DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

MINERAL RESOURCES OF THE JORDAN CRATERS WILDERNESS STUDY AREA, MALHEUR COUNTY, OREGON

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the 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 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 the Jordan Craters Wilderness Study Area (OR-003-128), Malheur County, Oregon.

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Abstract

At the request of the U.S. Bureau of Land Management, the U.S. Geological Survey and the U.S. Bureau of Mines evaluated approximately 23,225 acres within the Jordan Craters Wilderness Study Area (OR-003-128) for identified mineral resources (known) and for mineral resource potential (undiscovered). Within this report, the area studied is referred to as the "study area"; any reference to the Jordon Craters Wilderness Study Area refers only to that part for which a mineral survey was requested. Fieldwork for this report was done in 1986. There are no identified mineral resources within the study area, nor is there any potential for metallic, nonmetallic, uranium and thorium, or geothermal energy resources. There is low potential for undiscovered oil and gas resources in the study area. Basalt, sand, and gravel underlie most of the study area but is not considered a resource because basalt is abundant in the region and other sources are closer to existing markets.

Character and Setting

The study area is in southeastern Oregon about 18 mi northwest of the town of Jordan Valley (fig. 1). The study area is in the northwestern Great Basin physiographic province and is covered by Cenozoic (see appendixes for geologic time chart) volcanic rocks. There is no evidence of mining or prospecting within the study area.

Identified Mineral Resources and Mineral Resource Potential

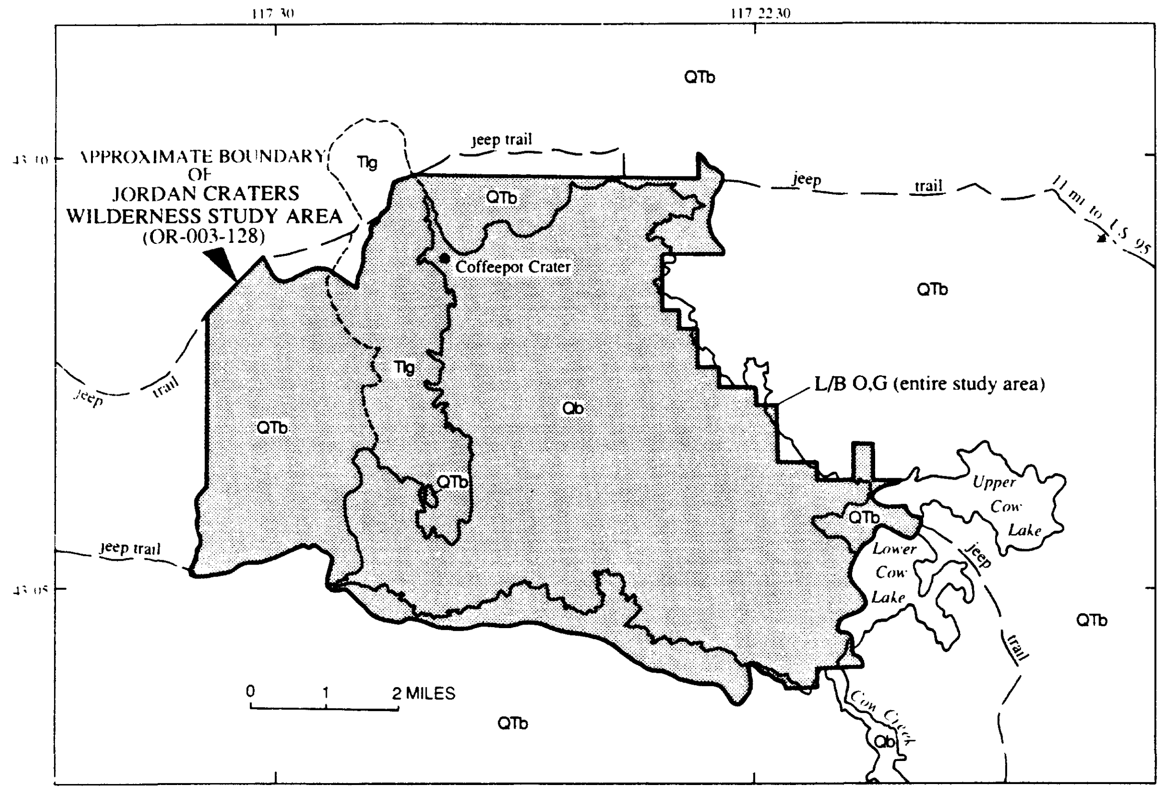
No mineral resources are identified in the study area. Geologic, geochemical, geophysical, and mineral-resource studies suggest that there is no potential for metallic, nonmetallic, uranium and thorium, or geothermal energy resources in the study area. There is low potential for undiscovered resources of oil and gas in the study area. Basalt, sand, and gravel underlie most of the study area and have a number of commercial uses, but they are not considered resources because they are abundant in the region and other sources are closer to existing markets.

