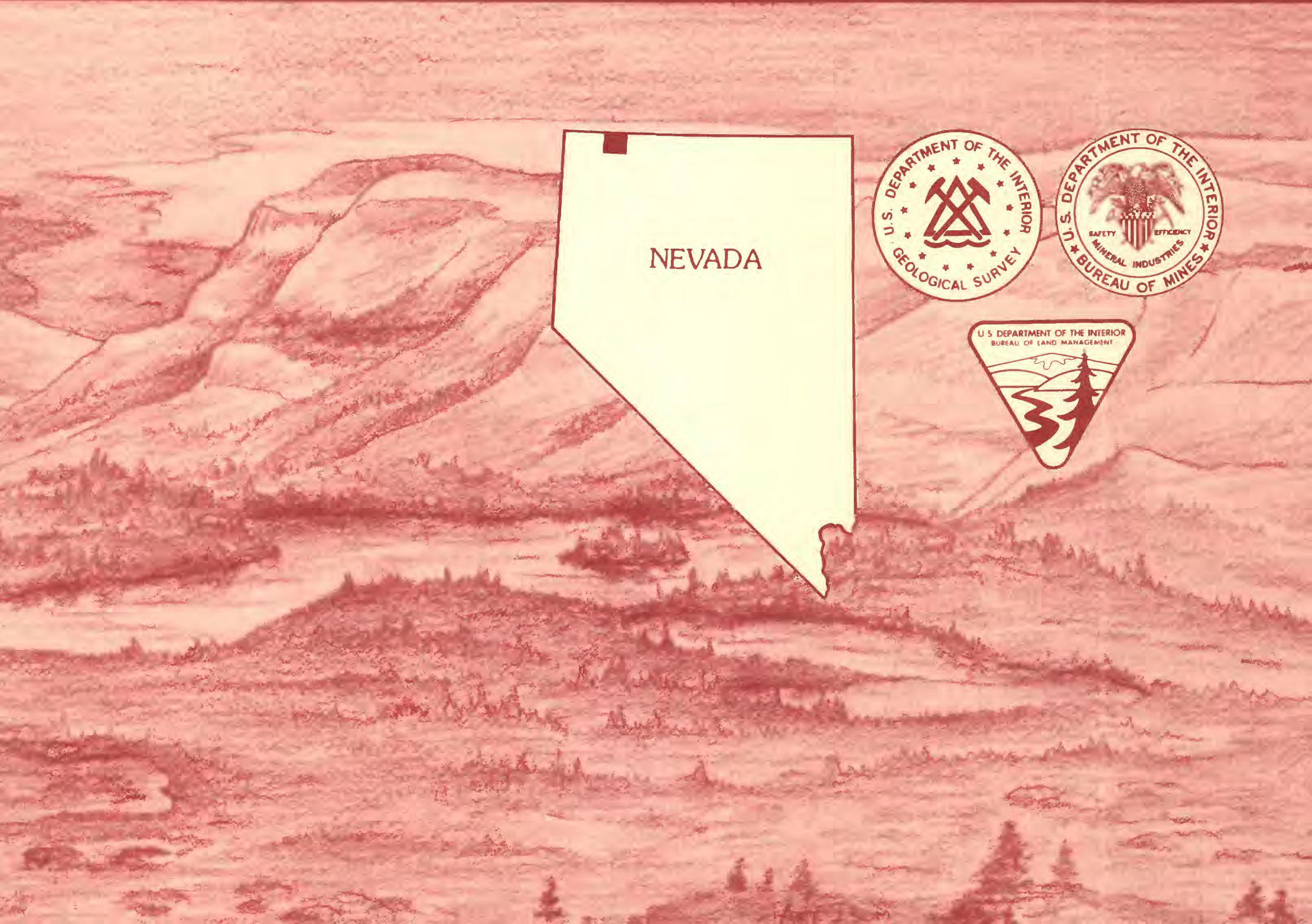
Mineral Resources of the South Jackson Mountains Wilderness Study Area, Humboldt County, Nevada

U.S. GEOLOGICAL SURVEY BULLETIN 1726–B



Chapter B

Mineral Resources of the South Jackson Mountains Wilderness Study Area, Humboldt County, Nevada

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U.S. Bureau of Mines

U.S. GEOLOGICAL SURVEY BULLETIN 1726

MINERAL RESOURCES OF WILDERNESS STUDY AREAS:
HUMBOLDT AND PERSHING COUNTIES, NEVADA

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Area

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of part of the South Jackson Mountains Wilderness Study Area (NV-020-603), Humboldt County, Nevada.

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Mineral Resources of the South Jackson Mountains Wilderness Study Area, Humboldt County, Nevada

By Martin L. Sorensen, Donald Plouff, *and* Robert L. Turner
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SUMMARY

Abstract

The South Jackson Mountains Wilderness Study Area (NV-020-603) is in south-central Humboldt County, Nev. At the request of the Bureau of Land Management, mineral surveys were conducted on 10,300 acres of the wilderness study area by the U.S. Geological Survey and the U.S. Bureau of Mines. In this report, the area studied is referred to as "the study area". The results of geologic, geochemical, geophysical, and mineral surveys conducted in 1984 and 1985 delineate one area in the northeastern part of the study area with a moderate potential for undiscovered iron resources in metavolcanic rocks and two areas, in the southeast and northeast corners of the study area, with moderate potential for undiscovered gold, silver, copper, lead, or zinc in metavolcanic rocks. The potential for undiscovered oil and gas and geothermal resources is low.

Character and Setting

The South Jackson Mountains Wilderness Study Area (NV-020-603) includes approximately 10,300 acres on the west flank of the Jackson Mountains in south-central Humboldt County, about 50 mi northwest of Winnemucca, Nev. (fig. 1). The north-trending Jackson Mountains are flanked by the Desert Valley to the east and the Black Rock Desert to the west. Elevations in the study area range from 4,400 ft along the west boundary to 8,923 ft at King Lear Peak. The study area is underlain mostly by marine sedimentary and volcanic rocks that have been complexly folded and faulted and intruded by dikes, sills, and small plugs.

Mining in the Jackson Creek unorganized mining district, just north of the study area boundary, and in the Red Butte unorganized mining district, approximately 3 mi south of the study area boundary, began early in this century. The Claudia mine in the Red Butte mining district and the Prodigal mine (Bull Creek claims) about 4 mi south of the study area produced small amounts of gold, silver, copper, and lead between 1919 and 1947. The Red Boy mine, about 1 mi east of the study area, produced small amounts of gold, silver, copper, lead, and zinc during 1940 and 1948.

Identified Resources

There are no identified resources in the South Jackson Mountains Wilderness Study Area. Several commodities are present within the study area, including silver, copper, and iron, and lesser amounts of gold, lead, zinc, vanadium, barium, and cobalt. The deposits of these commodities, however, are too small or too poorly exposed to allow resource estimates.

