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MINERAL RESOURCES OF THE HIGH ROCK LAKE WILDERNESS STUDY
AREA (BLM NO. NV-020-007), HUMBOLDT COUNTY, NEVADA

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This open file report presents the results of a Bureau of Mines wilderness study and will be incorporated in a joint report with the U.S. Geological Survey. The report is preliminary and has not been edited or reviewed for conformity with the U.S. Bureau of Mines standards and nomenclature. Work on this study was conducted by personnel from Western Field Operations Center, East 360 Third Avenue, Spokane, Washington 99202.

PREFACE

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and U.S. Bureau of Mines to conduct mineral surveys on U.S. Bureau of Land Management (BLM) administered land designated as Wilderness Study Areas (WSA) "...to determine the mineral values, if any, that may be present...". Results must be made available to the public and submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral survey of the High Rock Lake Wilderness Study Area (BLM No. NV-020-007), Humboldt County, Nevada.

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ABSTRACT

During 1984, U.S. Bureau of Mines personnel conducted a mineral survey of the High Rock Lake Wilderness Study Area (WSA), Humboldt County, Nevada. Eight mineral properties and two mineralized zones were examined during the study; none are in the portion of the WSA preliminarily recommended suitable for wilderness by the Bureau of Land Management. No significant metallic mineral values were noted at any of the sites; however, occurrences of precious opal and zeolites exist in the area.

The WSA is dominated by a Tertiary volcanic sequence consisting of interbedded basalts and tuffs, and volcanoclastics. Within the volcanic section, opal occurs as cavity fillings along a 6.8-mile-long fracture zone that parallels the WSA's eastern boundary. Precious opal found along this zone displays gem quality opalescence, but due to its tendency to dehydrate at surface conditions, the opal will remain a curiosity until means to preserve its opalescence are developed.

Volcanoclastic rocks exposed inside the WSA near Donnelly Canyon contain significant concentrations of clinoptilolite, a zeolite used mainly for waste-water treatment and soil conditioning. Due to the small size and remote location the occurrence cannot be commercially developed.

INTRODUCTION

In 1984, the U.S. Bureau of Mines (Bureau) and the U.S. Geological Survey (USGS) conducted a mineral survey of the High Rock Lake Wilderness Study Area (WSA) (BLM No. NV-020-007), Humboldt County, Nevada. The data gathered will be used to help determine the suitability of the area for inclusion into the National Wilderness Preservation System. The Bureau assessed the resources of mines, prospects, and mineralized zones; the Geological Survey conducted geological, geochemical, and geophysical investigations. This report presents the Bureau's findings and will be selectively combined with Geological Survey data in a joint publication.

This report covers all lands within the original WSA, or 61,902 acres. However, the Bureau of Land Management (BLM), Winnemucca District, Nevada, has recommended that 47,902 acres within the original WSA boundary be withdrawn from wilderness consideration, leaving a preliminarily Recommended Suitable Area (RSA) of 14,000 acres.