INTRODUCTION

This mineral survey was requested by the U.S. Bureau of Land Management and is the result of a cooperative effort by the U.S. Bureau of Mines and the U.S. Geological Survey. An introduction to the wilderness review process, mineral survey methods, and agency responsibilities was provided by Beikman and others (1983). The U.S. Bureau of Mines evaluates identified resources at individual mines and known mineralized areas by collecting data on current and past mining activities and through field examination of mines, prospects, claims, and mineralized areas. Identified resources are classified according to a system that is a modification of that described by McKelvey (1972) and U.S. Bureau of Mines and U.S. Geological Survey (1980). Studies by the U.S. Geological Survey are designed to provide a reasonable scientific basis for assessing the potential for undiscovered mineral resources by determining geologic units and structures, possible environments of mineral deposition, presence of geochemical and geophysical anomalies, and applicable ore-deposit models. Mineral assessment methodology and terminology as they apply to these surveys were discussed by Goudarzi (1984). See appendixes for the definition of levels of mineral resource potential and certainty of assessment and for the resource/reserve classification.

Location and physiography

The study area includes 23,225 acres within a topographic depression on the Owyhee Plateau in southeastern Oregon (fig. 1). Jordan Valley, Oregon, the nearest community, is about 20 mi southeast of the study area. The topography of the study area is



EXPLANATION

☐ Area having low mineral resource potential (L); data only suggest level of potential (B)

Commodity

O,G Oil and gas

Geologic map units

Qb Alkaline olivine basalt of Jordan Craters (Quaternary)
QTb Basalt (Quaternary and (or) Tertiary)
Tlg Leslie Gulch Tuff of Kittleman (1962a) (Tertiary)

—— Contact--Dashed where approximately located

Correlation of map units

Unit	Age	Era
Qb	Quaternary	CENOZOIC
QTb	Quaternary/Tertiary	
Tlg	Tertiary	

Figure 1. Map showing location, mineral resource potential, and generalized geology of the Jordan Craters Wilderness Study Area, Malheur County, Oregon

shown on the Jordan Craters South, Jordan Craters North, and Cow Lakes 7 1/2' quadrangles. Elevations range from 4,320 ft near the south boundary of the study area to 4,700 ft at Coffeepot Crater. Vegetation consists of grass and brush on hill slopes; the youngest volcanic flows are essentially devoid of vegetation. Access to the study area is limited to secondary roads from U.S. Highway 95, 8 mi north of Jordan Valley.

Previous Studies

Kittleman and others (1965; 1967), Walker and Repenning (1966), and Walker (1977) described the regional geology of southeastern Oregon. Hart and Mertzman (1983) described the late Cenozoic volcanic stratigraphy of the Jordan Valley area. Millhollen (1965) described the petrology and geology of the basalts of the Cow Creek Lakes area; Otto and Hutchison (1977) described the geology of the basalt of Jordan Craters. Previous geophysical investigations include an aerial radiometric and magnetic survey for the U.S. Department of Energy (Geometrics, Inc., 1979) and an aeromagnetic survey by the U.S. Geological Survey (1972).

