the potential for finding significant manganese resources within the King Range and Chemise Mountain areas is very low.

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Table 1.--Geochemical data for anomalous samples from the King Range and Chemise Mountain Instant Study Areas. (Atomic-absorption analyses for Zn, Hg, and Au by B. Arbogast. Emission spectrographic analyses of mineralized samples by C. Heropoulos and C. Laughrey. Semiquantitative six-step spectrographic analyses (*) by C. Forn. As determined by colorimetric techniques. All values in parts per million.)

Beach Sediment

Element	Threshold Value	SK-3		MK-104		MK-91		MK-59	
Zn-----------	73	---	---	---	---	---	---	---	---
Hg-----------	.194	0.20	0.16	---	---	---	---	---	---
Au-----------	.05	.20	<.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Stream Sediment

Element	Threshold Value	SK-2		OK-15		MK-42		OK-12		OK-1B		SK-10		OK-7		OK-6		SK-21	
Zn----	99	---	---	120	120	---	---	---	---	---	---	110	110	-----	-----	-----	-----	100	100
Hg----	.25	---	---	---	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----	---	---
Au----	.19	---	---	---	---	0.05	0	<0.05	0	0.1	0	---	---	-----	-----	-----	-----	---	---
Mn----	1,021	---	---	---	---	---	---	---	---	---	---	---	---	1,500	2,000	1,500	2,000	---	---
Cu----	41	---	---	---	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----	---	---
Pb----	9	10	10	---	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----	---	---
V-----	97	---	---	---	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----	---	---

Bedrock Samples[1/]

Element	Threshold Value	MK-19	MK-25	MK-60	MK-61	MK-1	MK-94	MK-66a	MK-66b	MK-14	MK-112b
Zn----	150	---	---	---	---	---	---	---	---	---	---
Hg----	.12	---	---	---	---	---	---	---	---	---	---
Mn----	387	500	700	500	700	1,000	---	700	1,000	500	500
Cu----	70	---	---	---	---	---	---	---	150	100	100
Pb----	1	---	---	---	---	---	10	---	---	---	---
V-----	125	---	---	---	---	---	---	150	200	150	---
Co----	14	15	---	15	---	---	15	15	20	20	30
Ni----	63	---	---	---	---	---	---	---	---	---	300
Sc----	14	---	---	---	---	---	---	---	15	15	---

Element	Threshold Value	MK-114	MK-118a	MK-118b	MK-121	MK-76A	MK-105	MK-82	MK-110	MK-84
Zn----	150	---	200	250	---	---	540	---	---	---
Hg----	.12	---	---	---	---	---	.14	---	---	---
Mn----	387	---	---	---	700	---	> 5,000	700	1,500	500
Cu----	70	100	---	---	---	---	70	---	---	---
Pb----	1	---	---	---	---	10	30	---	10	---
V-----	125	---	---	---	---	---	300	---	---	---
Co----	14	15	---	---	---	15	30	20	15	---
Ni----	63	---	---	---	---	---	300	---	---	---
Sc----	14	---	---	---	---	---	---	---	---	---

Mineralized Samples [2/]

Element	SK-15	SK-13	SK-14	MK-127	MK-128	MK-126	MK-117	SK-24	SK-17	SK-20
Zn----	>20,000	>*10,000; 150,000	2,400; 64,000	1,500	1,100	10,000	500	40,000	*200; 300	170; >20,000
Hg----	1.0	.26	.36	---	---	---	---	---	.06	.40
Mn----	4,900	*2,000	*200; 14,000	7,000	5,000	5,000	7,000	---	*5,000	*5,000
Cu----	4,600	*1,000	*2,000; 2,200	15,000	500	650	---	1,000	---	*7,000
Pb----	20,000	*2,000	1,100; *5,000	15,000	2,700	4,000	---	7,800	---	*50
V-----	---	---	--- ---	---	---	---	---	---	*100	*300
Co----	170	*20	57; *30	20	20	23	.42	---	*300	*20
Ni----	---	---	--- ---	---	170	---	---	---	*300	---
Sc----	---	---	--- ---	---	29	---	39	---	---	---
Y-----	---	---	170	88	---	---	---	---	---	---
Ag----	880	*70	14; *100	140	8	3	---	32	---	---
Bi----	---	---	*20	---	---	---	---	---	---	---
Cd----	1,800	*300	*100; 710	52	---	40	---	---	---	—
Mo----	---	---	--- ---	---	---	---	12	---	*50	*20
Sb----	1,700	---	*100	---	---	---	---	---	---	—
U-----	---	---	--- ---	---	120	60	180	43	---	—
Ga----	5	---	6	---	---	---	---	---	---	—
Yb----	---	---	--- ---	4	---	---	---	---	---	—
Au----	---	.1	.1	---	---	---	---	.1	.1	—
Sn----	920	*300	*150; 310	130	---	---	---	---	*150	—

[1/] On figure 4 samples MK-66a, b, are from Loc. 1, MK-14 and MK-112b are from Loc. 2, MK-114 is from Loc. 3, and MK-118a, b, and MK-121 are from Loc. 5.

[2/] On figure 4 samples SK-15, -13, -14, and MK-127 are from Loc. 1, MK-128 is from Loc. 2, MK-126 is from Loc. 3, MK-117 is from Loc. 4, SK-24 is from Loc. 5, SK-17 is from Loc. 6 and SK-20 is from Loc. 7.