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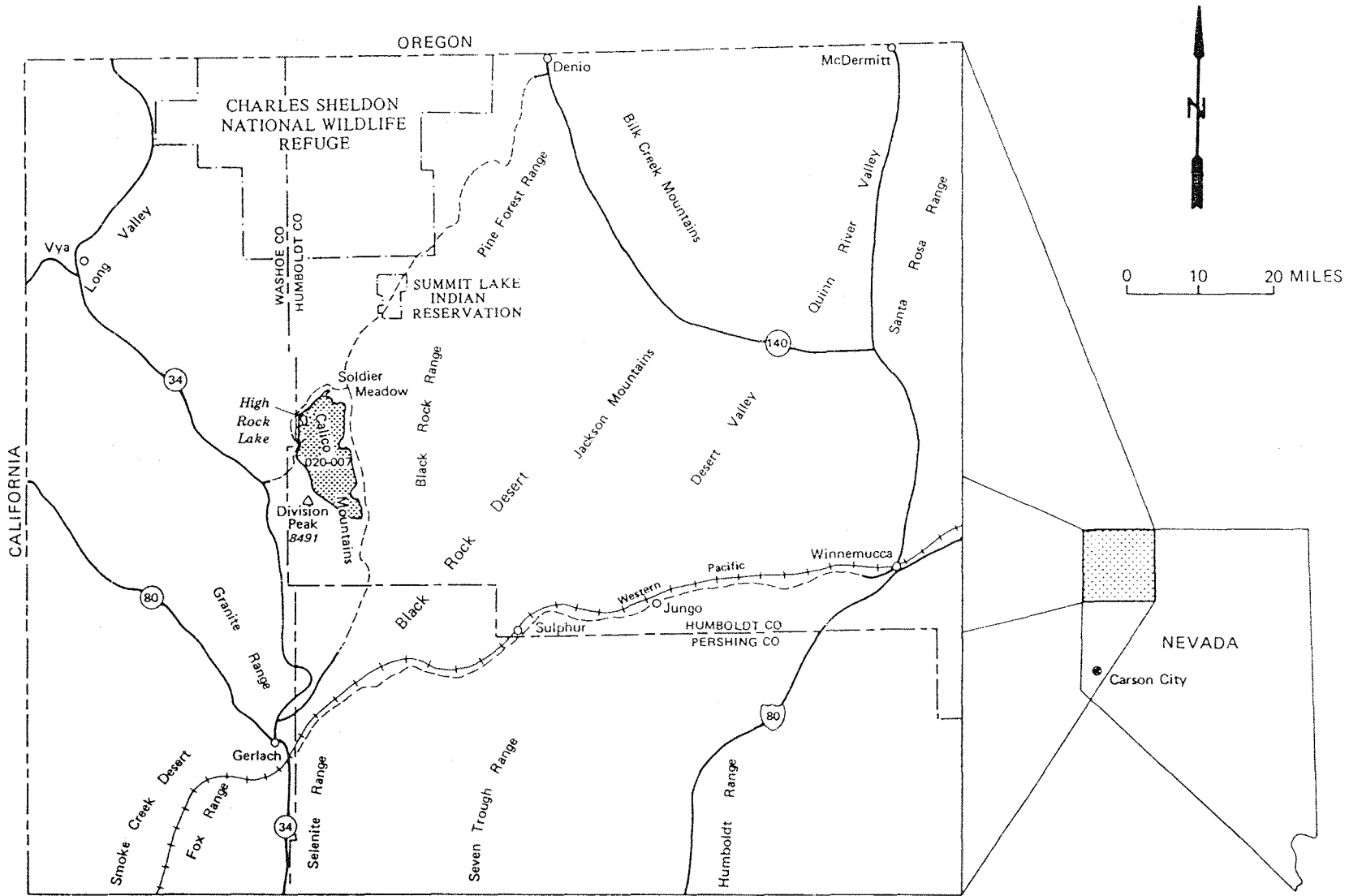


FIGURE 1. Location of Carson National Wildlife Refuge.

Geographic Setting

The High Rock Lake WSA encompasses the northern portion of the Calico Mountains in the Black Rock Desert region of northwestern Nevada (fig.1). The WSA is about 40 miles northeast of Gerlach, Nevada, and is accessible by the Soldier Meadow county road (HU217) and by a jeep trail (W1) through Smokey Canyon. Numerous jeep trails provide access to major drainages. The historic Applegate-Lassen emigrant trail passes along the northern boundary of the WSA.