Present Investigations

The U.S. Geological Survey conducted field investigations in the summer of 1986. Work consisted of geologic mapping, geochemical sampling and geophysical investigations including aeromagnetic, gravity, and aerial gamma-ray surveys. Geochemical samples were collected to obtain information about mineral suites and trace-element signatures that suggest mineralized areas.

Bureau of Mines personnel examined Malheur County records and U.S. Bureau of Land Management master title plats for mining claims in the study area; they also studied U.S. Bureau of Mines library materials and production records for additional information. During June 1986, a field search was conducted for prospects and mineralized zones in or near the study area. Traverses of the study area were made on foot, by helicopter, and by motorcycle. A systematic aerial photo-based search for potential decorative stone was conducted in the study area, and a few representative samples were collected.

APPRAISAL OF IDENTIFIED RESOURCES

By J.M. Linne
Bureau of Mines

The literature search and a thorough ground search indicated no areas of metallic mineralization or industrial minerals within or adjacent to the study area. No mining activity has been recorded within or near the study area. None of the five rock-chip samples of the Leslie Gulch Tuff Member of the Sucker Creek Formation of Kittleman (1962a, b) contain zeolites or other valuable minerals in anomalous concentrations. Chemical analyses of three stream-sediment samples from these rocks indicate normal crustal concentrations of economic elements (Rimal, 1985). Several small (less than 1 acre) isolated areas are covered by thin platy blocks of basalt similar to rock sold by stoneyards for facing material. None of these occurrences are large enough to warrant quarrying.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

By J. P. Calzia, Susan Hubbard-Sharpless, R. L. Turner, Andrew Griscom, *and* D. L. Sawatzky
Geological Survey

Geology

The study area is on the Owyhee Plateau southeast of the Owyhee River in southeastern Oregon. The topography and geology of this region resulted from late Cenozoic crustal extension and magmatism (Stewart, 1971).

Jordan Craters is a collective term for both the group of four volcanic craters that form a northwest-trending lineament and the lava field surrounding Coffeepot Crater, the youngest and northwesternmost crater of this lineament. Otto and Hutchison (1977) reported that cinder- and spatter-cone eruptions are characteristic of volcanic activity at Jordan Craters. Intermittent eruptions produced the cinder cone that stands 260 ft above the crater floor. The last stage of volcanism began about 0.15 million years before present (Ma) (Hart and Mertzman, 1983), discharging pyroclastic rocks to the west and lava to the east and south. The lava, an alkaline olivine basalt, flowed southeastward for a maximum distance of 10 mi, filling stream valleys that were part of the Cow Creek drainage system. The lava overlies the upper Miocene Leslie Gulch Tuff Member to the west, and it overlies older basalts to the north, east, and south. The alkaline olivine basalt is characterized by greater than 16 percent aluminum oxide (Al_2O_3), greater than 2.4 percent titanium oxide (TiO_2) (Hart and Mertzman, 1983), and uniform initial strontium isotope ratios of 0.7039 (R.W. Kistler, written commun, 1987). The older basalts, including low-potassium, high-aluminum olivine tholeiite, alkaline olivine basalt, and tholeiites with chemical characteristics transitional to the other lavas (Hart and Mertzman, 1983), yield potassium-argon ages that range from 3.84 to 0.25 Ma (Hart and Mertzman, 1983). Otto and Hutchison (1977) estimated that approximately 0.4 mi^3 of basalt was discharged from Coffeepot Crater.

Large lava tube systems developed beneath the smooth, ropy (pahoehoe) crust of the basalt of Jordan Craters. Some of the lava tubes are tens of feet wide and hundreds of feet long. Many tubes have collapsed to form deep trenches and large collapse pits. Pressure ridges, occasionally over 300 ft long and 30 ft high, formed as a result of liquid lava pushing upward beneath the congealed crust. A line of spatter cones, ranging in height from 3 to 25 ft, forms a ridge that trends southwest from Coffeepot Crater. These dome-shaped cones often have quenched lava adhering to their hollow interior walls. The spatter cones erupted pyroclastic material on the basalt of Jordan Craters.

