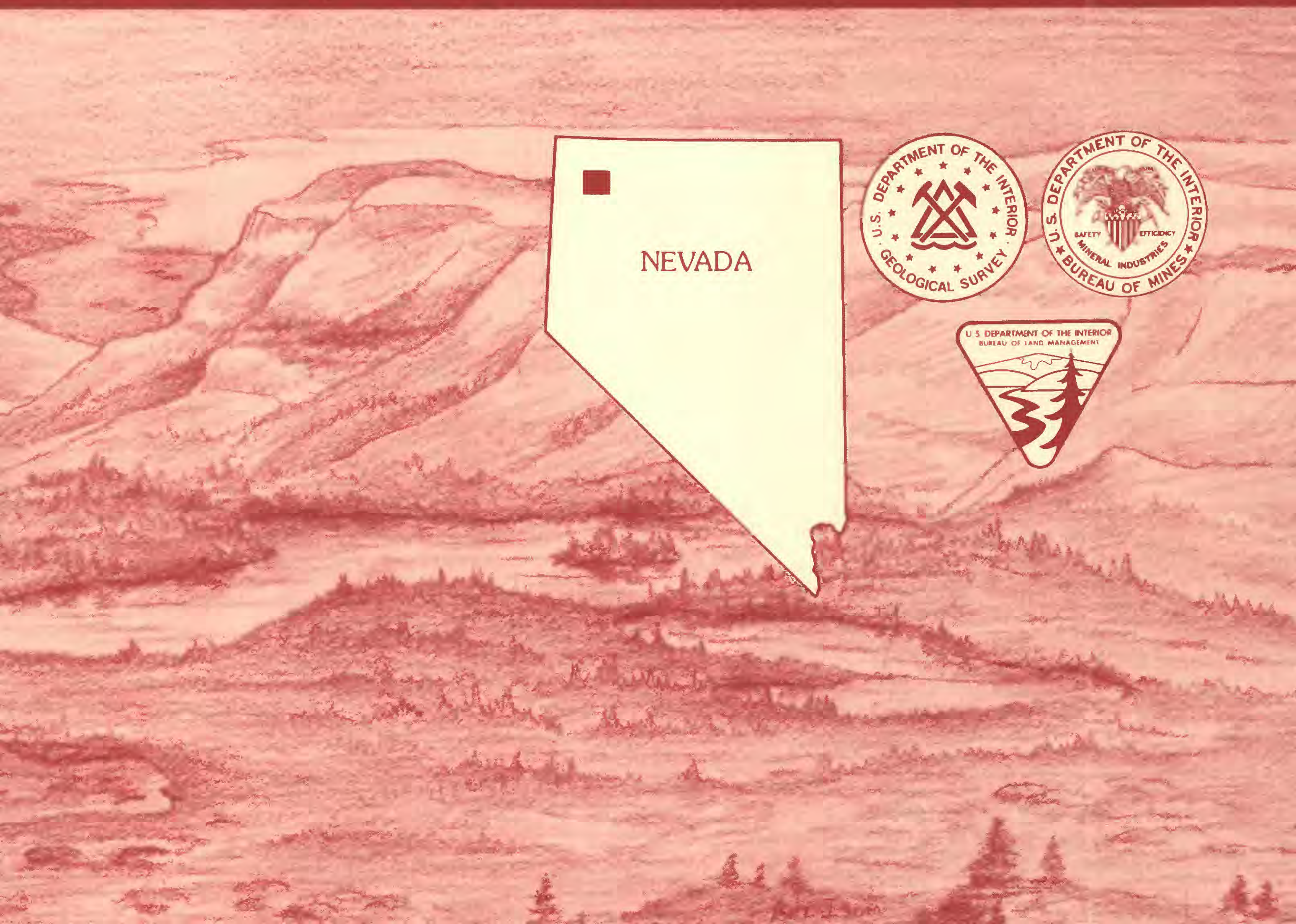
Mineral Resources of the Pahute Peak Wilderness Study Area, Humboldt County, Nevada

U.S. GEOLOGICAL SURVEY BULLETIN 1726–C



Chapter C

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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

U.S. GEOLOGICAL SURVEY
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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 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 Pahute Peak Wilderness Study Area (NV-020-621), Humboldt County, Nevada.

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Mineral Resources of the Pahute Peak Wilderness Study Area, Humboldt County, Nevada

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SUMMARY

Abstract

The part of the Pahute Peak Wilderness Study Area (NV-020-621) requested for mineral surveys encompasses 25,200 acres in the central and southern parts of the Black Rock Range. Fieldwork for this report was done in 1984 and 1985. Three areas are identified as having mineral resource potential, and one area has potential for geothermal resources. An area at the northwest corner of the study area has moderate resource potential for gold, silver, copper, lead, zinc, molybdenum, and tungsten. An area adjacent and partially overlapping to the south has high resource potential for gold and silver. Most of the northern two-thirds of the study area has moderate resource potential for gold and silver. An area in the southwestern part of the study area has high potential for geothermal resources. There is low potential throughout the study area for mercury and uranium resources. Minor amounts of opal and petrified wood are found in the study area, but there are no indications of resource potential. In this report, references to the Pahute Peak Wilderness Study Area or study area refer only to that part of the wilderness study area requested by the U.S. Bureau of Land Management for mineral surveys.