The WSA straddles the northern Calico Mountains, a typical fault-bounded range of the Basin and Range Physiographic Province. The topography in the WSA is moderately rugged, controlled mainly by a normal fault that runs along the western front of the range. Vertical displacement along the fault has resulted in an eastward-tilted fault block (Korringa, 1973, p. 3849). A landslide which formed High Rock Lake at the west end of Box Canyon reflects the rapid rise of the block. The effects of faulting are best exhibited north of Box Canyon, where the tilting of the fault block and corresponding vertical displacement has created a flatiron mesa with imposing 700-ft bluffs above High Rock Lake. The mesa, which essentially is the RSA, is transected by Box and Fly Canyons, two spectacular 600-ft deep, steep-walled chasms that trend easterly across the area. The topography south of Box Canyon is characterized by rolling hills dissected by the drainages of Willow, Cherry, and Donnelly Creeks. Maximum relief within the WSA is about 3,600 ft, with elevations ranging from about 4,100 ft to 7,660 ft.

The WSA is sparsely vegetated with greasewood, sagebrush, and cheatgrass, reflecting the low annual precipitation of this high desert biome.

Previous Studies

Several geologic studies covering portions of the WSA have been done. Publications by Willden (1963), Noble, and others (1970), Korringa (1973), and Greene and Plouff (1981) discuss the general geology and volcanic stratigraphy of the area. A report on a geochemical sampling program, done on the area under BLM contract by Barringer Resources, Incorporated (1982), was useful.

Present Studies

During the summer of 1984, Bureau of Mines personnel conducted field examinations of the High Rock Lake WSA. All available information on geology, mining, and mineral resources in the area, including federal and Humboldt County mining claim records, was reviewed prior to field work. Field examinations, which included mapping and sampling of mines, prospects, and mineralized zones, were conducted for 18 employee-days.

Fifty samples were taken during the Bureau of Mines' study. Most were rock chip samples taken from faults transecting Miocene basalts and tuffs. Pan samples of alluvium were taken in all major drainages. All chip samples were crushed, pulverized, mixed, and split at the Western Field Operations Center. The samples were then checked for radioactivity and fluorescence. A split of each sample was then sent to the Bureau of Mines Reno Research Center and analyzed by emission spectrography and atomic absorption to check for the presence of economic minerals. All samples were fire assayed to determine gold and silver content. Those samples thought to contain zeolites were analyzed by x-ray diffraction and given an ammonium cation exchange capacity test. Opal specimens were appraised by local jewelers (Spokane, WA) for suitability as an ornamental material. Appraisal parameters were opalescence (play of colors), degree of translucency, markings, coloring, and stability.

ACKNOWLEDGEMENTS

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GEOLOGY

Areal Geology

The High Rock Lake WSA is generally underlain by a Tertiary volcanic sequence, except for a small area in upper Donnelly Canyon where granodiorite of Cretaceous or Tertiary age and metamorphosed clastic sedimentary rocks of Triassic or Jurassic age are exposed (Willden, 1963, p. 93). The volcanic rocks consist of faulted sequences of interbedded basalt flows and tuffs, rhyolitic ash-flow tuffs of the Soldier Meadow Tuff Sheet, and volcaniclastics. Volcanic vent centers and a postulated caldera in the Soldier Meadow area are likely sources for most volcanic units in the High Rock Lake area (Greene and Plouff, 1981). The dominant structural feature, especially evident in the area north of Box Canyon, is an eastward tilted horst, caused by normal faulting along the western and eastern margins of the study area. The main fault can be traced from the west flank of Division Peak to the hot springs near Mud Meadow (fig. 2).

