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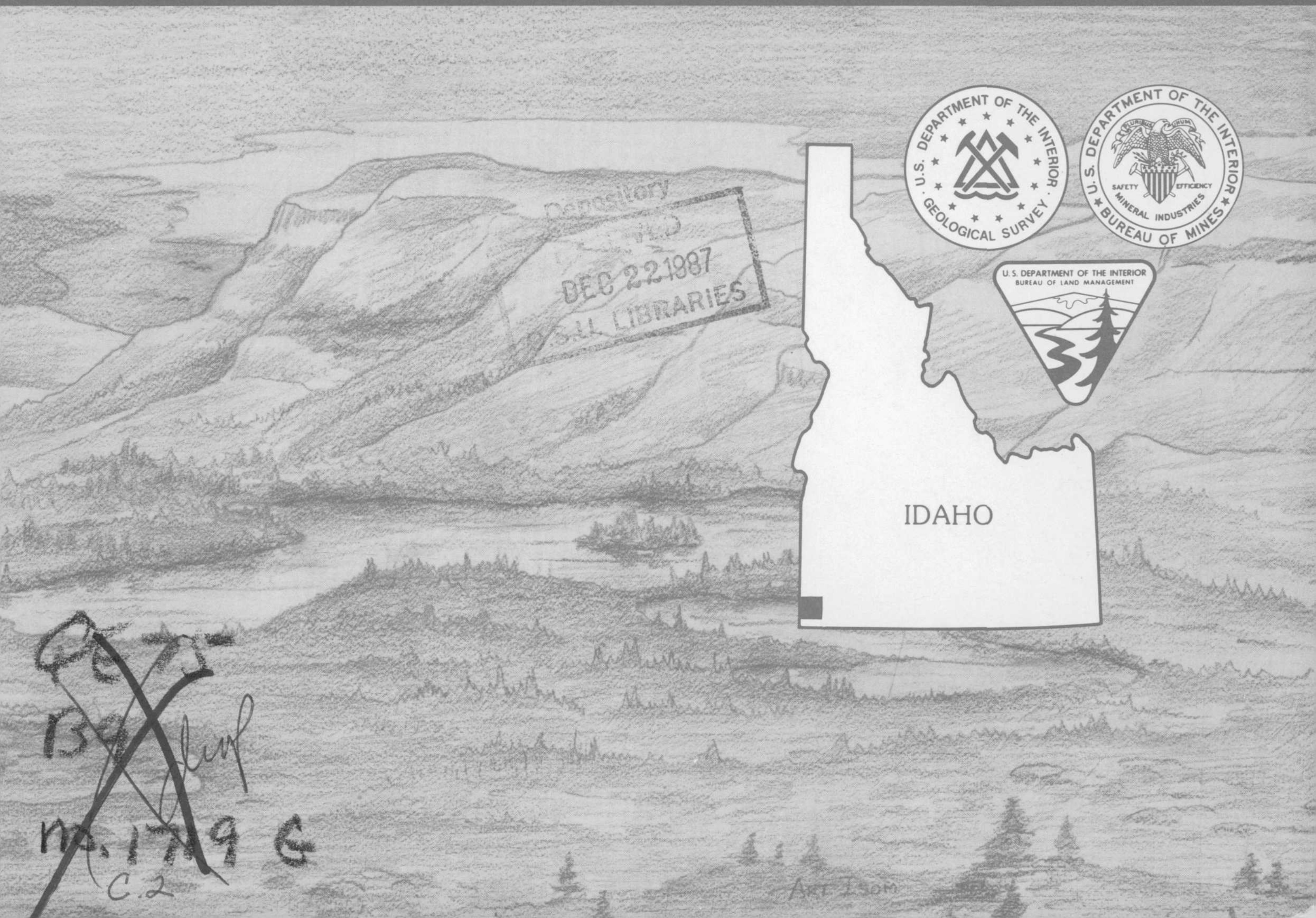

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Mineral Resources of the Upper Deep Creek Wilderness Study Area, Owyhee County, Idaho

By SCOTT A. MINOR, HARLEY D. KING, DOLORES M. KULIK, and DONALD L. SAWATZKY
U.S. Geological Survey

DONALD O. CAPSTICK
U.S. Bureau of Mines

U.S. GEOLOGICAL SURVEY BULLETIN 1719

MINERAL RESOURCES OF WILDERNESS STUDY AREAS:
OWYHEE RIVER REGION, IDAHO AND NEVADA

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

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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 Upper Deep Creek Wilderness Study Area (ID-111-044), Owyhee County, Idaho.

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FIGURES

Mineral Resources of the Upper Deep Creek Wilderness Study Area Owyhee County, Idaho

By Scott A. Minor, Harley D. King, Dolores M. Kulik, *and* Donald L. Sawatzky
U.S. Geological Survey

Donald O. Capstick
U.S. Bureau of Mines

SUMMARY

Abstract

The Upper Deep Creek Wilderness Study Area (ID-111-044) is located on the northern Owyhee Plateau in southwest Idaho and encompasses 11,510 acres, of which the U.S. Geological Survey and the U.S. Bureau of Mines were asked to study 5,700 acres. Hereafter, the terms "study area" and "wilderness study area" refer only to the smaller acreage. Field work for this report was conducted in 1985 to assess the identified mineral resources (known) and mineral resource potential (undiscovered) of the area. No mines, prospects, or claims are located in the study area and there are no identified mineral or energy resources. The study area has moderate resource potential for small gold placers and low potential for gold and silver resources in epithermal (hydrothermal) deposits. The study area also has low potential for tin and uranium resources; the southern part has low potential for diatomite resources. The potential for oil, gas, and geothermal energy resources in the study area is low.