Character and setting

The Pahute Peak Wilderness Study Area is in the central and southern parts of the Black Rock Range in Humboldt County, northwest Nev. (fig. 1). The study area includes some of the most rugged parts of the range, and relief locally exceeds 4,000 ft. A major active normal fault system bounds the west margin of the range. The area is underlain largely by slightly tilted rhyolitic to basaltic volcanic rocks of Oligocene and Miocene(?) age (fig. 2; see appendix for geologic time chart). Some of these rocks are hydrothermally altered, whereas others were altered by reaction with groundwater. Granodiorite to quartz monzonite of Cretaceous age and metasedimentary rocks of probable Mesozoic and Paleozoic age are exposed locally in the northwestern part of the study area. A few landslide masses are present along the west side of the Black Rock Range.

Identified Resources

There are no identified resources within the Pahute Peak Wilderness Study Area.

Mineral Resource Potential

The northwestern part of the study area around Copper Canyon is underlain by granitic and metasedimentary rocks and has moderate resource potential for gold, silver, copper, lead, molybdenum, tungsten, and particularly for zinc in skarn deposits. An area underlain by volcanic rock 2 mi south of Copper Canyon has high potential for gold and silver resources in precious-metal deposits of epithermal vein or disseminated type. Areas underlain by Cenozoic volcanic rocks in the central and northern

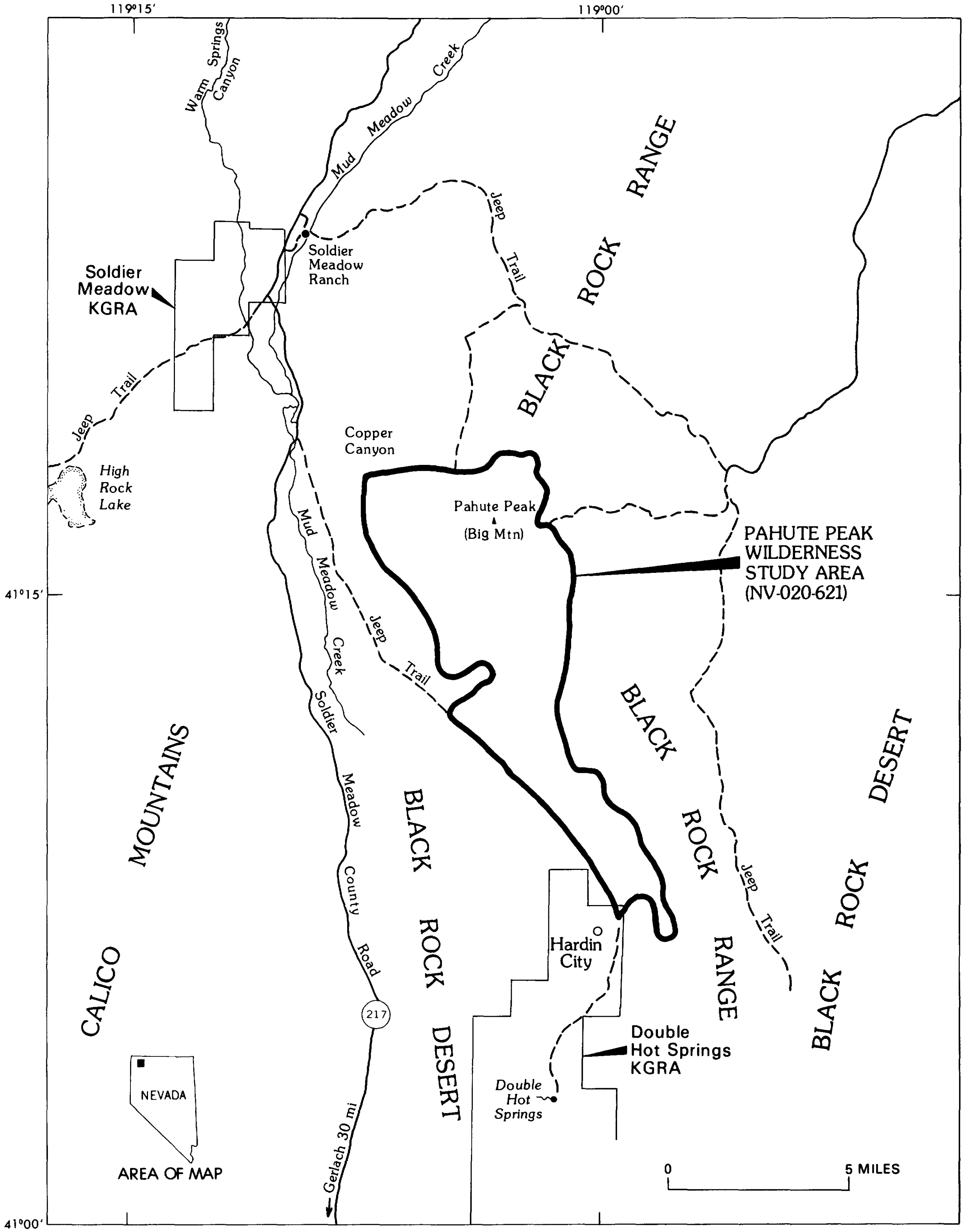

Figure 1. Index map showing location of the Pahute Peak Wilderness Study Area, Humboldt County, Nevada. Locations of Known Geothermal Resource Areas (KRGA) from Muffler (1979).

parts of the study area have moderate resource potential for gold and silver in epithermal vein or disseminated deposits. The southwestern part of the study area has high potential for geothermal energy resources. The entire study area has low resource potential for mercury and uranium.