Geochemistry

Twenty-four samples of basalt and tuff were collected from eighteen sites within the study area. Rocks were selected as the sample media because the study area is nearly totally covered by basalt and no streams cut through or drain this basalt.

Rock samples were collected from altered and unaltered outcrops and from stream float. Samples that appeared fresh and unaltered were collected to provide information on geochemical background values. Altered samples were collected to determine the suite of elements associated with the observed alteration. The samples were crushed and pulverized to a fine powder, and were analyzed for 31 elements by direct-current arc, semiquantitative, emission spectrographic analyses (Grimes and Marranzino, 1968). Analytical data and a description of the sampling and analytical techniques were provided by M.S. Erickson (written commun., 1987).

Basalt samples from 9 of the 18 sample sites contain low but anomalous values of antimony (4-6 parts per million, ppm Sb); none of the tuff samples contain detectable antimony. It is possible that the range of antimony values from the basalt represents background values because these samples appear fresh and unaltered. Geochemical data from the Leslie Gulch Tuff Member do not suggest any anomalous concentrations of the analyzed elements, although silicification was observed in these rocks.

Geophysics

Geophysical evaluation of the mineral resources of the study area was based on interpretations of aeromagnetic, gravity, aerial gamma-ray spectrometer and remote sensing data. A regional aeromagnetic survey was flown over the study area in 1972 (U.S. Geological Survey, 1972). Data were collected along parallel east-west flightlines spaced at an interval of 2 mi and flown at a constant barometric elevation of 9,000 ft above sea level. The Earth's main magnetic field was subtracted from the data that were then plotted and hand-contoured at a scale of 1:250,000. Additional aeromagnetic data are available in the atlas on the Boise quadrangle (scale 1:500,000) published for the Department of Energy (Geometrics, Inc., 1979). These data consist of profiles that were derived from east-west flightlines spaced at 3 mi intervals and flown by helicopter at an average height of 400 ft above the ground surface; 3 profiles cross the study area.

Magnetic minerals, where locally concentrated or depleted, may cause a high or low magnetic anomaly that can be a guide to mineral occurrences or deposits. Boundaries between magnetic and relatively less magnetic rock units are located approximately at the steepest gradient on the flanks of the magnetic anomaly. Most of the anomalies in the study area are probably caused by the large masses of lava flows and other volcanic rocks. Survey aircraft maintained an altitude of 4,200 to 4,600 ft above the ground surface, a distance sufficient to suppress most of the short-wavelength anomalies generated by the rock units at or near the surface. These short-wavelength anomalies may be seen on the low-level profiles across the study area (Geometrics, Inc., 1979). An aeromagnetic map (U.S. Geological Survey, 1972) shows two broad aeromagnetic highs, 6 - 8 mi across, just beyond the east and the south borders, respectively, of the study area. These highs are associated with structurally uplifted areas exposing a thick sequence of Tertiary volcanic rocks that falls within the central parts of the highs. A smaller local magnetic high extends north-south along the ridge, underlain by tuff, that traverses the west-central part of the study area. These aeromagnetic data suggest that the tuff is relatively magnetic in this general region. The young basalt flows of Jordan Craters are also very magnetic, on the basis of evidence from the low-altitude magnetic profiles, but the flows are clearly thin (less than 500 ft) relative to the height above ground of the contoured data (U.S. Geological Survey, 1972) and thus are not expressed on the aeromagnetic map. The magnetic data do not provide any evidence suggesting the presence of any mineral resources in the study area.

A gravity survey of the study area was conducted by the U.S. Geological Survey in 1986 to supplement available data from the National Geophysical Data Center, Boulder, CO 80303. About 15 gravity stations are situated within or on the border of the study area; station spacing ranges from about 3 to 5 mi.

The gravity field is high to the east and south of the study area. These high-gravity areas are associated with structurally uplifted older, dense rocks that are closer to the surface. A steep gravity gradient slopes down to the west in the western part of the study area and is interpreted as a concealed fault that trends north-south. This fault appears to be the southernmost end of a major fault extending at least 70 mi north (Lillie, 1977). A gravity low to the west of this fault does not have an easily identified source. The gravity low extends nearly 20 mi northwest across the Owyhee River Canyon, in which no low-density rock unit is exposed that might cause the anomaly (J.G. Evans, written commun., 1987). The source of the low may be, at least in part, low-density fill in a buried caldera that may have provided a source for some of the nearby Tertiary tuffs, the oldest rocks within 20 mi of the study area. However, other more complex explanations for the gravity low are also possible.