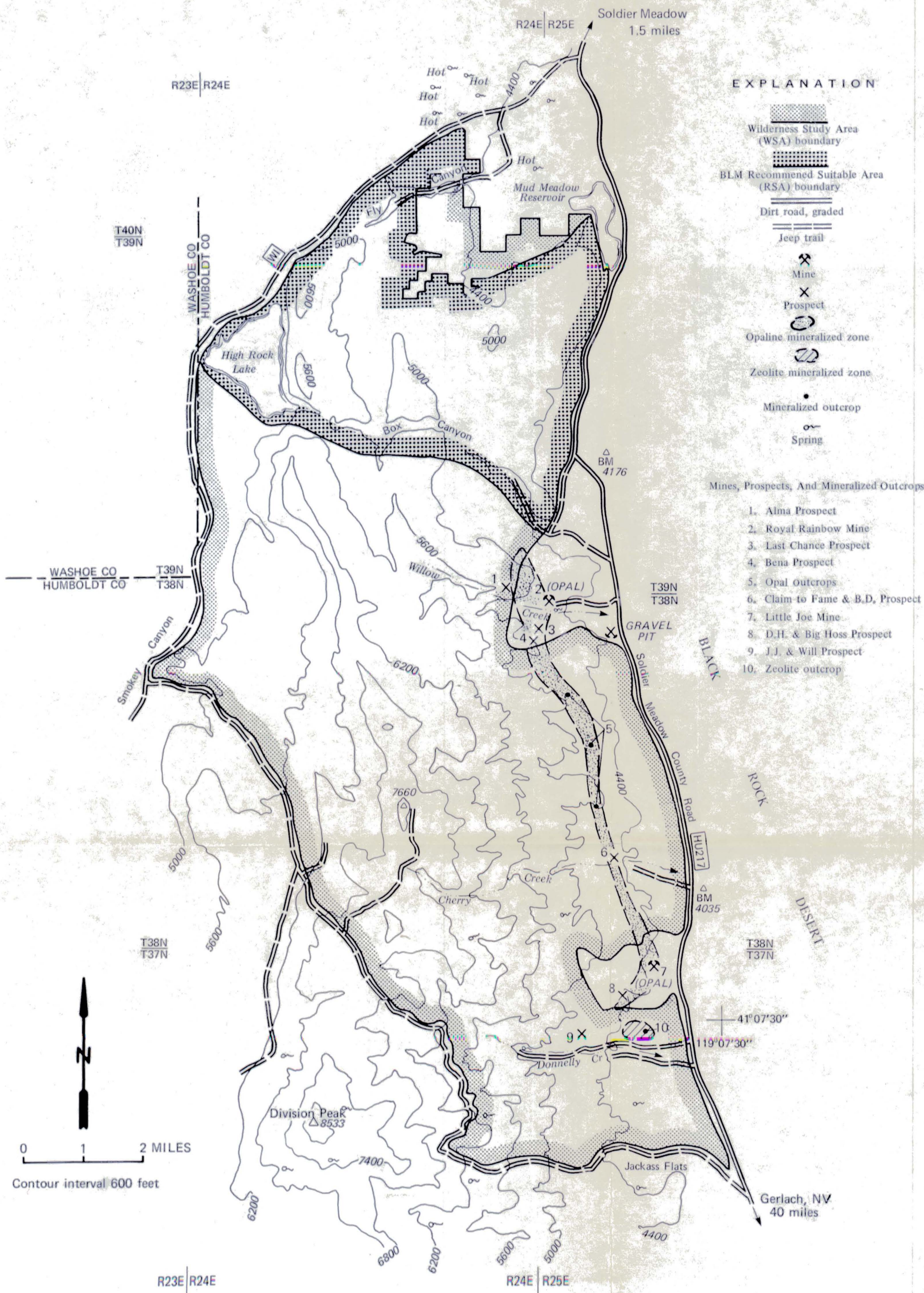


FIGURE 2. - Mines, prospects, and mineralized zones in and adjacent to the High Rock Lake WSA (BLM No. NY-020-007)

Geology of Mineral Deposits

Opal

Within the volcanic section, precious opal ^{3/} occurs in fracture zones along cooling and lithologic breaks between interbedded basalt and ash-flow tuffs. Where vesicular basalt is overlain by siliceous rhyolitic tuffs (Royal Rainbow and Little Joe Mines, and the Last Chance, Bena, and Claim to Fame Prospects), opal has formed as cavity fillings in vesicles and along fractures in the upper layers of basalt. The opal was likely emplaced as a post consolidation product of hot spring activity, or possibly by meteoric solutions leaching downward from the overlying siliceous tuffs. The solution channelways trend in a northerly direction, paralleling the eastern fault zone and the alignment of hot springs, indicating a hydrothermal origin. However, the close proximity of the tuffs to the basalt would indicate that at least some of the silica was leached from above. In any event, the solutions traveled through vertical fractures causing alteration of adjacent rock and precipitation of opal in nearby basalt cavities.