INTRODUCTION

Area Description

The part of the Pahute Peak Wilderness Study Area (NV-020-621) studied covers 25,200 acres in the western part of the central and southern Black Rock Range in western Humboldt County, Nev. (fig. 1). The terrain is rugged over much of the study area, with elevations ranging from 4,005 ft in the southwestern part of the area to 8,594 ft at the summit of Pahute Peak (also known as Big Mountain). Cliffs and steep canyons are common, especially on the west slope of the range. The climate is arid to semiarid and vegetation is sparse, with saltbush, greasewood, and sagebrush the dominant vegetation.

The best access to the study area is from Gerlach via the Soldier Meadow County Road (HU 217). From this road an unimproved dirt road generally follows the west margin of the study area. An unmapped but well-used jeep trail traverses the northern part of the study area, and unimproved jeep trails that cross the desert piedmont provide access to the west margin of the study area.

Previous and Present Investigations

The Pahute Peak Wilderness Study Area includes parts of the Big Mountain, Clapper Creek, Pidgeon Spring, and Pidgeon Spring SW 7 1/2-minute quadrangles. Willden (1964) presented a geologic map of Humboldt County that differentiated Cenozoic and pre-Cenozoic rocks, but provides little detail of the Cenozoic stratigraphy. Unpublished reconnaissance geologic mapping of the Cenozoic rocks of the western part of Humboldt County by D.C. Noble, done for the geologic map of Nevada (Stewart and Carlson, 1978), served as the foundation for the geologic mapping done for this study. For information on mines and prospects, the U.S. Bureau of Mines searched Humboldt County claim records, U.S. Bureau of Land Management claim records, and U.S. Bureau of Mines production records. Claim owners were contacted for additional information and for permission to examine and publish data about their properties. Field studies to examine mines, prospects, and mineralized sites were carried out in 1984 by R.S. Gaps, J.E. Olson, and N.T. Zilka of the U.S. Bureau of Mines (Olson, 1986). All mineral properties identified were examined, sampled, and, if warranted, mapped.

The geochemical evaluation was based on data obtained from the geochemical evaluation of the study area by Barringer Resources, Inc. (1982), data on heavy-mineral concentrates (Day and Barton, 1986), and quantitative rock geochemical data (Olson, 1986). Rock geochemical data are available from the U.S. Bureau of Mines, Western Field Operations Center, E. 360 Third Avenue, Spokane, Washington, 99202.

APPRAISAL OF IDENTIFIED RESOURCES

By Jerry E. Olson, U.S. Bureau of Mines

Mining History

Mining has occurred in districts near the Pahute Peak Wilderness Study Area, but only four prospects are located within the study area.

Allen Hardin reportedly found a 25-lb chunk of cerargyrite (horn silver) in 1849 near the study area (Vanderburg, 1938). Hardin City and a millsite were built (about 1 mi southwest of the present study area) subsequent to reports of the discovery of a "lost" silver mine. No workings exist near the millsite and there was apparently no production, but parts of the mill are still standing.

Mining Claims

U.S. Bureau of Land Management records indicate four areas under active or recent claim within or adjacent to the study area, and an additional claim was identified during field work. None of these claims are patented. The Copper Canyon area (fig. 2), at the north edge of the study area, is developed by numerous underground and surface workings. The remaining four claim blocks are 2 to 4 mi south of Copper Canyon. Workings are limited to a few small pits. Workings reported by the U.S. Bureau of Land Management (1983) near Clapper Creek were not found.

Mineralized Areas

Three mineralized areas were sampled by the U.S. Bureau of Mines. These three areas correspond to three areas discussed by the U.S. Bureau of Land Management (1983) and are based largely on interpretation of geochemical data in Barringer Resources, Inc. (1982).

Copper Canyon Area

Within the Copper Canyon area there are numerous workings, including a 300-ft adit near the mouth of the canyon. Several smaller adits and pits expose narrow quartz veins and probable poorly developed skarn zones. In the 28 rock samples analyzed by the U.S. Bureau of Mines, gold values were at or below detection limits. Molybdenum, tin, and tungsten were not detected. Silver values were generally low, but two samples contain 15 and 17 parts per million (ppm). Zinc concentrations in four samples from shear and gossan zones range from 0.018 to 8.7 weight percent and was detected in amounts ranging from 0.8 to 8 weight percent in three other rock samples. Because zinc-bearing skarns are commonly found distant from the source (Einaudi and others,