Mineral Resource Potential

An intense aeromagnetic high covering 2 mi^2 within the study area between Hobo and Bliss Canyons (fig. 3) indicates the presence of rocks with a high magnetite content at relatively shallow depth. The area of this aeromagnetic high has a moderate potential (fig. 2) for undiscovered iron resources similar to those at the Iron King mine. Magnetic gradients that may represent mineralized contact zones between plutons and country rocks are present in the northeastern and southeastern parts of the study area. Two areas overlain by these magnetic gradients have a moderate potential for gold, silver, copper, lead, or zinc in vein deposits similar to those at the

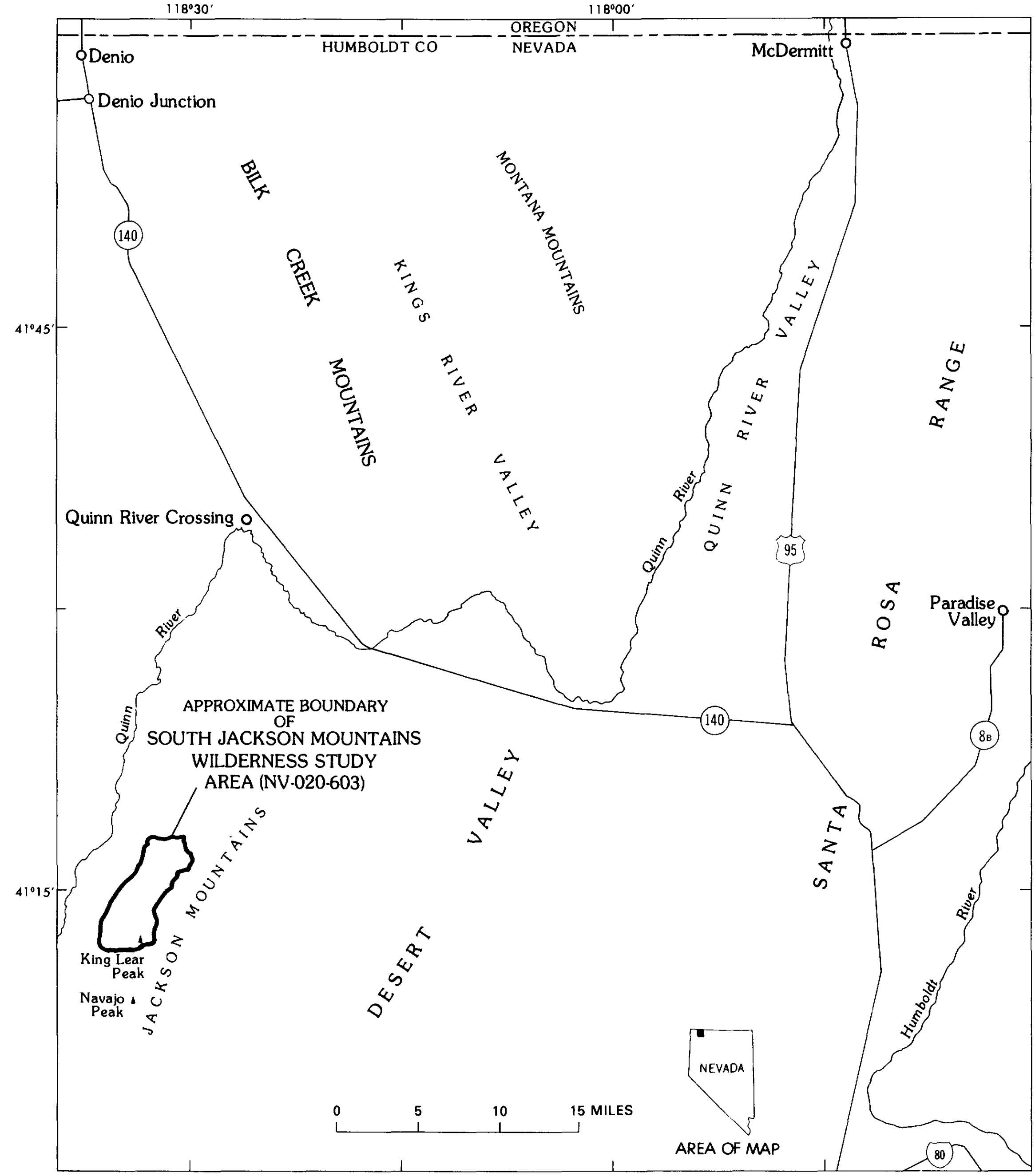


Figure 1. Index map showing location of the South Jackson Mountains Wilderness Study Area, Humboldt County, Nevada.

Avalanche and Red Boy properties.

The potential for oil and gas and geothermal resources in the study area is low.

INTRODUCTION

Description of Area

The South Jackson Mountains Wilderness Study Area (NV-020-603) is on the west flank of the Jackson Mountains in south-central Humboldt County, Nev., approximately 50 mi northwest of Winnemucca (fig. 1).

The north-trending Jackson Mountains, flanked by the Desert Valley to the east and the Black Rock Desert to the west, are in the western part of the Basin and Range physiographic province. The range rises a short distance south of Quinn River Crossing, trends generally south for approximately 45 mi, and ends near the south boundary of Humboldt County. It has a maximum width of 12 mi. The range is bordered by Nevada Highway 140 on the north, Nevada Highway 49 on the south, and unimproved desert roads on the east and west. The terrain is generally rugged, particularly along the west slopes of King Lear Peak, which rises to an elevation of 8,923 ft.

Previous and Present Studies

Reports on the Red Butte and Jackson Creek mining districts by Ransome (1909, p. 27-30), Hill (1912, p. 213-214), and Vanderburg (1938) contain brief descriptions of early mining activity. The U.S. Bureau of Mines (USBM) examined the Red Boy and Humboldt King mines during World War II as part of a War Minerals program and examined the Humboldt King property again for the Defense Minerals Exploration Administration in 1954 (USBM files). The first detailed geologic studies in the Jackson Mountains were by Willden (1958, 1960, 1961, 1963, 1964) and included geologic mapping, discussions of geologic history, and descriptions of mineral deposits. Iron deposits examined by Shawe and others (1962) included several about 1 mi east of the study area. Solak (1962) and Fisher (1962) described the geology and magnetic properties of iron deposits near the Iron King mine. Russell (1981, 1984) mapped and described the geology of the Jackson Mountains. Reports by Barringer Resources, Inc. (1982) and the U.S. Bureau of Land Management (1983a, 1983b, 1983c) include geochemical results, mining history, and other information pertaining to the study area.

Field investigations for the present study were conducted during 1984 and 1985. The U.S. Geological Survey (USGS) field checked published geologic maps and remapped selected areas, evaluated published geochemical data (Barringer Resources, Inc., 1982), sampled selected areas for geochemical analysis, collected and evaluated gravity data, and evaluated aeromagnetic data for the study area. The USBM evaluated known mineral deposits, mines, prospects, and mining claims, investigated the history of mining, and appraised identified mineral resources. The USBM researched the pertinent literature, Humboldt County mining records, and files of the USBM, Nevada Bureau of Mines, and the Bureau of Land Management (BLM). Claimants, mine owners, and mining companies were contacted to obtain information on claim location, history, and economic geology.

The descriptions of geologic structure, stratigraphy, and history used in this report are based on studies of the Jackson Mountains by Willden (1963) and Russell (1981, 1984). The descriptions of mines and prospects in and near the study area are taken from unpublished data of the USBM.