A north-trending opalized zone (fig.2, no.5) is intermittantly exposed along the tuff-basalt contact between the 4,400-4,800-ft elevations from the Little Joe (Duffy) Mine (fig.2, no.7) to the Royal Rainbow Mine (fig.2, no.2), a distance of 6.8 miles. Opal along the zone is found in isolated pockets and is usually dehydrated and partially crystallized into chalcedony; no precious opal was found within the WSA. The geologic setting at the Little Joe Mine differs from other claims in the area in that precious opal occurs in a very dense, unaltered basalt, rather than an altered vesicular basalt.

The varieties of opaline silica in or adjacent to the study area include milk opal, hyalite, moss opal, and precious fire opal. The vast majority of the opal in and adjacent to the WSA is common opal.

Zeolites

White, finely bedded, tuffaceous volcanoclastic sedimentary rocks containing zeolites were seen in the low hills near Donnelly Canyon in sections 7 and 8, T. 37 N., R. 25 E. (fig. 2, no. 10). This sedimentary sequence abuts against and intertongues with the major volcanic formations that underlie most of the WSA, and represents a small erosional remnant of a much larger waterlain sequence. The unit has an exposed thickness of about 200 ft and covers an area approximately 7,500 by 1,000 ft. Limited samples indicate that the contained rhyolitic tuff sediments have undergone fairly uniform, widespread alteration which resulted in a 50% clinoptilolite content.

^{3/} Opal: An amorphous hydrous silica, SiO₂·nH₂O. When it shows a play of colors, or opalescence, it becomes a gemstone of precious opal commerce known as fire opal (Thrush and Bureau of Mines Staff, 1968, p.857)

MINES, PROSPECTS, AND MINERALIZED ZONES

The nearest mining district to the WSA, the Donnelly District, is located approximately four miles southwest. The district had a total production of about \$100,000 worth of gold and silver produced from quartz veins in granodiorite (Vanderburg, 1938, p. 20). No extensions of these deposits are known to occur in the WSA. The district has been inactive for many years. In addition to the claims in the Donnelly District, several claims have been staked for uranium in the vicinity of Smokey Canyon, just outside the WSA's western boundary. Prospecting on these claims has failed to disclose any uranium resources.

Twenty-eight mining claims encompassing approximately 600 acres in the WSA are listed in BLM 1984 records. None of the properties are currently being mined or developed, nor is there evidence of past production from any claim within the WSA. Adjacent to the east side of the area two opal mines, the Little Joe and the Royal Rainbow, operate intermittently, producing opal on consignment or charging visitors a digging fee (Stromer and Duffield, claimants, oral commun., 1984). The owners of the opal mines earn a few thousand dollars each year through collection of opal digging fees and the sale of a few stones (the Duffield Opal, a 1,744 carat precious opal was featured in the October, 1977 issue of Lapidary Journal). No patented claims lie in the WSA; the nearest patented property is at the Little Joe Mine.

Sites Examined

Eight mineral properties and two mineralized zones were examined during this study. Of these, three properties and two mineralized zones are in the WSA and five properties are adjacent; none are in the RSA (fig. 2). The three prospects within the WSA include the Alma (no.1), Claim to Fame and BD (no.6), and the J.J. and Will (no.9); all three properties are inactive. Opalized outcrops (no.5) are part of an opalized mineralized zone that trends from the Royal Rainbow Mine (no. 2) to the Little Joe Mine (no. 7), a distance of 6.8 miles. Zeolite bearing volcanoclastic rocks (no.10) crop out near the mouth of Donnelly Creek.