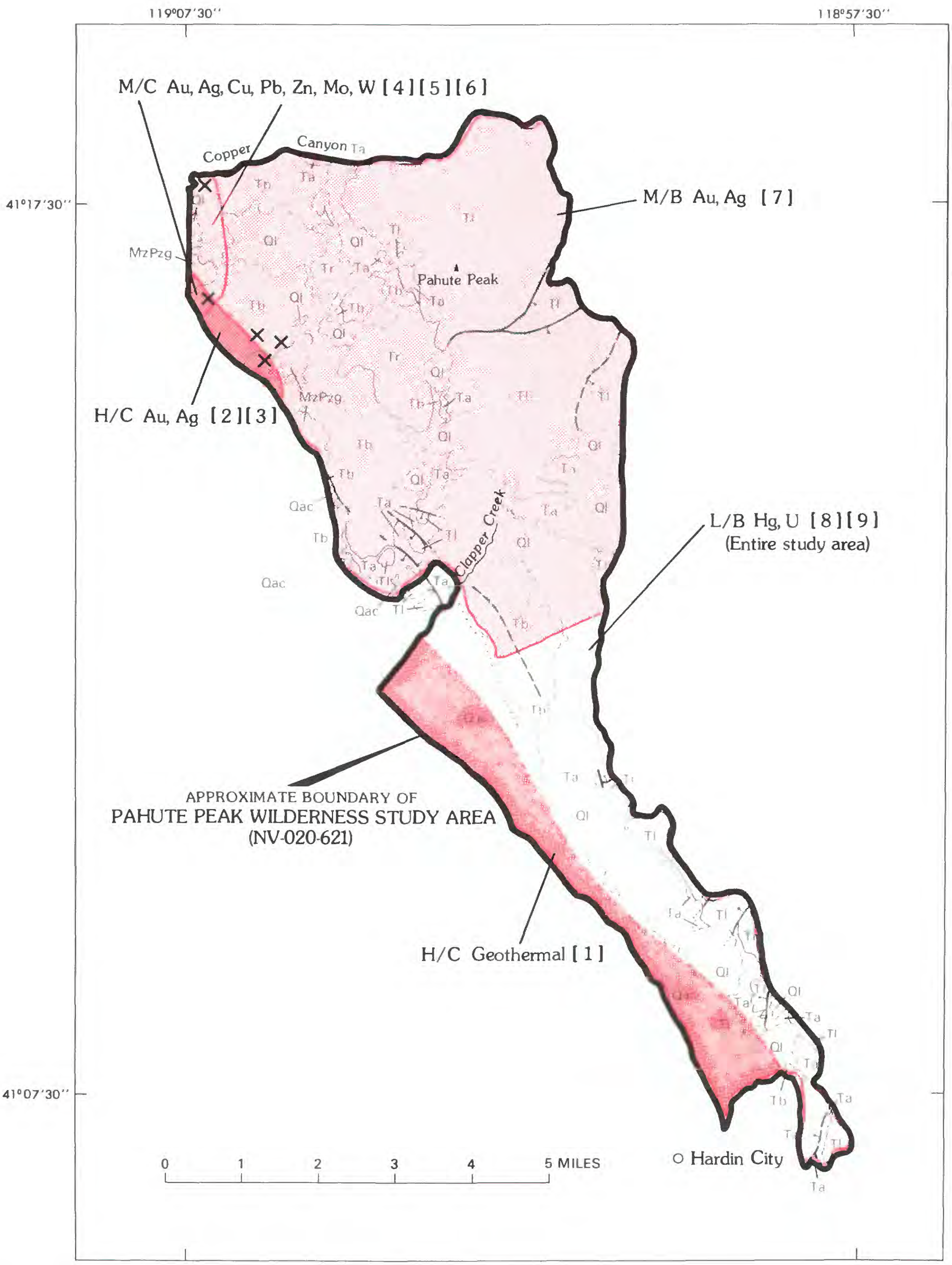

Figure 2. Mineral resource potential and generalized geology of the Pahute Peak Wilderness Study Area, Humboldt County, Nevada.

1981), the data may imply a source pluton beneath the Cenozoic volcanic rocks.

About 2 mi south of Copper Canyon a 20- to 30-ft-wide fault zone can be traced for at least 0.25 mi along the range front. This zone strikes N. 30° W. and dips 80° S. Within this zone, silicified volcanic and intrusive rocks contain disseminated pyrite and are cut by iron oxide-filled veinlets. Less than 0.25 mi farther south, another area of more pervasive argillic and silicic alteration is present along the same trend. Three pits in this area expose strongly altered volcanic and plutonic (gabbroic?) rocks with visible primary sulfide minerals (probably chalcopyrite and arsenopyrite) and minor secondary copper minerals (Olson, 1986). Of 14 samples taken from the range-front fault zone and from old workings, 8 contain detectable amounts of gold, and 12 samples have detectable silver. The maximum and median values for gold and silver were 2.8 and 1.2, and 1.6 and 0.7 ppm respectively (Olson, 1986). Anomalous arsenic values in six samples range from 0.1 to 17 weight percent. Antimony is present in six samples and ranges from 3.0 to 33 ppm. The alteration and anomalous precious-metal concentrations, which may be related to hydrothermal (hot spring) activity along the range-front zone, may indicate a larger mineralized area. No other workings or evidence of alteration or mineralization were found within the Copper Canyon area.

EXPLANATION

Area with high mineral resource potential

Area with moderate mineral resource potential

Area with low mineral resource potential

See appendix for definition of levels of mineral resource potential and certainty of assessment

Commodities

Ag	Silver
Au	Gold
Cu	Copper
Hg	Mercury
Mo	Molybdenum
Pb	Lead
U	Uranium
W	Tungsten
Zn	Zinc

[ ] Deposit types

1	Geothermal water
2	Epithermal base- and precious-metal vein deposits
3	Hot-spring low-grade gold
4	Porphyry base metals
5	Zinc-bearing skarn
6	Replacement
7	Volcanic-hosted gold
8	Epithermal mercury
9	Volcanogenic uranium

Geologic map units

Qac	Alluvium and colluvium (Quaternary)--Locally includes lake sediments and sand dunes
Ql	Landslide deposits (Quaternary)--Locally includes colluvium, alluvium, and talus
Tl	Rhyolite, dacite, and basalt (Miocene? and Oligocene)--Includes interbedded tuffs and volcaniclastic sedimentary rock
Ta	Rhyolite ash-flow and air-fall tuffs (Oligocene)--Ashdown Tuff and local units of volcaniclastic sedimentary rock
Tr	Rhyolite (Oligocene)--Domes, short flows, and dikes
Tb	Basalt (Oligocene)--Flows, dikes, and sills with interbeds of tuff and volcaniclastic sedimentary rocks
MzPzg	Granitic and metasedimentary rocks (Mesozoic and Paleozoic?)--Includes quartz monzonite and granodiorite of Cretaceous age and locally metamorphosed limestone and other sedimentary rocks that may range from Mississippian to Cretaceous age

Contact--Dashed where approximately located

Fault--Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

× Prospect

Figure 2. Continued.