Acknowledgments

The assistance and cooperation of V.C. Dunn and other personnel of the BLM, Winnemucca, Nev., is gratefully acknowledged. Billiton Exploration USA, Inc., Wescord Resources, Long Lac Mineral Exploration, Inc., and claim owners Terry Harris, Fred Sherill, and Bud Johnson provided valuable information. Vaughn Girol, Vince Vandenbasch, and Spencee Willett, USBM, and C.F. Erdman and V.E. Langenheim, U.S. Geological Survey, assisted in the field investigations. Samples collected by the U.S. Geological Survey were analyzed by M.J. Malcolm and D.L. Fey of the U.S. Geological Survey, Denver, Colo.

APPRAISAL OF IDENTIFIED RESOURCES

By Michael M. Hamilton, U.S. Bureau of Mines

Mineral Exploration History and Current Activity

Although mining of precious metals in the region began in the 1860's, it was not until the early 1900's that mining activity began in the Jackson Mountains. The Red Butte unorganized mining district south of the study area was first prospected for gold and copper in 1907. The total production from the district was three carloads of copper-lead ore, one carload of lead-zinc-silver ore, and about 20 tons of antimony ore, most of which was shipped during World War I (Vanderburg, 1938, p. 41). The Claudia mine, about 5 mi south of the study area, was developed in the 1910's and produced a total of 25.8 oz gold, 144 oz silver, 262 lb copper, and 943 lb lead in 1919 and 1947 (USBM records). In 1986 the mine was being developed for possible future production. The Iron Chief prospect, about 7 mi south of the study area, was probably active in the 1950's but there is no production record. The Prodigal mine (Bull Creek claims), about 4 mi south of the study area, produced 1.43 oz gold, 213 oz silver, and 648 lb copper in 1923 (USBM records).

The Jackson Creek unorganized mining district, approximately 2 mi north of the study area, centered around the Harrison Grove mine (New Northern Light), which was patented in 1907. Hill (1912, p. 213) reported copper mining in the Jackson Creek area shortly thereafter. Production from this mining district probably totals less than 1,000 tons of copper ore (USBM unpub. data). The Jackson Queen and the Humboldt King properties, about 1 mi north of the study area (fig. 2), were active in the 1910's and 1920's with intermittent exploration to the present. The Humboldt King mine probably produced a small amount

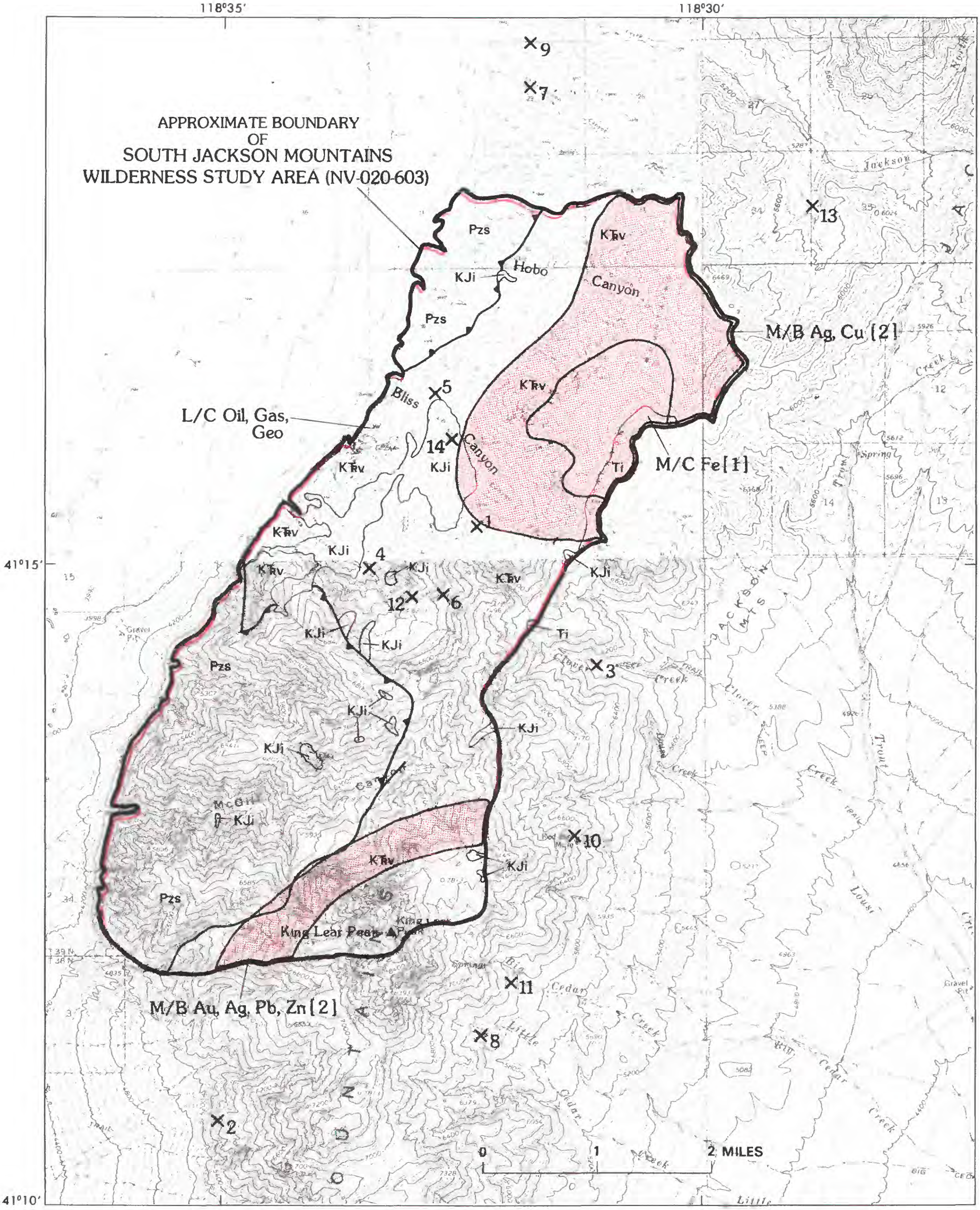


Figure 2. Mineral resource potential of the South Jackson Mountains Wilderness Study Area, Humboldt County, Nevada. Contour interval 40 ft. Geology generalized from Sorensen (1986).