Character and Setting

The Upper Deep Creek Wilderness Study Area is located on the northern Owyhee Plateau of southwest Idaho (fig. 1), about 80 mi southwest of Boise. The terrain is characterized by a stream-dissected plateau, averaging about 5,300 ft in elevation, with several prominent canyons, including the 200- to 400-ft-deep canyon of Deep Creek that extends the length of the study area. The surrounding Owyhee Plateau is underlain by a thick (greater than 800 ft) flat-lying sequence of Miocene (see appendix for geologic time chart) rhyolitic ash-flow tuffs, basalt flows, and minor interbedded sedimentary rocks. A thick rhyolitic ash-flow tuff is exposed in most of the study area; the tuff is overlain in the southern part by a sequence of thin basalt flows and basal sedimentary rocks (fig. 2). Geologic and geophysical data indicate that the study area lies within a large collapsed caldera. The ash-flow tuff and overlying units are interpreted to be part of a post-collapse sequence that has filled and buried most of the caldera. A small (0.5 by 0.25 mi) basalt maar crater (Indian Lake, fig. 2) is located directly east of the study area.

Identified Resources

No mining claims were located and no minerals were produced in the study area. There are no identified mineral or energy resources within the study area.

Mineral Resource Potential

There is moderate resource potential for placer gold resources obtained by recreational, suction-dredge methods along the Deep Creek stream bed (fig. 2); relatively high concentrations of particulate gold were identified in sand and gravel bars along the creek within the study area.

The entire study area has a low potential for gold and silver resources in epithermal deposits (fig. 2). This is indicated by weak, sporadic geochemical anomalies, and the presence of placer gold. Altered

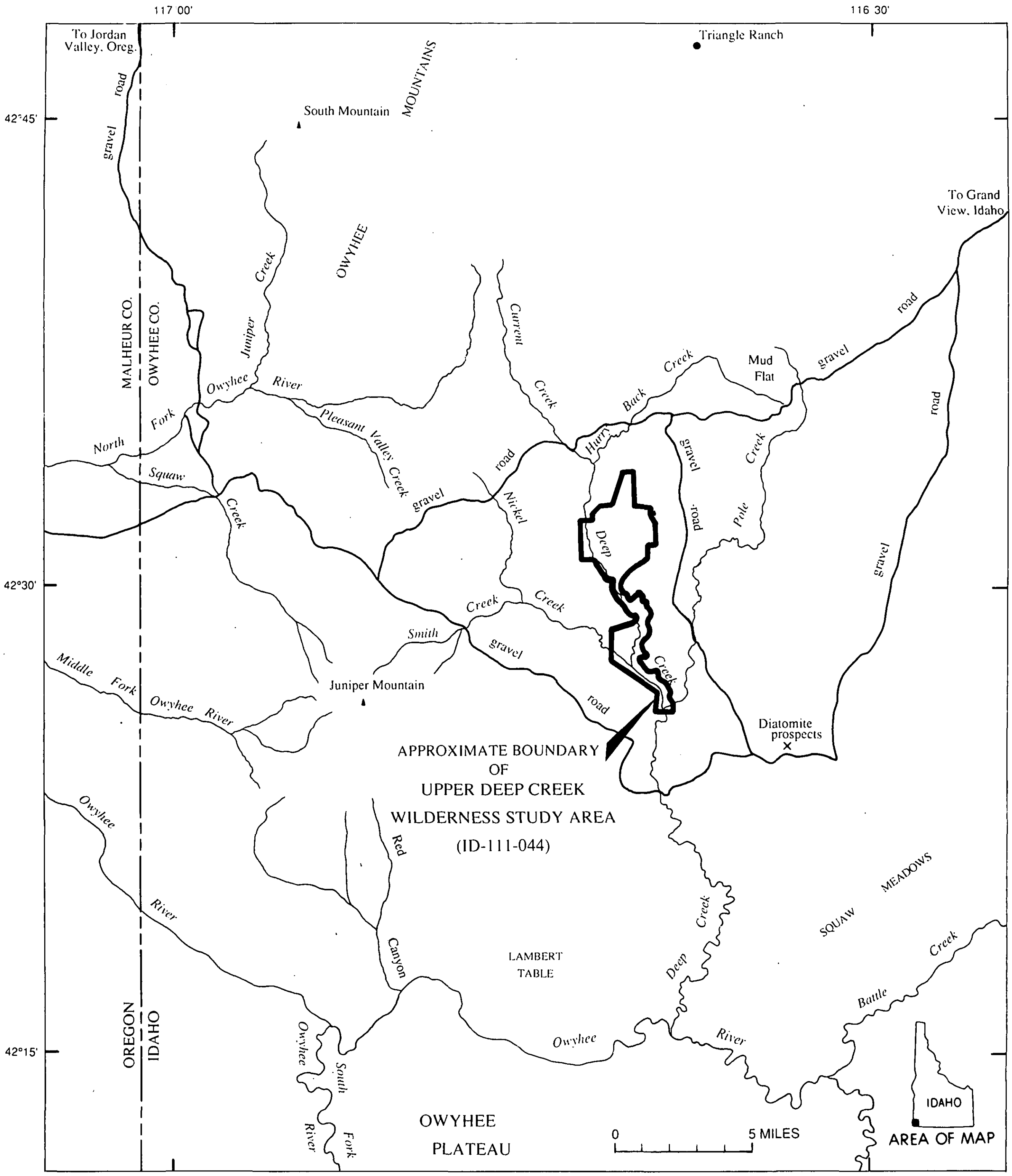

Figure 1. Index map showing location of Upper Deep Creek Wilderness Study Area, Owyhee County, Idaho.

rock is generally lacking, and any occurrences of precious metals in near-surface rocks are probably insignificant.