Pahute Peak Area

The Pahute Peak area is south of the Copper Canyon zone in the northwestern part of the study area. Two pits expose a fluorite vein that cuts volcanic and altered intrusive rocks on the north side of an unnamed canyon about 2.5 mi southeast of Copper Canyon. The vein is 2 to 4 ft wide, strikes east, and can be traced for about 300 ft. The vein contains massive fluorite with cryptocrystalline silica and opaque minerals. Two samples of vein material contain 20 percent and 10 percent fluorine (41 percent and 21 percent, respectively, of equivalent CaF_2). Resources were not quantified because of the low grade and lack of exposure. One sample of charcoal(?) in tuff from the upper end of the same canyon contains 0.06 percent equivalent uranium (Garside, 1973). The presence of vein fluorite, uranium oxide, and trace amounts of molybdenum, tungsten, and gold in rock chip samples, and the close proximity of a rhyolite dome, may be indicative of a buried porphyry molybdenum system (Burt and others, 1982). No other workings were found in the area. Of 25 samples taken at selected sites, four contain from 0.04 to 0.22 ppm gold and two contain about 2 ppm silver (Olson, 1986).

Clapper Creek Area

Five samples collected along a ridge 1 mi northwest of Clapper Creek from silicified rhyolite domes contain 0.4 to 0.9 ppm silver. A 5-ft adit and numerous small pits reported at an andesite-quartzite contact by the U.S. Bureau of Land Management were not found by the U.S. Bureau of Mines (Olson, 1986).

Other Areas

No workings were found elsewhere in the Pahute Peak Wilderness Study Area. Of 105 samples taken by the U.S. Bureau of Mines outside the areas discussed above, 10 contain detectable amounts of gold and silver (Olson, 1986). These were collected in the southernmost part of the study area, northeast, east, and southeast of Clapper Creek, and southeast of Pahute Peak.

Five samples were collected within the study area for analysis of zeolite minerals. The two samples with the most zeolites contained only 9 percent clinoptilolite and are therefore not considered important source rocks for zeolite minerals.

Petrified Wood

Petrified (opalized) wood is found in volcaniclastic beds interbedded with basalt at four sites about 1 mi south of Clapper Creek. Petrified wood fragments range in size from small chips to one partially buried log about 50 ft long and 3 ft in diameter. Because the areas are largely inaccessible by vehicle, the large segments would be difficult to excavate. Smaller pieces may be of limited commercial or recreational interest.

Geothermal Energy

Double Hot Springs is about 4 mi southwest of the south end of the study area (fig. 1). There are several springs with surface temperatures of about 176 ^{o}F and a mean reservoir temperature of about 261 ^{o}F (Brook and others, 1979). The Black Rock Point hydrothermal area is about 7 mi south of the south end of the study area and has springs with temperatures to 194 ^{o}F and a mean reservoir temperture of about 264 ^{o}F (Brook and others, 1979). Both of these hot spring areas are within the Double Hot Springs Known Geothermal Resource Area (KGRA), which is adjacent to the south end of the study area (fig. 1).

The Soldier Meadow hydrothermal area (KGRA) is about 6 mi northwest of the northwest corner of the study area (fig. 1) and includes several springs with surface temperatures of about 129 ^{o}F and a subsurface temperature of about 239 ^{o}F (White and Williams, 1975).

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

By Donald C. Noble, Donald Plouff, Joel R. Bergquist, and Harlan N. Barton
U.S. Geological Survey

Geology

The Black Rock Range is a fault-block range that is structurally typical of the Basin and Range province. Major normal fault systems of late Cenozoic age bound both the east and west margins of the range. The western fault system is presently active, and the total throw is greater in most places than that of the eastern fault system. Like the Calico Mountains to the west and the Jackson Mountains to the east, parts of the range are slightly tilted to the east. Both the Black Rock Range and the Pahute Peak Wilderness Study Area are underlain almost entirely by volcanic rocks of Oligocene and Miocene(?) age.

Granodiorite and quartz monzonite, which are similar to other plutonic rocks in western Nevada, are exposed over about 0.75 mi^2 between Copper Canyon and Clapper Creek. Radiometric age determinations of 96 million years (Ma) indicate that these rocks are of Cretaceous age (Smith and others, 1971). Small bodies of metamorphosed limestone and other sedimentary rocks, intruded by the plutonic rocks, probably correlate with strata of Mississippian to Cretaceous age exposed in the southernmost part of the Black Rock Range, 20 mi northeast in the Pine Forest Range, and 30 mi east in the Jackson Mountains (Silberling and Jones, 1984).