EXPLANATION

Area with moderate mineral resource potential

Area with low mineral resource potential

See Appendix 1 for definition of levels of mineral resource potential and certainty of assessment

Commodities

Au	Gold
Ag	Silver
Cu	Copper
Fe	Iron
Pb	Lead
Zn	Zinc
Geo	Geothermal
	Oil, Gas

[ ] Deposit types

1	Veins or replacement deposits associated with dioritic intrusions
2	Epithermal base- and precious-metal deposits

Geologic map units

Ti	Intrusive rocks (Tertiary)
KJi	Intrusive rocks (Cretaceous and Jurassic)
KRv	Volcanic and volcaniclastic sedimentary rocks (Cretaceous to Triassic)--Includes Happy Creek Volcanic Complex, Boulder Creek beds of Russell (1981), and King Lear Formation
Pzs	Sedimentary rocks (Paleozoic)

Contact

Normal fault

Thrust fault--Sawteeth on upper plate

×4 Mine or prospect--See table 1 for description

Mines and prospects

1	Avalanche prospect
2	Bluebird prospect
3	Clover prospect
4	Cold Springs prospect
5	Crystal prospect
6	Cuprite prospect
7	Humboldt King mine
8	Iron Girl prospect
9	Jackson Queen prospect
10	Red Boy mine
11	Red Star prospect
12	Shamrock prospect
13	White Point prospect
14	unnamed prospect

Figure 2. Continued.

of copper ore. Exploration of copper deposits in Christiorsson Canyon and on the west side of the Humboldt King property by Louisiana Land and Exploration Company and McPhar Geophysics in 1973 revealed no minable deposits.

Iron deposits in the Jackson Mountains were explored and developed during the 1950's and 1960's. The Iron King and Red Bird mines, about 4 mi northeast of the study area, collectively produced about 1.3 million tons of high-grade magnetite ore between 1952 and 1966 (Moore, 1971, p. 174 and 178). During this period, most of the iron deposits in and near the study area were explored. The Bull Iron prospect, about 3 mi south of the study area, and the Red Star and Iron Girl prospects (fig. 2) were drilled in an unsuccessful attempt to locate minable deposits. At present, there is little interest in mining iron deposits in the Jackson Mountains.

The Red Boy mine, about 1 mi east of the study area (fig. 2), produced a total of 1 oz gold, 748 oz silver, 49 lb copper, 5,073 lb lead, and 12,446 lb zinc in the two years of operation, 1940 and 1948 (USBM production records).

Recent mineral activity in the Jackson Mountains consists of exploration and staking of claims. In the late 1970's, the Lillian claim group was mapped and sampled for low-grade, bulk-tonnage, precious-metal deposits. In 1984, Wescord Resources, Reno, Nev. initiated an exploration program for volcanogenic massive-sulfide deposits at the Avalanche, Red Boy, Red Star, and Clover properties (fig. 2). In 1985, Wescord Resources leased its interest to Long Lac Minerals Exploration, Inc., Sparks, Nev., which plans to continue detailed mapping, sampling, geochemical surveys, and possible drilling.

County claim location records indicate that, from 1900 to the present, approximately 550 lode claims have been located in the southern part of the Jackson Mountains, many of which are relocations of previous claims. None were patented. In early 1986, there were eight active properties with a total of 126 claims.

Identified Resources

There are no identified resources in the South Jackson Mountains Wilderness Study Area. Several commodities are present within the study area in amounts too small to allow resource estimates, including silver, copper, and iron, and lesser amounts of gold, lead, zinc, vanadium, barium, and cobalt.

Volcanogenic deposits associated with the Happy Creek Volcanic Complex include mineral occurrences at the Red Boy, Humboldt King, and Avalanche properties. The Red Boy mine, about 1 mi east of the study area, has two exposures of sulfide-bearing veins that contain anomalous concentrations of gold, silver, lead, and zinc. This occurrence may extend into the study area in the Clover Creek and Big Cedar Creek areas. Veins bearing silver, copper, and minor cobalt and nickel occur on the Humboldt King property and constitute the largest exposed mineral deposits adjacent to the north side of the study area.

Locally high-grade gold-silver-lead-antimony veins at the Claudia, Tip and Dip, and Lillian properties, 3 to 5 mi south of the study area, have been explored. The Claudia mine has the only exposed sulfide-bearing zone of significant size (table 1). Tentative plans to resume mining at the Claudia mine are based on an assumption of reserves at depth sufficient to support a small mining operation. Silicified Tertiary rocks on the west side of the Lillian claims may have been the source of anomalous concentrations of gold detected in stream sediments (Barringer Resources Inc., 1982).

ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES

by Martin L. Sorensen, Donald Plouff, and Robert L. Turner
U.S. Geological Survey

Geology

The South Jackson Mountains Wilderness Study Area is in the western part of the Basin and Range Physiographic Province, an area characterized by narrow, north-trending block-faulted ranges that are separated by broad alluviated valleys. It is underlain mostly by marine sedimentary and volcanic rocks that are late Paleozoic and Mesozoic in age (380-150 million years before present (Ma); see Appendix 1 for geological time chart). These rocks have been complexly folded, faulted and intruded by dikes, sills, and small plugs.

The informally designated McGill Canyon unit of Russell (1981, 1984) is the oldest rock unit exposed in the southern Jackson Mountains. It is considered to be late Paleozoic on the basis of fossils that range from Devonian through Permian in age. Within the study area, the McGill Canyon unit consists mostly of shale, locally sandy mudstone, and fine- to medium-grained sandstone. The uppermost part of the McGill Canyon unit is a fault-bounded section of massive gray limestone of Mississippian to Permian age. The McGill Canyon unit is everywhere underlain by west-dipping thrust faults and so is allochthonous with respect to all other nonintrusive rock formations in the southern Jackson Mountains.

The informally designated Boulder Creek beds of Russell (1981, 1984) are stratigraphically younger than the McGill Canyon unit but mostly are structurally beneath those rocks. The Boulder Creek beds are considered to be Triassic and Jurassic(?) in age on the basis of Triassic fossils (Russell, 1981, p. 45-46; 1984, p. 317). Within the study area, the Boulder Creek beds form a sequence of generally deformed shale, sandstone, limestone, chert, and volcanogenic sedimentary rocks. Locally, pelitic and calcareous sedimentary rocks grade upward to volcaniclastic sedimentary rocks that are conformably overlain by the Happy Creek Volcanic Complex.

The Happy Creek Volcanic Complex (Sorensen 1986) forms the scenic prominence of King Lear Peak and underlies much of the higher parts of the study area. The complex consists of andesite and basaltic-andesite flows and flow breccias, volcaniclastic sedimentary rocks, and quartz-diorite and diorite intrusions (Russell, 1984, p. 318). These rocks are considered to be Jurassic and Triassic(?) in age on the basis of a whole-rock rubidium/strontium isochron age of 160 Ma (Russell, 1984, p. 318) and because the unit locally is conformable above the Triassic and Jurassic(?) Boulder Creek beds (Russell, 1984, p. 318).

The King Lear Formation, named by Willden (1958; 1963, p. D18) for exposures on the southeast side of King Lear Peak, is the youngest sedimentary rock unit within the study area. The King Lear Formation consists of alluvial fan deposits of mudstone, volcanic sandstone and conglomerate, and sparse lacustrine limestone. Fossils within the limestone suggest an Early Cretaceous age for the unit (Willden, 1963, p. D21).

Unconsolidated Quaternary alluvium is present near the head of Alaska Canyon, just south of Hobo Canyon, near the ridgecrest northeast of Bliss Canyon, and in many of the larger stream canyons in the study area (Sorensen, 1986).