There is low potential for tin resources in the rhyolitic tuff underlying the study area. A tin-bearing mineral identified in heavy-mineral-concentrate samples suggests the possible presence of rhyolite-hosted tin deposits, but many of the common attributes of this type of deposit are lacking.

The potential for uranium resources is low throughout the study area. Several weak uranium and thorium geochemical anomalies were detected but no minerals bearing these elements other than zircon, which may contain thorium, were observed. The elemental anomalies are believed to reflect relatively high background values of uranium and thorium within the rhyolitic ash-flow tuff.

No diatomite was identified within the limited exposures of sedimentary rock in the study area. The depositional environment of the sedimentary rocks may have been favorable for the formation of only small-volume, discontinuous diatomite deposits. The diatomite resource potential is therefore assessed as low for areas underlain by sedimentary rock in the southern part of the study area.

Hydrocarbon source and reservoir rocks are not present in the study area, and there are no active oil and gas leases nor producing wells in the area. It is unknown, but doubtful, if hydrocarbon source or reservoir rocks are present at depth beneath the study area; therefore, the potential for oil and gas resources is low. Similarly, the potential for geothermal resources is assessed as low; no recent volcanic rocks, hot springs, or geothermal wells exist in the area despite probable high regional heat flow.

INTRODUCTION

This mineral survey was requested by the U.S. Bureau of Land Managment and is a joint effort by the U.S. Geological Survey and the U.S. Bureau of Mines. 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 the system described by 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 appendix for the definition of levels of mineral resource potential, certainty of assessment, and classification of identified resources.

Character and Setting

The Upper Deep Creek Wilderness Study Area is located about 35 mi southeast of Jordan Valley, Oreg., and 80 mi southwest of Boise on the northern Owyhee Plateau of southwest Idaho (fig. 1). The U.S. Bureau of Land Management requested studies on a total of 5,700 acres of the 11,510-acre Upper Deep Creek Wilderness Study Area. Other wilderness study areas in the region include the North Fork Owyhee River (ID-016-040) (Minor and others, 1986) and Deep Creek-Owyhee River (ID-016-049A) (Sawlan and others, 1987) Wilderness Study Areas located about 3 mi northwest and southeast of the study area, respectively.

Elevations in the Upper Deep Creek Wilderness Study Area range from about 5,770 ft along the north boundary to 4,800 ft where Deep Creek crosses the south boundary. The rugged, extensively stream-dissected northern part of the study area contrasts sharply with the curving, table-rimmed Deep Creek canyon of the southern part (fig. 2). The 200- to 400-ft-deep, steeply walled canyon cut by south-flowing Deep Creek dominates the study-area landscape. The surrounding Owyhee Plateau region is characterized by flat-lying to gently rolling tablelands locally incised by tributary streams of the Owyhee River such as Deep Creek (fig. 1). Most of the streams are intermittent, reflecting the semiarid climate of the region. Juniper trees, low-lying sage and other brush, and seasonal varieties of grasses and wildflowers grow throughout most of the study area. The larger stream channels support a variety of riparian vegetation.

An improved county-maintained gravel road that extends from Jordan Valley, Oreg., to Grand View, Idaho, passes within 2 mi of the northern edge of the study area and provides the best access (fig. 1). Several less-used gravel roads and jeep trails branching off this road extend south to or near the study area.

Previous and Present Investigations

The earliest published geologic map of the region, which covers the northern part of the study area, was a reconnaissance map (scale 1:62,500) accompanying a report by Bennett (1976) on the geology and geochemistry of the South Mountain-Juniper Mountain area. The only geologic map covering the entire study area is that of western Owyhee County (scale 1:125,000) by Ekren and others (1981) . Other geologic studies related to the study area have addressed the rhyolite ash-flow tuffs (Ekren and others, 1984) and stratigraphy (Ekren and others, 1982) of the region.

The U.S. Bureau of Land Management conducted a preliminary mineral survey of lands proposed for wilderness study areas in the region, including the Upper Deek Creek Wilderness Study Area (Gloria Derby, unpub. data, 1981). Geochemical (Oak Ridge Gaseous Diffusion Plant, 1982; Berry and others, 1982) and geophysical (Geodata International, Inc., 1979) surveys were conducted for the U.S. Department of Energy's National Uranium Resource Evaluation (NURE) program to assess the radioactive mineral potential of the region. A geology, energy, and mineral (GEM) resources report was prepared by Mathews and Blackburn (1982) for the Pole Creek GEM Resource Area, which includes the Upper Deep Creek Wilderness Study Area.

The U.S. Geological Survey conducted field investigations in the study area in the summer of