The Cenozoic stratigraphy of western Humboldt County has been discussed by Noble and others (1970, 1973). On the basis of this work and on mapping carried out as part of the present study, the Cenozoic rocks in the Pahute Peak study area can be subdivided into four units.

The lowermost volcanic unit consists of flows, dikes, and sills of basalt that interfinger with and intrude bedded tuffs, volcanic sandstones, and related strata. The basalts contain phenocrysts of plagioclase, clinopyroxene, and olivine, the latter typically altered, in a generally glassy or originally glassy groundmass. The volcaniclastic rocks locally contain logs, stumps, and smaller fragments of petrified wood. Both the flow rocks and pyroclastic rocks have been subjected to pervasive low-grade alteration characterized by the formation of abundant smectite and other secondary minerals. The highly irregular nature of the dikes and sills and the intricate manner in which the mafic flows intrude and interfinger with the pyroclastic rocks suggests that the flows were erupted through wet, unconsolidated pyroclastic strata.

The basalts of the lowermost volcanic unit are late Oligocene or older and underlie rocks of late Oligocene age. The basalts were dated at 26.3±0.9 Ma using potassium-argon methods on a whole-rock sample of basalt from the northern part of the study area (Noble and others, 1973). Ages were recalculated using presently accepted constants. Because the dated sample contained a small amount of glassy groundmass, the radiometric age should be considered a minimum.

The next unit is made up of rhyolite domes, short flows, and dikes. The domes overlie and intrude the basalts and associated sedimentary rocks. The domes, which contain phenocrysts of plagioclase, sanidine, quartz, and biotite, typically show well-developed flow banding and commonly have marginal glassy zones. An Oligocene age is required for the rhyolites because of the radiometric ages available for the underlying and overlying units.

The third of the four Cenozoic units is composed of volcaniclastic rocks of rhyolitic composition that are exposed largely on the west flank of the Black Rock Range. Included in this unit is a distinctive reddish, reddish-brown- to orange-weathering ash-flow tuff, called the Ashdown Tuff (Noble and others, 1970), that is densely welded in most localities. The Ashdown Tuff is also exposed in the northern Black Rock Range and in the Pine Forest Range (Noble and others, 1970). Other units of ash-flow tuff are exposed locally, and north of Clapper Creek five ash-flow sheets can be recognized. These tuffs are medial to distal parts of ash-flow sheets from source areas outside of the Pahute Peak Wilderness Study Area.

Potassium-argon ages of about 25 Ma were obtained on the Ashdown Tuff in the northern part of the Black Rock Range, using presently accepted constants (Noble and others, 1970). Although no ages are available for the ash-flow sheets that underlie the Ashdown Tuff, regional relations (Noble, 1972; Robinson and others, 1984; Duffield and McKee, 1986) suggest that all the rocks of this unit are of late Oligocene age.

The fourth and stratigraphically highest unit is composed of ash-flow and air-fall tuffs that are overlain and intruded by buff- to black-weathering flows of rhyolite, dacite, and basalt. These rocks range from platy-weathering rhyolite flows exposed on Pahute Peak to olivine-bearing basalt exposed in the southern part of the study area. Pyroxene-bearing felsic rocks of probable ferrodacite composition are also common. A potassium-argon age of 25.9±0.9 Ma was obtained on a sample from this unit taken south of Clapper Creek. Similar ages have been obtained on correlative flows in the northern and central parts of the Black Rock Range (Noble and others, 1973). The lava flows of this group overlie the Ashdown Tuff and are in turn overlain elsewhere by the Summit Lake Tuff of Miocene (about 16 Ma) age (Noble and others, 1970).

Mafic flows that contain phenocrysts of olivine, clinopyroxene, and plagioclase overlie the rhyolitic and ferrodacitic flows in the southern part of the study area. These rocks probably are either of similar age to the underlying late Oligocene rhyolitic and rhyodacitic flows, or are correlative with basalts of middle Miocene age in other parts of northwestern Nevada and southeastern Oregon (Noble and others, 1970; Stewart and Carlson, 1978; Hart and Carlson, 1985).

Many landslides are present on the west side of the Black Rock Range (Stewart and Carlson, 1978), and parts of the study area are underlain by landslide material. In places it is difficult to distinguish normal faults from slip surfaces, and areas near Clapper Creek that are mapped as bedrock may in fact be underlain by landslide material. In addition to alluvium, colluvium, talus, and landslide deposits, the Quaternary deposits in the southwestern part of the study area include lake sediments and sand dunes.

The granitic and metasedimentary rocks of pre-Cenozoic age and, locally, the volcanic and sedimentary rocks of Cenozoic age are hydrothermally altered. Much alteration of originally glassy Tertiary volcanic rocks, particularly of the lowest volcanic unit, probably represents a combination of weathering and post-depositional alteration of highly reactive volcanic glass by groundwater.

Geochemical Studies

A wide range of major- and minor-element data on stream-sediment samples collected and analyzed by Barringer Resources, Inc. (1982), formed the principal data base for geochemical studies of the Pahute Peak Wilderness Study Area. Forty-seven samples were collected within the study area, giving a sampling density of about 1 sample per mi^2. In addition, the U.S. Geological Survey took 23 samples of heavy-mineral concentrates from stream sediment along the west edge of the Pahute Peak Wilderness Study Area.

Samples were analyzed for 31 elements (Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Th, Ti, V, W, Y, Zn, and Zr) using a six-step semiquantitative emission spectrographic method (Grimes and Marranzino, 1968). Results of the analyses from the study area are given by Day and Barton (1986).