Rock units older than the King Lear Formation have been intruded by dikes, sills, and small plugs or stocks. Some of the intrusions are very fine grained white felsite, but most are greenish-brown- to tan-weathering rocks consisting of phenocrysts of plagioclase, pyroxene, hornblende, and sparse quartz in a fine-grained groundmass that commonly contains epidote and sericite. Russell (1981, p. 170-179) indicates that these rocks were emplaced during Jurassic to Cretaceous time, after the eruption of the Happy Creek Volcanic Complex and before deposition of the King Lear Formation.

A small dacite porphyry plug is present east of Bliss Canyon along the east boundary of the study area. It consists of abundant plagioclase phenocrysts and very scarce quartz phenocrysts in a dark-greenish-gray groundmass that contains fine-grained epidote and mafic material. These rocks are probably Tertiary in age (Willden, 1963, p. D30).

Geologic structure within the study area is typified by west-dipping thrust faults. The McGill Canyon unit is underlain by thrusts that have emplaced it structurally above Boulder Creek and Happy Creek units in the northwestern and southwestern parts of the study area. The Boulder Creek beds are cut by thrust faults that have telescoped the section in the northwestern part of the study area. The west-dipping Deer Creek thrust (Willden, 1963), which is exposed 1 mi southeast of King Lear Peak, may underlie the study area.

Geochemical Studies

Geochemical studies were conducted as an aid in the mineral resource assessment of the South Jackson Mountains Wilderness Study Area. These studies were conducted at two levels, a review of the results of a regional reconnaissance survey, and a detailed study of a small area on the west side near Bliss Canyon, where the reconnaissance data suggested possible mineralization. For the detailed survey, the sampling density averaged one sample per square mile.

During the reconnaissance study, conducted by Barringer Resources, Inc. (1982), 89 stream-sediment samples were collected from localities in and near the original wilderness study area, which is larger than the area on which this mineral assessment was focused. We present here only the results for the current 10,300-acre study area. The drainage basins of the sampled streams range from approximately one-half to several square miles. The report by Barringer Resources, Inc. (1982, v. 4), provides a complete description of sample preparation and analytical techniques. The resulting chemical analyses were examined for indications of geochemical anomalies by constructing histograms for arsenic, copper, lead, and zinc (elements that are commonly indicative of several types of mineral deposits) and by defining the threshold value for anomalous concentrations for each of these elements as its mean value plus two standard deviations.

Arsenic, copper, and zinc are present at low levels in all samples. Copper (greater than 130 ppm) and zinc (greater than 165 ppm) concentrations are slightly anomalous in samples from localities east and southeast of the study area; arsenic (greater than 37 ppm) and zinc (greater than 165 ppm) are slightly anomalous in samples from localities along a northeast-trending zone near the west boundary of the study area, where the background levels of lead (10-20 ppm) are high. Gold (0.17 ppm) is present in one sample collected 3.5 mi south of the study area near Navajo Peak. Silver (0.010 ppm, 0.005 ppm) was detected in two samples collected 1.5 mi north of the study area near Jackson Creek. Cadmium, chromium, and nickel are present at low concentrations in samples from scattered localities on the west side of the study area. These reconnaissance geochemical data do not indicate any significant mineral deposits within the study area, but they do suggest the necessity for more detailed sampling in the zone of elevated arsenic and zinc values along the west boundary of the study area.

Additional stream-sediment concentrate and rock samples for a more detailed study were collected near the mouth of Bliss Canyon in the northwestern part of the study area to determine the source of the arsenic and zinc detected in the reconnaissance study. All rock types were sampled and include unmineralized outcrop, mineralized outcrop, and mineralized or altered stream boulders. Nine stream-sediment concentrate samples and eight rock samples were collected from the 1.5-mi-long zone. Methods of collection, preparation, and analysis, and the results of those chemical analyses are described in Day and others (1986).

Chemical analyses of the rocks indicate low levels of arsenic, antimony, bismuth, and zinc in carbonate rocks from the McGill Canyon unit. Spectrographic analysis of the slightly magnetic and nonmagnetic fractions of heavy-mineral separates from the rock samples disclosed the presence of low levels of antimony, arsenic, barium, chromium, copper, lead, nickel, and silver. Spectrographic analyses of the nonmagnetic fraction of the stream-sediment concentrates indicate the presence of gold at one site, silver, lead, and zinc at two sites, and barium and strontium at most sites. The stream-sediment concentrates are derived from the Happy Creek Volcanic Complex and the McGill Canyon unit.

Thus, both rock units seem to be slightly mineralized but none of the geochemical analyses indicate significant mineralization within the study area.

Geophysical Studies

J.S. Duval (written commun., 1985) estimated concentrations of potassium, equivalent uranium, and equivalent thorium by examining unpublished composite-color maps of gamma-ray spectrometric data. The maps were prepared at a scale of 1:1,000,000 from radiometric data acquired in regional surveys contracted by the U.S. Department of Energy as part of the National Uranium Resource Evaluation (NURE) program. Flightlines were flown at an altitude of about 400 ft above mean terrain (Geodata International, Inc., 1979). One north and three east-west-bearing flightlines spaced at intervals of about 3 mi covered the study area. Radioelement detection was diminished in the west half of the study area where flight levels exceeded 700 ft above the ground. Based on criteria discussed by Duval (1983), the study area has moderate radioactivity with values of 1.0-2.5 percent potassium, 2 to 5 ppm equivalent uranium, and 4 to 11 ppm equivalent thorium. There is no indication of anomalous concentrations of radioelements.

The U.S. Geological Survey established 40 gravity stations in the surrounding area in 1984 to prepare a regional Bouguer gravity anomaly map (Donald Plouff, unpub. data, 1984). The map also includes anomalies determined from principal facts for six gravity stations from the Defense Mapping Agency gravity file (available from Terrestrial Geophysics Data Service, National Oceanic and Atmospheric Administration, Boulder, Colo.). The gravity map shows that the study area lies along the crest of an elongated gravity high that is about 6 mi wide and varies from about 10 to 20 milligals (mGal) in amplitude. Gravity gradients that exceed 10 mGal/mi along a relatively closely spaced profile located about 4 mi south of the study area suggest that contacts of the Jackson Mountain block with the less dense rocks in the flanking basins are steep and fault controlled.

A regional aeromagnetic map (U.S. Geological Survey, 1972) that includes the study area shows a broad magnetic high over an 8 by 24 mi area of the Jackson Mountains. The survey was flown at a constant barometric elevation of 9,000 ft above sea level and at flightline spacings of 2 mi. A later aeromagnetic survey (U.S. Geological Survey, 1985) provides more detailed magnetic data for evaluating the resource potential of the study area. The flightlines were spaced 0.5 mi apart and were flown about 1,000 ft above the mean terrain.

The detailed aeromagnetic map shows that the Boulder Creek beds and McGill Canyon unit generally have a low magnetization, which is attributed to an inherent lack of magnetic minerals rather than an effect of rock alteration. The magnetic pattern shows little correlation with mapped faults, because the near-surface rocks on adjacent sides of the faults have nearly the same magnetization.