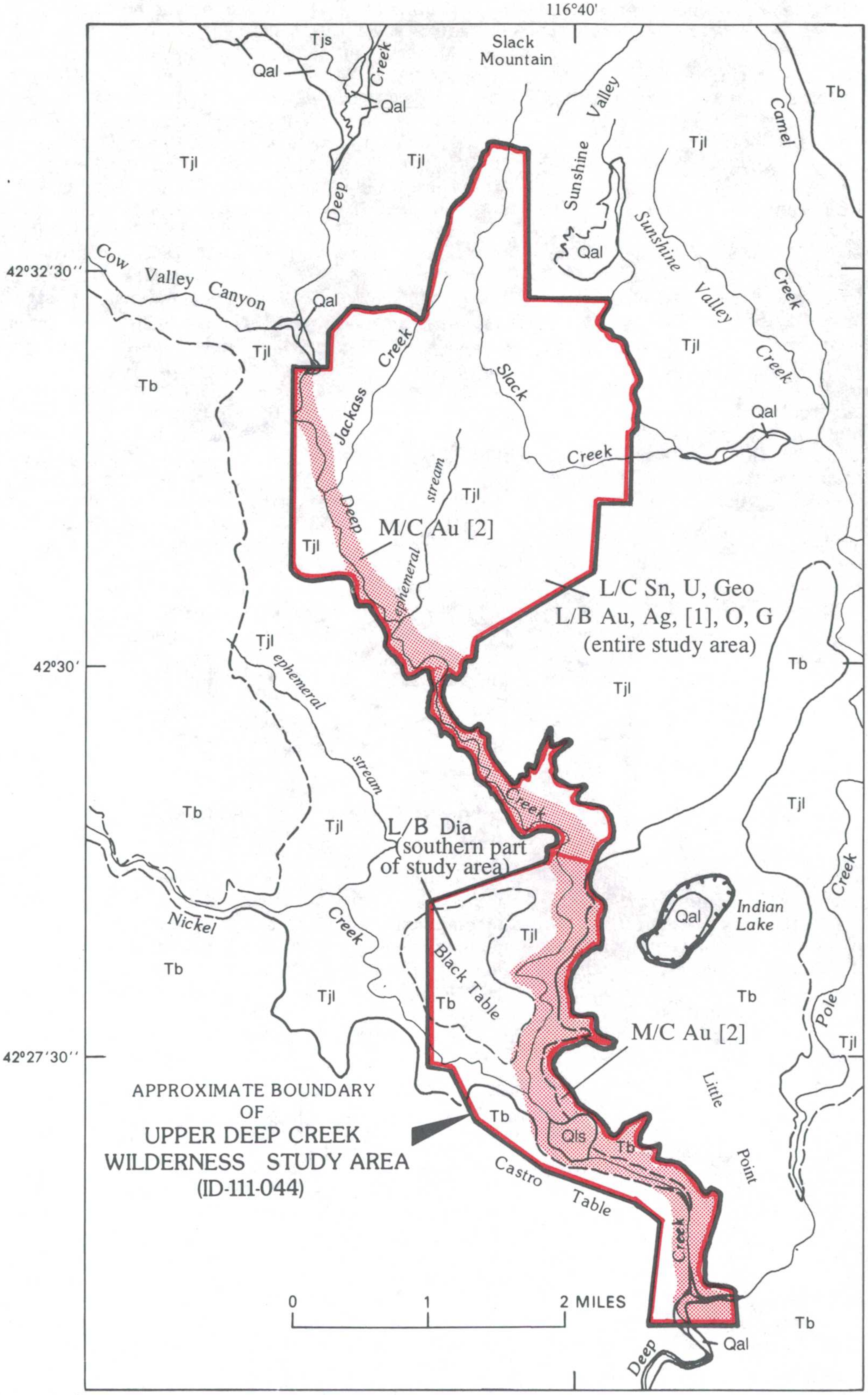

Figure 2. Mineral resource potential and geology of Upper Deep Creek Wilderness Study Area, Owyhee County, Idaho. Geology modified from Ekren and others (1981).

EXPLANATION

Area with moderate mineral resource potential

Area with low mineral resource potential

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

Commodities

Au	Gold
Ag	Silver
Sn	Tin
U	Uranium
Dia	Diatomite
O,G	Oil and Gas
Geo	Geothermal energy

Deposit types

[1]	Epithermal vein and dissemination
[2]	Placer

Geologic map units

Qal	Alluvium (Quaternary)
Qls	Landslide (Quaternary)
Tb	Banbury Basalt and unnamed interbedded sedimentary rocks (Miocene)
	Rocks of Juniper Mountain volcanic center (Miocene)--In this area, consist of:
Tjl	Tuff of Juniper Mountain (equivalent to lower lobes of Ekren and others, 1981)
Tjs	Swisher Mountain Tuff

Contact--Dashed where approximately located

Maar crater

Figure 2. Continued.

1985. The studies included checking of existing geologic maps, local supplementary mapping, and geochemical sampling. Linear features that appear in Landsat multispectral-scanner images of the region were mapped and interpreted. Gravity data were acquired, processed, and compiled to supplement preexisting gravity and aeromagnetic data. Geochemical analyses were obtained for 11 stream-sediment and nonmagnetic heavy-mineral-concentrate samples and 17 rock samples collected in the study area.

U.S. Bureau of Mines personnel conducted a library search of county, state, and U.S. Bureau of Land Management mining and mineral-lease records and U.S. Bureau of Mines production records for information on mines, prospects, and claims within the study area. Field work was conducted in 1985, which included a ground and air reconnaissance undertaken to search for evidence of undocumented prospecting activity. Three alluvial (placer) samples were collected to help evaluate any possible placer-gold resources. The results of work by the U.S. Bureau of Mines were reported by Capstick (1986). Detailed information is availible from the U.S. Bureau of Mines, Western Field Operations Center, E. 360 Third Avenue, Spokane, WA 99202.

APPRAISAL OF IDENTIFIED RESOURCES

By Donald O. Capstick
U.S. Bureau of Mines

History and Production

No mining claims have been located in the Upper Deep Creek Wilderness Study Area, and no minerals have been produced. A few tons of diatomite were extracted from a large diatomite deposit (Staley, 1964) about 5 mi southeast of the study area (fig. 1), but apparently there was no production since the 1930's (Powers, 1947; Capstick and Buehler, 1985). The Silver City mining district, about 35 mi north of the study area, has been active since 1863. Early gold and silver production in the district, from 1863 to about 1914, was valued at more than $40 million (Rodgers and others, 1980) from underground and placer mines. In 1977, the Delamar mine was reopened as an open-pit, large-tonnage, low-grade disseminated silver and gold mine. Output in 1985 was valued at about $20 million (Nerco, Inc., 1985). The silver and gold are in Miocene rhyolite-hosted epithermal deposits.