Barringer Resources, Inc. (1982), reports anomalous concentrations of barium, zinc, and molybdenum in the northwestern part of the Pahute Peak Wilderness Study Area. They relate these anomalous concentrations to their "mafic copper-nickel, base and precious metals, and epithermal gold-silver models". Sporadic arsenic values of 10 to 78 ppm and a single zinc value of about 200 ppm probably contributed significantly to anomalous composite values for the Barringer "base and precious metals and epithermal gold-silver models." These results are corroborated by U.S. Geological Survey data that include one sample of heavy-mineral concentrate from the Copper Canyon area that contains the following values in ppm: arsenic, 2,000; antimony, 500; lead, 15,000; and zinc, greater than 20,000. The anomaly is also corroborated by the rock-chip sampling done by the U.S. Bureau of Mines (Olson, 1986).

Data from the U.S. Bureau of Mines (Olson, 1986) define a zone with highly anomalous concentrations of gold, silver, arsenic, and antimony located about 2 mi south of Copper Canyon. In addition, anomalous concentrations of gold and silver were found north of Clapper Creek and at localities several miles northeast, east, and south of Clapper Creek. Slightly anomalous concentrations of cobalt, chromium, copper, and nickel values reported by Barringer Resources, Inc. (1982), probably are related to basalts that overlie the granitic and sedimentary rocks.

Garside (1973) reported uranium-impregnated fossil wood within the study area. However, there is no evidence of anomalous concentrations of uranium in stream-sediment samples from the study area.

Although there are a number of mercury occurrences in northwestern Nevada (Williams and Compton, 1953; Bonham, 1969), there is no evidence of anomalous concentrations of mercury within the study area.

Geophysical Studies

J.S. Duval (written commun., 1985) estimated concentrations of potassium, equivalent uranium, and equivalent thorium by examining 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 Resources Evaluation (NURE) Program.

East-trending flightlines were flown at altitudes of about 400 ft above mean terrain with a 3-mi spacing (Geodata International, Inc., 1979). Anomalous radioelement concentrations based on criteria discussed by Duval (1983) indicate that the study area has moderate radioactivity with values of 2 to 3 weight percent potassium, 2.0 to 3.5 ppm equivalent uranium, and 7 to 12 ppm equivalent thorium.

An aeromagnetic survey of the region was flown at a constant barometric elevation of 9,000 ft above sea level with east-trending flightlines spaced at 2-mi intervals (U.S. Geological Survey, 1972). Contoured aeromagnetic data reveal a gradient of northwest-trending contours of magnetic intensity over most of the study area. This prominent magnetic gradient occurs between a 15- by 25-mi magnetic high centered 1 mi north of the northeast corner of the study area and a 15- by 15-mi magnetic low centered about 1 mi west of the center of the west edge of the study area. The amplitudes of the anomalies are about 700 nanoteslas (nT) and 150 nT, respectively. A minor closure of the complex magnetic high occurs at about the midpoint of the east edge of the study area. A minor closure of the low occurs at the midpoint of the west edge of the study area.

The broad magnetic high partly reflects the magnetization of Tertiary volcanic rocks exposed at the surface, because a nose of the magnetic high generally overlies the crestline of the Black Rock Range, and the periphery of the anomaly partly follows the border of the range. The contours that enclose the magnetic high generally are not correlated with topography, and the amplitude and areal extent of the magnetic high are unlike the irregular magnetic pattern typically associated with near-surface Tertiary volcanic rocks. Therefore, the large magnetic high may, in large part, reflect an underlying mafic pluton with relatively high magnetization. The thickness of this body is uncertain because the extent of the steepest gradients along the edges of the central high indicates that the maximum depth to the top of the mafic pluton could be as much as 1.5 mi beneath the surface.

Donald Plouff and C.F. Erdman established two gravity stations in the northern part of the study area and eight stations north of the study area to supplement gravity data from the National Geophysical Data Center (1984). The preliminary Bouguer gravity anomaly map (Donald Plouff, unpub. data, 1985) shows a northeast-elongated, 5- by 8-mi gravity high with an amplitude of 8 millgals (mGal), which nearly coincides with the central part of the magnetic high. Noses of the gravity high, which extend farther northwest and northeast, also correlate with the shape of the magnetic high. A small gravity high with an amplitude of about 4 mGal is correlated with a small magnetic high in the southernmost part of the study area. A small gravity low correlates with a saddle in the magnetic high near lat 41° 16' east of the study area. Closely spaced north-northwest-trending gravity contours along the west edge of the study area apparently reflect the steep contact between the dense body with high magnetization to the north and the less dense sediments and rocks beneath the western arm of the Black Rock Desert.

CONCLUSIONS

The evaluation of mineral resource potential is based on a variety of data that include the geologic, geochemical, and geophysical features, a survey of mines and prospects, and the mineral resources present in the surrounding regions. Mineral resource potential was classified using the system of Goudarzi (1984).

The potential for the following types of resources were evaluated for the Pahute Peak Wilderness Study Area: (1) base-metal (copper, zinc, lead, molybdenum, tungsten) and associated precious-metal (gold-silver) deposits of porphyry, skarn, replacement, and vein type, (2) epithermal precious-metal (gold-silver) deposits of vein, disseminated, and hot-spring type, (3) volcanic-hosted uranium deposits, (4) deposits of petrified wood and opal, and (5) geothermal energy resources.