A prominent magnetic high with an amplitude of nearly 500 nanoteslas (nT) and a diameter of 1.8 mi is located south of Hobo Canyon in the northeastern part of the study area (fig. 3, location A). A magnetic saddle over Hobo Canyon separates that high from another magnetic high farther to the northeast with an amplitude of 100 nT and a diameter of 1.3 mi. Both magnetic highs are underlain by the Happy Creek Volcanic Complex, which is locally covered by a veneer of the King Lear Formation. The intensity of the magnetic high south of Hobo Canyon indicates that the near-surface rocks underlying the anomaly have a relatively high magnetite content. The Iron King deposit (fig. 3), which is localized along a contact between diorite intrusive rocks and the Happy Creek Volcanic Complex (Willden, 1963, p. 53), underlies a complexly shaped magnetic high that has a smaller areal extent, somewhat higher magnetic gradients, and a somewhat greater contour curvature than the prominent anomaly south of Hobo Canyon. A 4.5- by 5.5-mi magnetic high, centered about 4 mi north of the study area (fig. 3, location B), is caused by an underlying pluton.

The Avalanche prospect near the head of Bliss Canyon coincides with a magnetic gradient at the southwest edge of the prominent magnetic high (fig. 3, location A) south of Hobo Canyon. The Red Boy mine, about 1 mi east of the study area, coincides with a steep magnetic gradient that extends into the southeast corner of the study area (fig. 3, location C). Both gradients may reflect a mineralized contact zone between intrusive rocks and less magnetic country rock.

Mineral and Energy Resources Potential

Iron Resources

Iron occurrences associated with dioritic intrusions are present as veins and contact replacement deposits in the Happy Creek Volcanic Complex at several localities in the Jackson Mountains (Willden, 1963, p. D53). The close association of deposits and intrusions suggests that the iron may have been removed from andesite during emplacement of the diorite stocks or, alternatively, that the dioritic magma may have been the source of the iron (Willden, 1963, p. D54). The most significant deposit near the study area is at the Iron King mine, which underlies a prominent, complexly shaped aeromagnetic high. A large aeromagnetic high overlying the Happy Creek Volcanic Complex south of Hobo Canyon (fig. 3) suggests the presence of an intrusive body and indicates rocks with a high magnetite content at relatively shallow depths. Therefore, the area just south of Hobo Canyon has a moderate resource potential, certainty level C, for iron resources in deposits similar to those at the Iron King mine (fig. 2). See Appendix 1 for definition of levels of mineral resource potential and certainty of assessment.

Gold, Silver, Lead, and Zinc Resources in Massive Sulfide Deposits

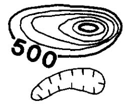
Massive sulfide deposits consisting of volcanogenic exhalative sulfide minerals are commonly associated with mafic to felsic volcanic rocks accumulated in a deep submarine volcanic-arc environment. The deposits are originally tabular to lens shaped, but may be remobilized by later magmatic or hydrothermal activity and redeposited along fractures, joints, or as epithermal hot-springs deposits.

The lithology and chemistry of the Happy Creek Volcanic Complex indicate its origin as a Mesozoic submarine volcanic arc (Russell, 1981, p. 160-169). Unpublished company reports (Wescord Resources, Reno, Nev. 1984, 1985) describe the Red Butte mining district and the area at the north boundary of the study area as possible volcanogenic exhalative vent zones, and classify an area between Hobo and Bliss Canyons as having resource potential for gold in epithermal deposits. Geochemical data indicate weak precious- and base-metal mineralization in rocks within the Hobo and Bliss Canyon drainage basins. Geophysical data indicate the Avalanche prospect is located on a magnetic gradient that is associated with the prominent magnetic high south of Hobo Canyon. The area of this magnetic gradient has a moderate potential, certainty level B, for silver and copper resources in massive sulfide deposits similar to that of the Avalanche prospect (fig. 2). Similarly, the Red Boy mine is located on a magnetic gradient that may represent a mineralized contact zone. The area of this magnetic gradient that lies within the study area has a moderate potential, certainty level B, for gold, silver, lead, and zinc resources in massive sulfide deposits similar to that of the Red Boy mine (fig. 2).

Oil and Gas Resources

The potential for oil and gas resources in the study area is low, certainty level C. Pre-Cretaceous rocks mostly consist of volcanic and volcaniclastic sedimentary rocks that lack hydrocarbons. Marine sedimentary and carbonate rocks constitute a small part of the pre-Cretaceous section, but probably have lost any hydrocarbons originally contained within them due to the low-grade regional metamorphism and igneous intrusion that occurred during Late Jurassic (Willden, 1963, p. D59) or Early Cretaceous (Russell, 1981, p. 185) time. The King Lear Formation of Early Cretaceous age postdates the regional metamorphism, but is not typified by organically rich rocks.

EXPLANATION



Magnetic contours--Showing residual magnetic intensity of Earth's magnetic field in nanoteslas (nT) (1 nT=1 gamma); International Geomagnetic Reference Field has been removed and an arbitrary datum has been added; contour interval 100 nT. Hachures indicate area of closed low

.... Boundary of magnetic anomaly (A-C) discussed in text

× Selected mine or prospect

Figure 3. Aeromagnetic map of the South Jackson Mountains Wilderness Area, Humboldt County, Nevada.