Mineral Deposits

No identified mineral resources were delineated within the study area. Gold, however, was found in three samples collected from sand and gravel bars along Deep Creek (Capstick, 1986); gold concentrations are 0.00052, 0.00054, and 0.0068 troy ounces/yd^3 with values of $0.21, $0.22, and $2.72/$yd^3$, respectively (at $400/troy ounce). These values are distinctly higher than the $0.02/$yd^3$ average typical of the Owyhee canyonland and drainages (Gabby and Mayerle, 1985). However, the volume of the sand and gravel deposits is insufficient to be minable by large-volume commercial methods. Such methods require average gold values of several dollars per cubic yard and several thousand cubic yards of gravel to be treated per day. Commonly, the size and number of individual gold particles may increase dramatically in material on or near bedrock, raising the values substantially. Consequently, the area may be attractive for recreational or small-scale commercial suction-dredge operations.

Available evidence suggests that the gold came from a nearby source; the gold is bright, indicating it may have recently been liberated from the host rock, and the surface of the individual gold particles is angular rather than rounded, indicating they had traveled only a short distance. The area drained by Deep Creek northwest of the study area, to within 4 mi of the boundary, was examined previously by the U.S. Bureau of Mines as part of their study of the North Fork Owyhee River Wilderness Study Area (Leszcykowski, 1986), and no gold was found. Therefore, the gold source may lie between the North Fork Owyhee River and Upper Deep Creek Wilderness Study Areas or within the northeastern part of the Upper Deep Creek Wilderness Study Area.

Blocky basalt forming the tables and canyon rims in the southern part of the study area (Banbury Basalt, fig. 2) may be suitable for use as dimension stone. Sand and gravel deposits (alluvium) usable for construction are also present in the study area. However, other higher quality, more accessible deposits of these commodities exist closer to markets. Basalt and sand and gravel do not constitute resources within the study area.

No jasper and only local, minor amounts of chalcedony and common opal(?) were noted in outcrops, although the geologic environment of the study area is similar to that of nearby wilderness study areas where these minerals are present in greater abundance (Capstick and Buehler, 1985; Gabby and Mayerle, 1985). There are no resource accumulations of these or other gem minerals in the study area.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

By Scott A. Minor, Harley D. King, Dolores M. Kulik, and Donald L. Sawatzky
U.S. Geological Survey

Geology

The Upper Deep Creek Wilderness Study Area lies within the Owyhee volcanic field of Panze (1975), which consists of a thick pile of complexly interfingering and overlapping Tertiary volcanic, pyroclastic, and subordinate sedimentary rocks. Basement rocks, consisting of Mesozoic intrusive and metamorphic units, crop out within the Owyhee Mountains north of the study area. Rocks of the volcanic field are locally displaced along normal faults trending primarily north-northwest.

The study area is underlain by flat-lying, middle and upper Miocene rhyolitic ash-flow tuff, basalt flows, and minor intercalated sedimentary rocks (fig. 2). The oldest rock unit is the tuff of Juniper Mountain (equivalent to the lower lobes of Juniper Mountain of Ekren and others, 1981), a subunit of the rocks of Juniper Mountain volcanic center (Ekren and others, 1981). The tuff of Juniper Mountain, which underlies most of the study area (fig. 2), is a rhyolitic ash-flow tuff made up of several cooling units. It has a minimum thickness of about 400 ft within the study area; its base is not exposed. The tuff typically contains more than 20 percent phenocrysts of quartz, plagioclase, potassium feldspar, and pyroxene. The gray, cryptocrystalline groundmass of the tuff weathers reddish to orangish brown. Flow foliations are ubiquitous and usually characterized by folds that have amplitudes as great as 300 ft. The tuff is characterized by outcrops that form jagged pinnacles and precipitous cliffs along the major drainages. The tuff apparently erupted from Juniper Mountain, a broad dome-shaped landform located 10 mi southwest of the study area (fig. 1) (Ekren and others, 1981 and 1984).

A geologic reconnaissance of the region indicated that the study area is within a caldera (Minor and others, 1986), the north margin of which is exposed about 22 mi north of the study area. (The caldera is also expressed by gravity data collected in the region--see Geophysical Studies section.) Eruption of the Swisher Mountain Tuff, the oldest subunit of the rocks of Juniper Mountain volcanic center and exposed about 3 mi north of the study area (Ekren and others, 1981), is inferred to have resulted in collapse of the caldera. Overlying rocks related to the Juniper Mountain volcanic center, including the tuff of Juniper Mountain, appear to be intracaldera tuffs that are possibly comagmatic with the Swisher Mountain Tuff. The younger tuffs and other overlying rocks overlap and conceal the caldera margin east, west, and south of the study area.

In the southern part of the study area, the tuff is overlain by flat-lying basalt flows and local basal sedimentary rocks mapped collectively by Ekren and others (1981) as "Banbury Basalt and unnamed interbedded sediments" (fig. 2). The basalt flows form mesas, including Little Point and Castro and Black Tables (fig. 2), that rim Deep Creek canyon in the southern part of the study area. The flows range from 25 to 50 ft in thickness and have a maximum cumulative thickness of about 350 ft at the south end of the study area. Tabular upper parts of the flows commonly possess vesicles that are locally lined with calcite, clay, and (or) zeolite minerals. The basalts are aphyric to sparsely porphyritic; phenocrysts consist of olivine and (or) plagioclase, as well as less abundant iron oxides and pyroxene. The basal sedimentary rocks, which are usually concealed by basalt talus, have a maximum thickness of about 100 ft. They consist primarily of variegated vitric-ash tuff and fluvial and lacustrine tuffaceous sandstone and siltstone.