Based on aeromagnetic surveys, Greene and Plouff (1981) postulated that a caldera borders the northern part of the WSA. Geochemical sampling conducted by Barringer Resources (1982) disclosed low level anomalies that may be indicative of base- and precious-metal deposits associated with the caldera. In order to check these anomalies, 28 samples were taken in unclaimed areas. All 28 samples were fire assayed for gold and silver and most were checked by semiquantitative emission spectroscopy for anomalous content of 42 elements ^{4/}. None of the samples contained significant concentrations of metals, nor were any mineralized structures seen.

^{4/} Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, columbium, copper, gallium, gold, hafnium, indium, iron, lanthanum, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, platinum, rhenium, scandium, silicon, silver, sodium, strontium, tantalum, tellurium, thallium, tin, titanium, vanadium, yttrium, zinc, and zirconium.

A Known Geothermal Resource Area (KGRA) is located just north of the WSA in Mud Meadow. Several other hot springs occur on the Black Rock Desert, adjacent to the study area. No hot springs are known to occur in the study area.

Descriptions of the mines, prospects, and mineralized zones examined for this report are presented in Table 1.

APPRAISAL OF MINERAL OCCURRENCES

The High Rock Lake Wilderness Study Area contains no identified mineral resources. Sample analyses contained no significant precious or base metal values. However, identified occurrences of opal (fig.2, nos.1,5,6) and zeolites (fig.2, no.10) were recognized within WSA boundaries.

Opal in the WSA occurs along a 6.8 mile zone just inside the eastern boundary. No deposits of precious opal were seen in the WSA along this zone--only dehydrated common opal in isolated pockets. Precious opal would probably be disclosed along the zone by trenching, however. Mining of these deposits would be difficult. The opal is incased in hard, dense basalt and must be recovered with great care by hand methods. Large-scale, mechanized mining methods can not be applied. The opal, like most produced from the mines just outside the WSA, would be a curiosity that can not be sold as a gemstone due to its tendency to dehydrate at surface conditions. Dehydration takes a few days to a few weeks to occur, causing the opal to "craze" (crack) and to crystalize into chalcedony. A means to preserve opalscence has not been developed.

Volcaniclastic rocks in the WSA near Donnelly Canyon contain significant clinoptilolite - a zeolite used mainly for soil conditioning and waste-water treatment. The grade (50% clinoptilolite), and cation exchange capability (1.2 milliequivalents/gram), is suitable for most commercial zeolite usages. However, it is unlikely the deposit will be developed because it is small, low grade, and distant from markets.

TABLE 1. - Mines, prospects, and mineralized outcrops in and adjacent to the High Rock Lake WSA (BLM No. NV-020-007)

[Asterisk (*) indicates outside study area]

Map no. (fig. 2)	Name (commodity)	Summary	Workings and production	Sample and resource data
1	Alma Prospect (opal).	Common opal occurs as vesicle fillings in upper 3 to 10 ft of basalt flow. The flow trends north, dips gently east, and is between conformable units of ash-flow tuffs. All exposed opal is dehydrated.	Three small prospect pits.	Four chip samples contained no significant metal values. One chip sample contained 0.1 oz/ton silver. No precious opal exposed.
2*	Royal Rainbow Mine (opal).	Precious and common opal are in amygdules and fractures in a vesicular basalt. The vesicles comprise about 30% of the rock, are elongate, and increase in size towards the top of the flow. The opalized basalt is cut by a dike that strikes N. 50°-60° W. and dips 65°-75° SW. Fractures caused by the emplacement of the dike probably provided plumbing system for much of the siliceous solutions.	Numerous small cuts (largest is 8 x 20 x 5 ft) on the divide between Willow Creek and Box Canyon. Five hundred tons of material has been removed.	One grab and four chip samples of vesicular basalt contained no significant metal values. One grab sample of opalized basalt contained precious opal.
3*	Last Chance Prospect (opal).	No mineralized structure is exposed. Vesicular basalt with dehydrated opal fillings is on the working dump.	One bulldozer trench is 40 ft long and 15 ft wide.	One grab sample of basalt with dehydrated opal, kaolinite, and epidote contained 0.1 oz/ton silver. No precious opal exposed.
4*	Bena Prospect (opal).	No opalized structure is exposed. Vesicular and platy basalt with dehydrated opal is in float at base of rhyolitic tuff. Opalized basalt has been slightly altered.	None.	One grab sample contained no significant metal values. No precious opal exposed.
5	Opal mineralized outcrops.	Dehydrated common opal occurs in three outcrops of vesicular basalt, near tuff contact. These outcrops are part of an opalized zone that is intermittently exposed from the Rainbow Mine to the Little Joe Mine, a distance of 6.8 miles. Basalt has undergone weak propylitic alteration. Much of the near-surface opal is hollow and cracks readily.	None.	Two chip samples of altered, silicified basalt contained no significant metal values. No precious opal exposed.
6	Claim to Fame and BD Prospect (opal).	Dehydrated common opal fills vesicles in a 5-10 ft zone in basalt that is overlain by ash-flow tuff. Basalt flow trends north, is tilted east, and has been somewhat propylitically altered.	One prospect pit is 10 x 15 x 8 ft.	One chip and two grab samples of altered basalt contained no significant metal values.