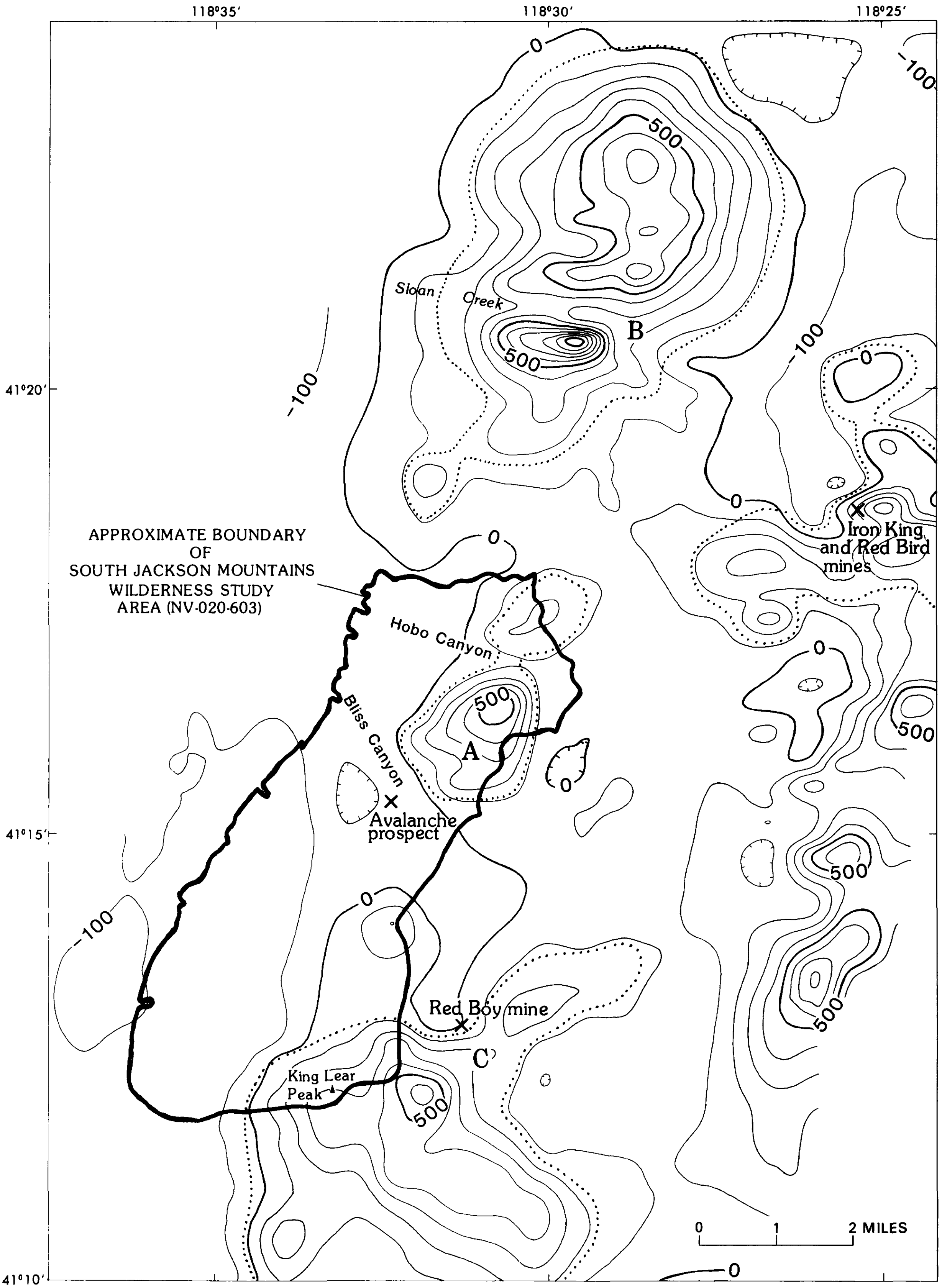


Figure 3. Continued.

Geothermal Resources

Hot springs are not present in the study area. The nearest known hot springs are at Macfarlane's Bath House spring, 14 mi south of the study area, and an unnamed spring near Quinn River Crossing, 22 mi north of the study area. The potential for geothermal resources within the study area is low, certainty level C.

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Table 1. Mines and prospects in and near the South Jackson Mountains Wilderness Study Area
[Bureau of Mines, unpublished data, 1986; *, outside study area]

Number (fig. 2)	Name (commodity)	Summary	Workings and production	Sample data
1	Avalanche prospect (silver, copper)	Silver- and copper-bearing veins trend northeast and dip northwest in andesite in the Happy Creek Volcanic Complex near contact with a felsite intrusion. Main vein is 340 ft long and averages 4.2 ft wide. Currently being explored as a volcanogenic massive-sulfide deposit.	One 50-ft adit with a small stope, one shallow shaft, 15 prospect pits, and a number of bulldozer scrapes. No known production.	Eleven chip samples from veins and mineralized shear zones contain from 0.0 to 0.04 parts per million (ppm) gold, 0.0 to 35 ppm silver, and 0.02 to 12 percent copper. Two chip and four grab samples from structures on southwest side of property contain from 0.0 to 0.48 ppm silver and 0.0018 to 0.0037 percent copper.
2*	Bluebird prospect (copper, silver, barium)	Several small, discontinuous, copper- and barium-bearing veins follow faults in andesite, greenstone, and basalt in the Happy Creek Volcanic Complex.	Three adits totaling 120 ft and four pits and trenches. No known production.	Seven chip samples from oxidized veins and altered wallrock contain from 0.0 to 0.028 ppm gold, 0.0 to 5.7 ppm silver, and 0.0069 to 6.2 percent copper. Two select samples from dumps contain 0.0 and 0.007 ppm gold, 6.5 and 12 ppm silver, and 8.4 and 10 percent copper. One grab sample of basalt contains no significant mineral concentrations.
3*	Clover prospect (silver, copper, lead)	Sulfide veins in andesite in the Happy Creek Volcanic Complex and Boulder Creek sedimentary rocks are close to an alkalic granite plug. Granite is altered and contains pyrite. On east side of prospect, minor alteration present at the contact between an intrusive hornblendite and sedimentary rocks. Being explored for volcanogenic massive-sulfide deposits.	Two adits totaling 170 ft in length and seven prospect pits. No known production.	Three chip samples from sulfide veins and mineralized fractures contain from 0.0 to 0.1 ppm gold and 0.0 to 11 ppm silver; three select samples contain from 0.01 to 0.02 ppm gold, 3 to 99 ppm silver, 0.018 to 0.40 percent copper, and 0.0027 to 3 percent lead. Three grab samples of altered granite are devoid of signficant mineral values as are two from altered hornblendite.
4	Cold Springs prospect (commodity unknown)	Altered shear zone in felsite strikes N. 40° E and dips 80° SE.	One adit 40 ft long, one caved adit, and one prospect pit. No known production.	Three chip samples contain small amounts of copper, barium, and iron.
5	Crystal prospect (commodity unknown)	Highly altered shale and limestone with layered calcite deposits, hematite, and barite veins is adjacent to felsite intrusion.	One 35-ft-deep shaft and two cuts. No known production.	One grab sample of altered dump rock with calcite veins has no significant values.
6	Cuprite prospect (silver, copper)	Limestone inclusion in andesite of the Happy Creek Volcanic Complex contains garnet skarn with copper. Copper also found in andesite.	One pit. No known production.	One grab sample of altered limestone contained 3.5 ppm silver and 0.39 percent copper. One grab sample of andesite contains 0.022 percent copper.
7*	Humboldt King mine (silver, copper, cobalt)	A 1,500-ft-long sulfide-bearing zone found in sheared andesite and in an adjacent, overlying thrust sheet. Geophysical anomalies on west and south sides of property may indicate massive-sulfide deposits at depth, possibly under a thrust sheet. Currently being explored for volcanogenic massive-sulfide deposits.	Ten adits, three shafts, and numerous cuts, trenches, and pits are along mineral zones. There are several old drill sites. Most underground workings are inaccessible. No known production.	Ten samples of altered metasedimentary rock contain no signficant mineral values. Twenty-three chip samples from the main mineralized zone contain from 0.0 to 0.36 ppm gold, 0.0 to 26 ppm silver, and 0.017 to 7.8 percent copper; four grab samples average 0.035 ppm gold, 6.0 ppm silver, and 2.6 percent copper; one select sample contains 0.011 ppm gold, and 14 percent copper. From other smaller veins seven chip samples contain from 0.0 to 0.013 ppm gold, 0.0 to 36 ppm silver, and 0.018 to 5.8 percent copper; two grab samples average 0.041 ppm gold, 5.9 ppm silver, and 0.12 percent copper; two select samples contain as much as 0.7 ppm silver and 0.1 percent copper. Two grab samples of altered volcanic rock contain no significant minerals. Twenty-two samples (company data) from the Humboldt King mine average 0.32 oz/ton silver, 1.8 percent copper, 0.078 percent nickel, and 0.076 percent cobalt.
8*	Iron Girl prospect (iron)	Three short lenses of magnetite found in andesite of the Happy Creek Volcanic Complex. Three other small occurrences of altered country rock have minor copper. Currently being explored for volcanogenic massive-sulfide deposits.	Four bulldozer contour cuts with drill sites, and two pits are on the main occurrence. Three bulldozer trenches are on smaller occurrences. No known production.	Five grab samples: two of magnetite and hematite average 60 percent iron, and three from altered country rock contain no significant values.