Small amounts of Quaternary alluvium are present along the major stream channels and consist of unconsolidated silt, sand, and gravel.

The study area lacks any faults with noticeable displacement. However, a zone of closely spaced, north-northwest-trending normal faults that cut rocks of the Swisher Mountain Tuff and Banbury Basalt is present about 3 mi to the northeast (Ekren and others, 1981). Indian Lake, an elliptical topographic depression (0.5 mi by 0.25 mi) located 0.5 mi east of the study area (fig. 2), was mapped by Ekren and others (1981) as a basalt maar. A maar is a crater having a low rim that forms principally by the violent explosion of steam derived from groundwater (Fisher and Schmincke, 1984).

Geochemical Studies

The reconnaissance geochemical study of the Upper Deep Creek Wilderness Study Area included the collection and analysis of 11 stream-sediment samples, 11 nonmagnetic heavy-mineral-concentrate samples, and 17 rock samples.

All samples were analyzed semiquantitatively using direct-current arc emission spectrographic methods; rock and stream-sediment samples were analyzed by the method described by Crock and others (1987) and nonmagnetic heavy-mineral concentrates by the method described by Grimes and Marranzino (1968). Certain elements of interest in terms of resource potential or which have high lower limits of determination by emission spectrography were also analyzed by other more precise methods; antimony, arsenic, bismuth, cadmium, and zinc were analyzed by inductively coupled argon plasma-atomic emission spectroscopy and gold and mercury were analyzed by atomic absorption (methods described in Crock and others, 1987). A split of each of the heavy-mineral-concentrate samples was examined with a binocular microscope for ore- and ore-related minerals. The analytical data are by M.S. Erickson and others (Unpublished data, 1986).

Anomalous values were determined primarily by considering the range, distribution, and mean of the elemental concentrations. Average elemental crustal abundances and high background values expected for certain rock types were also considered.

A stream-sediment sample collected in the northeast part of the study area along Slack Creek (fig. 2) contains 1.4 parts per million (ppm) mercury. No other notably anomalous values were detected in stream-sediment samples from the study area.

Bennett (1976) reported anomalous silver concentrations of 3.2 and 0.99 ppm in two stream-sediment samples collected along one of the Slack Creek tributaries in the study area. However, no anomalous metal values were reported for his remaining 10 samples collected in the northern part of the study area. Furthermore, no anomalous silver concentrations were detected during the present study in samples collected in this area. The sporadic, weak nature of the metal anomalies reported by Bennett (1976) and in this study indicate that there are no significant deposits of these or related elements near the surface.

Anomalously high concentrations of thorium and tin were detected in some of the heavy-mineral-concentrate samples collected in the study area. Three samples from the northern part of the study area contain anomalous concentrations of thorium (200-300 ppm). These samples were determined, by microscopic examination, to be composed predominantly of zircon, which can contain thorium. Other thorium-bearing minerals, such as thorite, were not noted. The values are considered to be too low to indicate a thorium-ore deposit, however, the element is of interest as a possible indicator of uranium. Only slightly anomalous concentrations (4.0-6.6 ppm) of uranium were detected in 4 out of 10 stream-sediment samples collected near the study area as part of the NURE assessment of the region (Oak Ridge Gaseous Diffusion Plant, 1982). NURE investigators concluded that rocks underlying the region are unfavorable for uranium deposits (Berry and others, 1982).

Tin is present in anomalous concentrations (1,500 and greater than 2,000 ppm) in two heavy-mineral-concentrate samples from the central and southern parts of the study area. Cassiterite variety wood tin, a common tin-bearing mineral, was identified by microscopic examination in the mineralogy splits of those samples. A rhyolite-hosted tin deposit is suggested by the occurrence of this variety of cassiterite and the predominance of welded rhyolitic tuff in the area (Boyle, 1974; Cox and Singer, 1986). Most of the characteristics described for this type of deposit, however, are lacking in the study area. The rhyolitic ash-flow tuffs underlying much of the Owyhee Plateau (see Ekren and others, 1981), including the tuff of Juniper Mountain, are probably of peralkalic chemistry (J.J. Rytuba, oral commun., 1986). Peralkalic rhyolites are commonly enriched in lithophile elements, including tin (MacDonald and Bailey, 1973), suggesting that the primary source of the tin is the lower lobes of Juniper Mountain.

No anomalous elemental concentrations are present in the 17 rock samples collected in the study area, with the exception of an 18-ppm arsenic value detected in a sample from Deep Creek canyon east of Black Table (fig. 2). The anomalous sample was taken from a local (approximately 0.25 mi^2) alteration zone within the tuff of Juniper Mountain. Two other rock samples from the same altered zone lack any anomalous concentrations. The high arsenic value may be associated with relatively high primary arsenic concentrations within the tuff of Juniper Mountain, or alternatively may be reflecting mineralized rock at depth.

Geophysical Studies

Geophysical data provide information on the subsurface distribution of rock masses and the structural framework of the region. Gravity and aeromagnetic studies were undertaken as part of the mineral resource evaluation of the study area.

Gravity data were obtained from files maintained by the Defense Mapping Agency of the U.S. Department of Defense and supplemented by additional field data obtained by the U.S. Geological Survey in 1985. Bouguer gravity anomaly values were computed using the 1967 gravity formula (International Association of Geodesy, 1967) and a reduction density of 2.67 g/cm^3 (grams per cubic centimeter). Terrain corrections were made by computer for a distance of 104 mi from the station using the method of Plouff (1977).