TABLE 1. - Mines, prospects, and mineralized outcrops in and adjacent to the High Rock Lake WSA (BLM No. NV-020-007)--Continued

Map no. (fig. 2)	Name (commodity)	Summary	Workings and production	Sample and resource data
7*	Little Joe Mine (opal).	Precious opal occurs along fractures in dense basalt. The opal is associated with a north-trending, vertically dipping fault zone that crosses the property. The massive basalt is overlain by a platy basalt and a siliceous ash-flow tuff. The basalt contains epidote and has undergone weak prophyllitic alteration. Common opal on the property is white to yellow and averages less than 1 in. in diameter. Less than 1% of the opal seen was precious opal. Most of the opal is unstable and dehydrates rapidly upon exposure to air.	A cut, which has an area of 10,000 ft ² , has had approximately 5,000 tons of opalized basalt removed. From a 180-ft trench, 20 tons of rock has been removed. Workings are on three claims; two are patented. In 1977, a 1,744 carat precious opal was extracted from this property.	Five chip samples of altered basalt contained no significant metal values. Precious opal with good opalescence was found, but was very unstable.
8*	DH and Big Hoss Prospect (opal).	Two poorly exposed zones of opalized vesicular basalt are present. The vesicular basalt is overlain by a platy, non-vesicular basalt, which in turn is overlain by an ash-flow layer. A fault and associated breccia zone crosses the property, and probably was a conduit for siliceous solutions.	Three prospect pits, the largest 12 x 10 x 4 ft, and a 300-ft bulldozer trench.	Two chip samples of vuggy basalt and one chip sample of brecciated basalt had no significant metal values. Fragments of precious opal were found.
9	JJ and Will Prospect ("turquoise").	Palagonite tuff and pyritic rhyolite are cut by a 2.0-ft-wide shear zone containing malachite-stained quartz. The zone strikes N. 10-20° E. with a vertical dip.	Two small prospect pits and a bulldozer trench in an area 0.5 mile long and 0.2 mile wide.	Three chip samples contained no significant metal values, and one had 0.1 oz/ton silver and 0.005% copper. No turquoise was seen.
10	Zeolite mineralized outcrop.	A succession of thin-bedded, waterlain volcanoclastic sedimentary rocks abut against and intertongue with the volcanic section. The reworked tuffs are white, gritty, and moderately indurated. The sedimentary sequence has an exposed total thickness of approximately 200 ft and covers an area approximately 750 x 1,000 ft. The beds strike north and dip gently west.	None.	Two chip samples each had 50% clinoptilolite (x-ray diffraction quantitative estimate). Cation exchange capacity (C.E.C.) tests resulted in an ammonium exchange of 0.07 and 1.2 milliequivalents per gram, the higher value being suitable for water purification and ammonia absorption purposes.

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