Table 1. Mines and prospects in and near the South Jackson Mountains Wilderness Study Area--Continued

Number (fig. 2)	Name (commodity)	Summary	Workings and production	Sample data
9*	Jackson Queen prospect (gold, silver, copper)	Copper-bearing quartz veins in andesite and greenstone trend northeast and may be extensions of deposits exposed at adjacent Harrison Grove and Humboldt King mines. Currently being explored for volcanogenic massive-sulfide deposits.	Four adits total about 300 ft in length. Also three prospect pits and one caved adit. No known production.	Eleven chip samples from main mineral zone contain from 0.0 to 4 ppm gold, 0.0 to 22 ppm silver, and 0.0027 to 12 percent copper; one grab sample from same zone contains 0.027 ppm gold, 1.7 ppm silver, and 0.017 percent copper. Two select samples from small veins contain 0.009 and 0.021 ppm gold, 20 and 2.4 ppm silver, and 6.7 and 0.82 percent copper.
10*	Red Boy mine (gold, silver, copper, lead, zinc)	Massive-sulfide deposits containing chalcopyrite, argentiferous galena, and sphalerite in andesite of the Happy Creek Volcanic Complex are poorly exposed at two locations 300 ft apart. Currently being explored.	One shaft and two adits are caved or flooded. One 20-ft-long adit is open. There are also 11 prospect pits and one cut. Production in 1940 and 1948 totaled 1 oz gold, 748 oz silver, 49 lb copper, 5,073 lb lead, and 12,446 lb zinc. In 1943 two carloads of ore, containing an unknown amount of metal, were shipped to a smelter.	Six chip samples of main sulfide-bearing vein contain 0.042 to 5.0 ppm gold, 3.8 to 500 ppm silver, 0.014 to 0.13 percent copper, 0.058 to 10 percent lead, and 0.35 to 7.0 percent zinc; one select sample from same vein contains 5 ppm gold, 190 ppm silver, 0.10 percent copper, 1.9 percent lead, and 24 percent zinc; one grab sample from a carbonate vein contains 0.076 ppm gold, 120 ppm silver, 0,52 percent lead, and 0.78 percent zinc. Two chip and two grab samples of altered andesite contain no signficant minerals.
11*	Red Star prospect (iron, copper)	Fifty claims cover an area currently being explored for volcanogenic massive-sulfide deposits. Several small iron deposits in the middle of the claim group are veins of magnetite and hematite in andesite of the Happy Creek Volcanic Complex.	Iron deposits are developed by several thousands of feet of bulldozer cuts and scrapes on both sides of Big Cedar Creek. These deposits were drilled in 1958 by Pacific Steel Co. No known production.	Six chip samples from iron deposits average 53 percent iron; one chip sample of altered wallrock contains 0.20 ppm gold, 1.0 ppm silver, 0.41 percent copper, and 14 percent iron. Three grab samples of andesite contain no significant minerals.
12	Shamrock prospect (commodity unknown)	Brecciated, bleached andesite is recemented with limonite and barite.	One prospect pit. No known production.	Of two grab samples, one contains 0.17 percent barium. There are no other significant values.
13*	White Point prospect (uranium)	Exploration for uranium was in moderately altered Tertiary dacite.	About 1,300 ft of bulldozer trenches and scrapes. No known production.	Nine samples average 9.1 ppm uranium. A geophysical survey showed low radioactivity of 150 to 200 counts per second.
14	Unnamed prospect (commodity unknown)	Altered shear zone with pyrite and barite in a felsic intrusion trends N. 75° E. and dips 40° NW.	One prospect pit. No known production.	One chip sample contains 0.015 percent copper.

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

Definitions of Mineral Resource Potential

LOW mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics define a geologic environment in which the existence of resources is unlikely. This broad category embraces areas with dispersed but insignificantly mineralized rock as well as areas with few or no indications of having been mineralized.

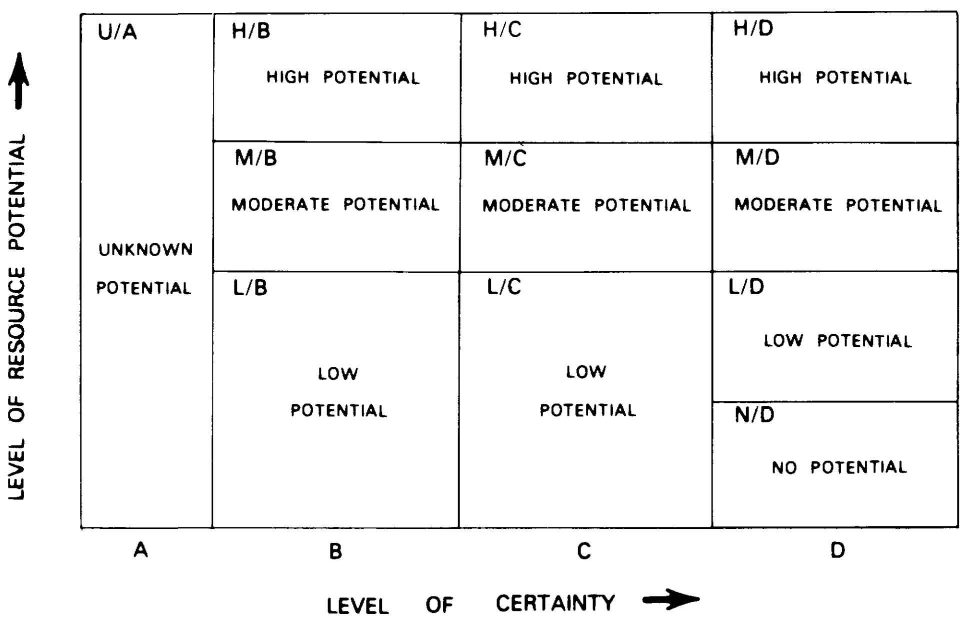
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application of mineral-deposit models indicates favorable ground for the specified type(s) of deposits.

HIGH mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a high degree of likelihood for resource accumulation, where data support mineral-deposit models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential to an area requires some positive knowledge that mineral-forming processes have been active in at least part of the area.

UNKNOWN mineral resource potential is assigned to areas where information is inadequate to assign low, moderate, or high levels of resource potential.

NO mineral resource potential is a category reserved for a specific type of resource in a well-defined area.

Levels of Certainty



A. Available information is not adequate for determination of the level of mineral resource potential.
B. Available information suggests the level of mineral resource potential.
C. Available information gives a good indication of the level of mineral resource potential.
D. Available information clearly defines the level of mineral resource potential.

Abstracted with minor modifications from:

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GEOLOGIC TIME CHART

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

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

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

[2]Informal time term without specific rank.

GPO 785-048/48032

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849