The area of extreme southwestern Idaho is characterized by intermediate Bouguer values of between -150 and -175 milligals (mGal) over a terrane underlain predominantly by rhyolitic rocks. Gravity values decrease to the south where the rhyolites become thicker and increase to the north where Cretaceous intrusive rocks crop out in the Owyhee Mountains. In the Owyhee Plateau region a roughly circular, low gravity anomaly 50 to 55 mi in diameter suggests an underlying volcano-tectonic depression or caldera that may have been a source of the ash-flow tuffs of the Juniper Mountain volcanic center (see Geology section). A 5- to 10-mGal gravity high superimposed on the west half of the extensive gravity low overlaps the southern part of the study area and may represent a caldera-related resurgent dome.

Aeromagnetic data evaluated in this report are from the aeromagnetic map of Idaho (U.S. Geological Survey, 1978). Flightlines were flown east-west at 5-mi spacing and 12,500 ft barometric elevation.

The aeromagnetic values show only moderate (approximately 300 gammas) variation over southwesternmost Idaho except in an area 30 mi northeast of the study area. There values increase to 1,400 gammas over a buried, highly magnetic mass that extends southeastward to the border between Idaho and Utah. This anomaly is well separated from the study area and was not evaluated for this report.

An aerial gamma-ray survey was performed in the region as part of the NURE program (Geodata International, Inc., 1979). Three east-west composite flightlines spaced at intervals of 3 mi traversed the study area. Values of equivalent uranium for rocks in the area determined from the aerial survey indicate that the tuff of Juniper Mountain has comparatively high background levels.

Linear features in Landsat multispectral-scanner (MSS) images were mapped by photogeologic interpretation for the region of southwestern Idaho. Linear features are the surface expression of rock fracture patterns and other structural and lithologic lineaments. Analysis of linear features, in conjunction with other geologic and geophysical data, are used to help define relations such as structural control of mineralization.

Generally few linear features are seen in the MSS images of the volcanic rocks of southwestern Idaho. However, two sets of linear features with dominant N. 20° W. and N. 60-80° E. trends are present in an area bounded by long 116°-117° W. and lat 42°30'-43° N., which includes the northern part of the study area. Maximum concentrations lie in an elongate zone trending N. 20° W., with the N. 20° W. trend prominent at the south end of the zone near the study area and the N. 80° E. trend prevalent at the north end. The dominant north-northwest trend is similar to that of major fault zones trending N. 20° W. and N. 40° W. that lie northeast of the study area. The east-northeast trend may be related to a pervasive regional-fracture set found in other linear-feature investigations in the region (for example, Rowan and Purdy, 1984) that proved to be an important structural control of mineralization.

Mineral and Energy Resource Potential

Trace-element signatures detected in rock and stream-sediment samples collected within the Upper Deep Creek Wilderness Study Area may reflect, in part, relatively high primary background concentrations of these elements in the tuff of Juniper Mountain exposed in most of the study area. Alternatively, the anomalies could be expressions of leakage halos related to mineralized rocks at depth. Anomalous concentrations of certain metals, such as those of arsenic, mercury, and silver detected in the study area, are commonly associated with auriferous mineral deposits (Boyle, 1974; Cox and Singer, 1986). Significant gold values were found in three placer samples collected along Deep Creek in the study area. The gold most likely was derived from gold-mineralized rocks upstream just northeast of the study area. One small zone of possible hydrothermal alteration was identified; the zone is characterized by silicified, argillically altered, bleached, and limonite-stained tuff; minor chalcedony and opal(?) line cavity walls within the zone. A slightly anomalous concentration of arsenic was detected in one of three rock samples from the altered zone. The sporadic and weak nature of the stream-sediment- and rock-sample metalliferous anomalies in the study area and the general lack of alteration suggest that any possible mineralized rocks are at some unknown depth. The numerous small fractures and joints that cut the rhyolitic ash-flow tuff would provide conduits for leakage of hydrothermal metal-rich solutions from below. The small alteration zone described above may have formed along one such conduit. Mineralization, if any, probably resulted from hydrothermal activity associated with caldera magmatism that occurred in the region in middle Miocene time, in a similar fashion to that postulated for the Delamar silver-gold mineralization (Halsor, 1983) in the Silver City mining district.

The cause(s) of the anomalous metal concentrations in the study area is conjectural due to the sparsity of alteration and mineral occurrences and the lack of deposits. There is little likelihood for discovery of gold and silver deposits other than, perhaps, placer gold obtained by recreational suction-dredging methods. Any mineralized rocks are concealed by an unknown thickness of volcanic and pyroclastic rocks. There is moderate potential, certainty level C, for small-volume placer gold along Deep Creek; the entire study area has a low potential, certainty level B, for gold and silver resources in epithermal mineral deposits (fig. 2).

The presence of the tin-bearing mineral cassiterite variety wood tin in two heavy-mineral-concentrate samples partly derived from rhyolitic welded ash-flow tuff in the study area indicates there is some possibility for the occurrence of tin resources. The common attributes of tin deposits in rhyolite flows—cassiterite-rich disseminations, veins, and veinlets within fractured and brecciated host rock (Cox and Singer, 1986)—were not observed in the study area. The tuff of Juniper Mountain (fig. 2) is a likely source of the tin; the tuff's apparent peralkalic chemistry is usually associated with high background values of tin. Such primary tin within the tuff is probably highly disseminated and is unlikely to be economically significant. The potential for tin resources in the study area is considered to be low with a C certainty level (fig. 2) because the geologic environment is not favorable for concentrations of tin minerals.