The alteration of Mesozoic granitic and metamorphic rocks exposed in prospect workings near Copper Canyon and in other areas of the Black Rock and Pine Forest Ranges, combined with locally anomalous metal values, indicate a potential in the Copper Canyon area for porphyry, skarn, and replacement deposits of base and precious metals, and particularly skarn and replacement deposits of zinc. The area involved is restricted to outcrops of pre-Cenozoic rock and areas directly east of outcrops where granitic rocks are overlain by a relatively thin cover of Cenozoic volcanic rocks. These areas have moderate resource potential, certainty level C, for gold, silver, copper lead, molybdenum, tungsten, and zinc. See appendix for definition of levels of resource potential and certainty of assessment.

Anomalous concentrations of gold, silver, arsenic, and antimony were found in an area with moderate to strong hydrothermal alteration along the western margin of the range about 2 mi south of Copper Canyon. The metal concentrations and alteration appear to be related to hydrothermal solutions localized by a normal fault zone of late Cenozoic age. This area has high resource potential, certainty level C, for gold and silver in epithermal vein or hot-spring type deposits.

Anomalous concentrations of gold and silver were recognized near Clapper Creek. Volcanic-hosted gold deposits of late Cenozoic age are known in northwestern Nevada, for example the Hog Ranch property, located in the northern part of the Leadville mining district, northern Washoe County, Nev. The central and northern parts of the study area thus have moderate resource potential, certainty level B, for gold and silver.

Although mercury deposits are known in northwestern Nevada, no anomalous concentrations of mercury were detected within the study area, and the study area has low potential, certainty level B, for mercury deposits.

Anomalous radioactivity was reported just below the west face of Pahute Peak, in the lowermost volcanic unit, and a sample of carbonized wood contained 0.06 percent equivalent uranium oxide (Garside, 1973). The petrified wood is sporadically distributed, and the stream-sediment survey conducted by Barringer Resources, Inc. (1982), did not reveal anomalous uranium values. No anomalous radioelement concentrations were recognized during an aerial gamma-ray survey. The study area has a low potential, certainty level B, for uranium resources.

Petrified wood is present in the Cenozoic sedimentary rocks of the lowermost volcanic unit. However, judging by its quality and lack of exploitation, it appears to be too sparse and too low grade to be considered a resource.

Although opal is mined locally in the Calico Mountains, rocks similar to the Calico host rocks are exposed over only a very small area in the southernmost part of the study area. There is no evidence of resource potential for opal.

From these investigations, it appears that the most important potential resource in the Pahute Peak Wilderness Study Area is geothermal energy. The northern part of the Double Hot Springs KGRA, which includes the Black Rock Point area, is adjacent to the southern tip of the study area (fig 1.). The Soldier Meadow KGRA is about 6 mi northwest of the study area. The mean reservoir temperatures of these areas were estimated to be about 261 to 264 °F and 239 °F, respectively (Brook and others, 1979; Renner and others, 1975; Mariner and others, 1974). No deep drilling for geothermal resources has been done in either KGRA. At present, only the hottest water in these KGRA's has marginal value for electrical generation, although it would be useful for industrial processing applications. The western part of the southern half of the study area has high potential for geothermal energy resources. This part of the Pahute Peak Wilderness Study Area has high potential, certainty level C, for geothermal resources.

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APPENDIX. 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.

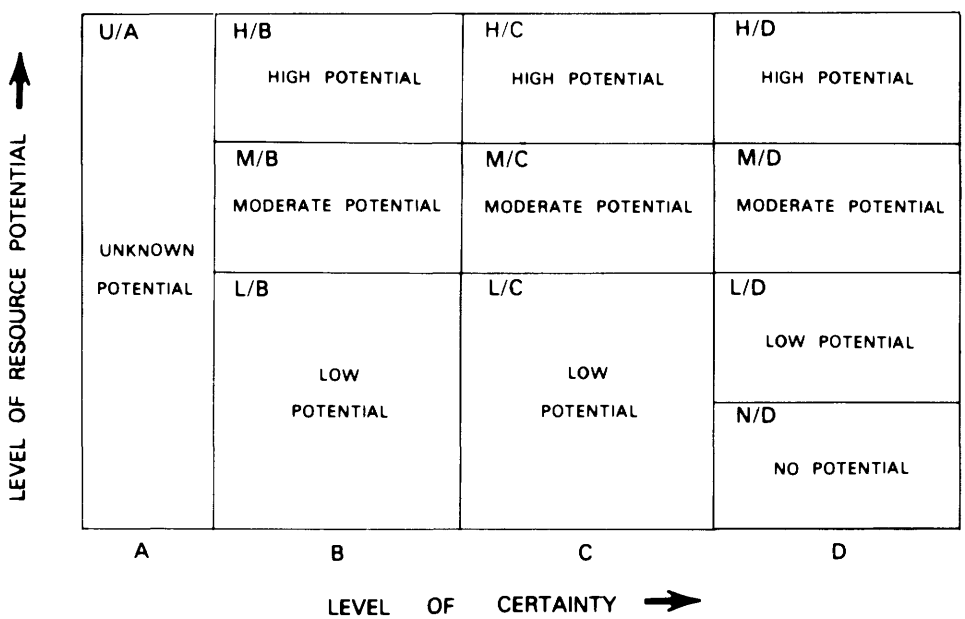
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application 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.

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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.

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