Aerial gamma-ray spectrometer measurements are available along east-west profiles (Geometrics, Inc., 1979) over the study area. The aerial radiometric data do not suggest that statistically significant anomalies for uranium, potassium, and thorium are present within the study area.

Linear features on 1:800,000-scale Landsat multispectral scanner images of southeastern Oregon were mapped by photogeologic interpretation. Trend concentration diagrams at 20° intervals of azimuth were made from these maps. Two major concentrations of linear features that trend N 5° to 35° E lie northeast and southwest of the study area; no concentrations of linear features are expressed at the surface within the study area.

Mineral Resource Potential

There is low oil and gas resource potential in the entire study area (Fouch, 1982; 1983). On the basis of unknown extent of a sedimentary section, if any, for sources and (or) reservoirs beneath the thick volcanic sequence, this assessment could be too high. The certainty of assessment, therefore, is B.

Observations made during field mapping and the results of the geochemical studies did not reveal evidence of metallic or nonmetallic mineral resource potential in the study area. Basalt, sand, and gravel are present in the study area but development of these materials is unlikely because similar materials of equal or better quality are abundant closer to existing markets. There is no potential for deposits of basalt, sand, and gravel beyond those already mapped with a certainty of D. The study area has no geothermal energy potential (Muffler, 1979). This assessment is corroborated by Luedke and Smith (1982) who show no volcanic centers in or near the study area young enough to be thermally active. It is unlikely that faults in the area penetrate to great enough depth to allow for deep circulation of hot groundwater. The certainty of assessment is therefore D. There is no uranium or thorium resource potential in the study area with a certainty of D on the basis of a lack of permissive host rocks and the results of the gamma-ray survey.

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APPENDIXES

DEFINITION OF LEVELS OF MINERAL RESOURCE POTENTIAL AND CERTAINTY OF ASSESSMENT

LEVELS OF RESOURCE POTENTIAL

- H **HIGH** mineral resource potential is assigned to areas where geologic, geochemical, and geophysical char-acteristics 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.
- M **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 reasonable likelihood for resource accumulation, and (or) where an application of mineral-deposit models indicates favorable ground for the specified type(s) of deposits.
- L **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 permissive. This broad category embraces areas with dispersed but insignificantly mineralized rock, as well as areas with little or no indication of having been mineralized.
- N **NO** mineral resource potential is a category reserved for a specific type of resource in a well-defined area.
- U **UNKNOWN** mineral resource potential is assigned to areas where information is inadequate to assign a low, moderate, or high level of resource potential.

LEVELS OF CERTAINTY

- A Available information is not adequate for determination of the level of mineral resource potential.
- B Available information only 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.

LEVEL OF RESOURCE POTENTIAL ⟶

A	B	C	D
U/A	H/B HIGH POTENTIAL	H/C HIGH POTENTIAL	H/D HIGH POTENTIAL
UNKNOWN POTENTIAL	M/B MODERATE POTENTIAL	M/C MODERATE POTENTIAL	M/D MODERATE POTENTIAL
	L/B LOW POTENTIAL	L/C LOW POTENTIAL	L/D LOW POTENTIAL
			N/D NO POTENTIAL

LEVEL OF CERTAINTY ⟶

Abstracted with minor modifications from:

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RESOURCE/RESERVE CLASSIFICATION

	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		

Major elements of mineral resource classification, excluding reserve base and inferred reserve base. Modified from McKelvey, V.E., 1972, Mineral resource estimates and public policy: American Scientist, v. 60, p. 32-40; and U.S. Bureau of Mines and U.S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U.S. Geological Survey Circular 831, p. 5.

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 MILLION YEARS (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	[1]~570
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.