There is little likelihood for uranium resources in the study area. No uranium-bearing mineral occurrences or hydrothermal alteration assemblages commonly associated with volcanic-hosted uranium deposits were identified. Several weak thorium and uranium geochemical anomalies detected in and near the study area probably reflect the relatively high equivalent-uranium background values determined by aerial survey (Geodata International, Inc., 1979) for the rhyolitic tuff unit. The study area is thus judged to have low potential, certainty level C, for uranium resources (fig. 2).

Lacustrine sedimentary rocks formed in a geologic environment favorable for the accumulation of diatomite are locally exposed along the base of the Banbury Basalt in the southern part of the study area (fig. 2). Large, relatively high-grade diatomite deposits mined 5 mi southeast of the study area (fig. 1) (Staley, 1964) are contained in lacustrine strata essentially correlative with the sedimentary rocks, although the deposits apparently pinch out and do not extend into the study area. The sedimentary rocks in the study area are largely concealed by several hundred feet of basalt overburden and, along the canyon walls, by basalt talus. No diatomite was identified in the few exposures of the unit and any undiscovered deposits would most likely be thin and discontinuous. There is low potential for diatomite resources in the southern part of the study area, certainty level B (fig. 2).

Available geologic data do not indicate the presence of oil and gas resources in or near the study area. The Owyhee Plateau is underlain by at least 1,000 ft of Tertiary volcanic and pyroclastic rocks (Ekren and others, 1981) that are not likely sources or reservoirs of hydrocarbons. The nearest Tertiary sedimentary rocks that are possible hydrocarbon sources are in the Sucker Creek Formation (Warner, 1980) and are located 32 mi northwest of the study area. These rocks were probably deposited in localized basins that do not extend into the study area. It is not known if significant amounts of sedimentary rocks older than those that crop out exist at depth under the study area. The localized sedimentary rocks at the base of the Banbury Basalt lack surficial tar and oil seeps, black shales, or other evidence of hydrocarbons. The nearest exposed pre-Tertiary basement rocks, about 15 mi northwest of the study area (Ekren and others, 1981), consist of metamorphic and intrusive rocks--also unlikely hydrocarbon sources or reservoirs.

In assessing the petroleum potential of wilderness lands in Idaho, Sandberg (1983) determined that the study area has "low potential" for yielding oil or gas. At present, there are no active oil and gas leases nor producing wells in the study area and surroundings. In consideration of the unfavorable, although somewhat limited, geologic evidence regarding the presence of hydrocarbon source and reservoir rocks and the lack of oil and gas leases, exploration, and production, the study area is judged to have low potential, certainty level B, for oil and gas resources (fig. 2).

Strong indications of geothermal activity, such as hot springs, sulfurous odors, and recent volcanism, are lacking in the study area. A list of thermal springs and wells in Idaho compiled by Bliss (1983) did not include any such features in the study area region. In an evaluation of geothermal resources of southern Idaho, Mabey (1983) noted that the regional heat flow in the Owyhee Plateau area is probably high, and favorable structures for hydrothermal convection likely exist there. However, he did not identify any geothermal systems in or near the study area. The potential for geothermal resources in the study area is low, certainty level C, because direct evidence of these resources is lacking.

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APPENDIXES

DEFINITION OF LEVELS OF MINERAL RESOURCE POTENTIAL AND CERTAINTY OF ASSESSMENT

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 few or no indications of having been mineralized.

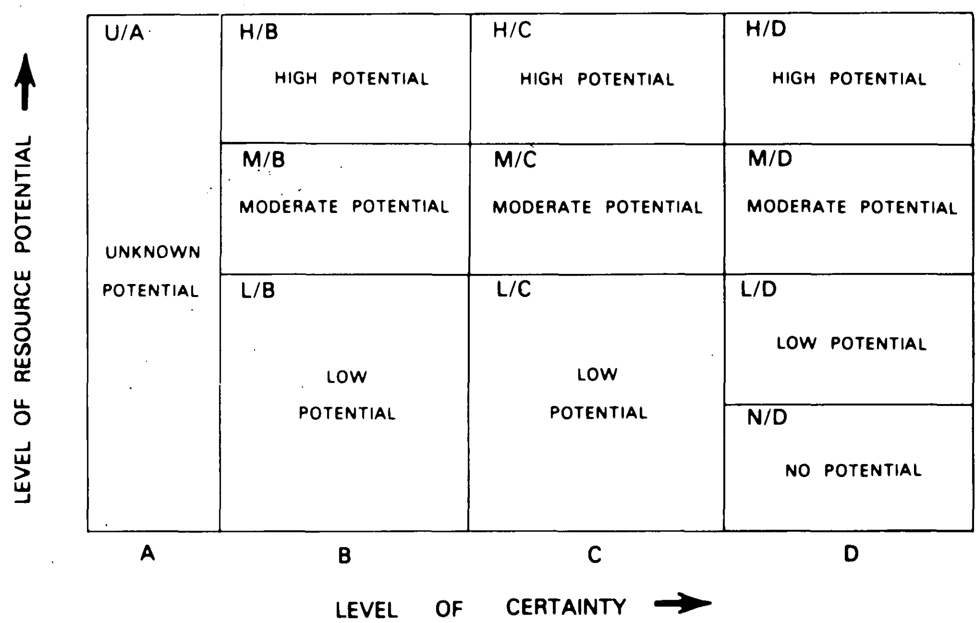
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate reasonable likelihood of resource accumulation, and (or) where an application 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 occurence, where interpretations of data indicate a high degree of likelihood for resource accumulation, where data supports 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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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 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 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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U.S. DEPARTMENT OF THE INTERIOR

March 3, 1849

Minor and others—MINERAL RESOURCES, UPPER DEEP CREEK WILDERNESS STUDY AREA, OWYHEE COUNTY, IDAHO—U.S. Geological Survey Bulletin 1719-G