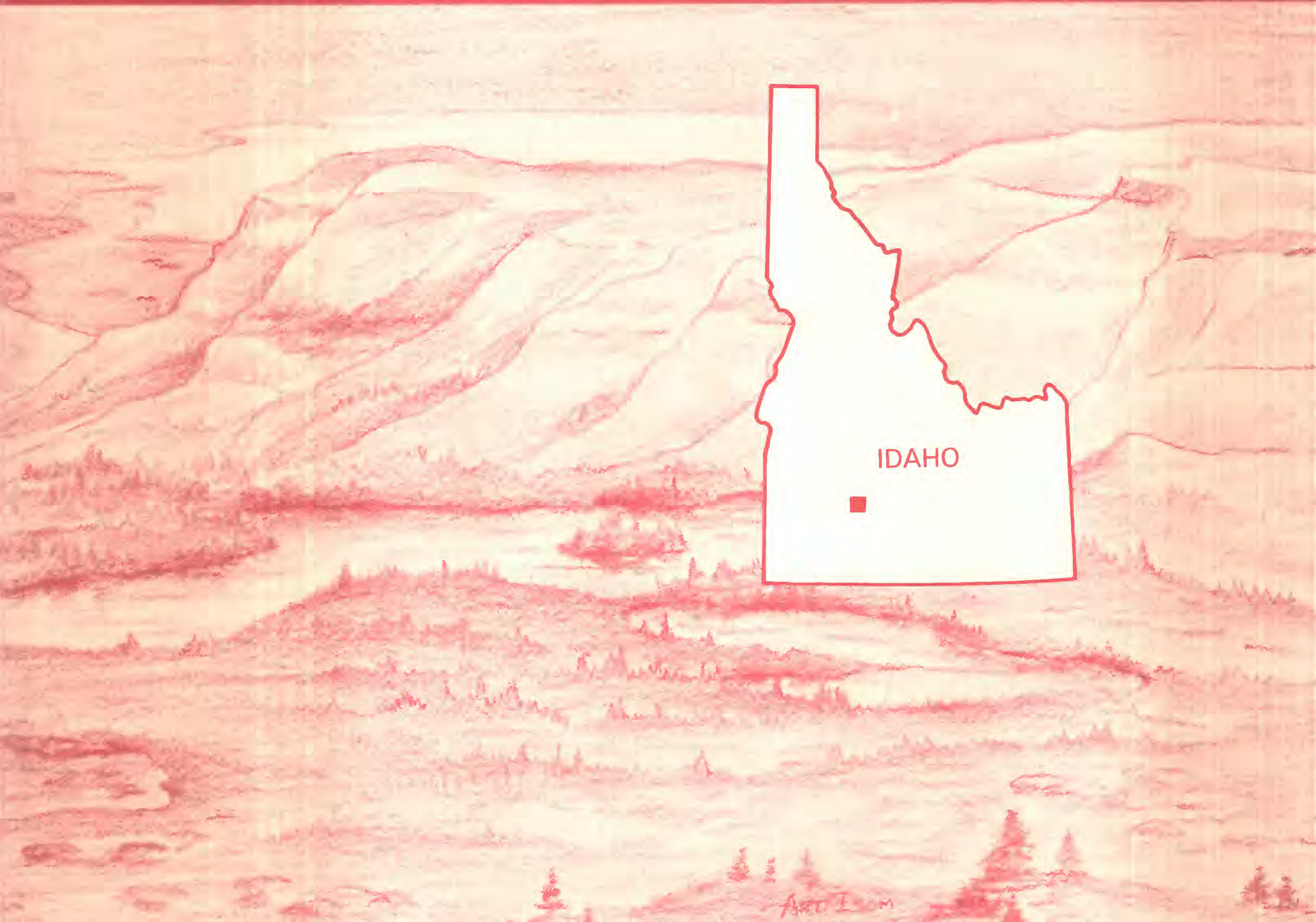
Mineral Resources of the King Hill Creek Wilderness Study Area, Elmore County, Idaho

U.S. GEOLOGICAL SURVEY BULLETIN 1721–B



Chapter B

Mineral Resources of the King Hill Creek Wilderness Study Area, Elmore County, Idaho

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U.S. GEOLOGICAL SURVEY BULLETIN 1721

MINERAL RESOURCES OF WILDERNESS STUDY AREAS—
SOUTH-CENTRAL IDAHO

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Areas

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 Congress. This report presents the results of a mineral survey of a part of the King Hill Creek Wilderness Study Area (ID-019–002), Elmore County, Idaho.

CONTENTS

PLATE

[Plate is in pocket]

FIGURES

Mineral Resources of the King Hill Creek Wilderness Study Area, Elmore County, Idaho

By Margo I. Toth, Harley D. King, *and* Dolores M. Kulik
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SUMMARY

In 1985 the U.S. Bureau of Mines and the U.S. Geological Survey conducted investigations to appraise the identified mineral resources and assess the mineral resource potential of the King Hill Creek (ID–019–002) Wilderness Study Area. These investigations revealed no identified mineral resources. A small area in the northwestern part of the study area has moderate potential for undiscovered antimony, arsenic, and gold resources in the Idavada Volcanics (fig. 1). The remaining part of the study area has low mineral resource potential for all undiscovered metals, and the entire study area has low mineral resource potential for undiscovered oil, gas, and coal and moderate potential for undiscovered resources of geothermal energy.

The King Hill Creek Wilderness Study Area is 5 mi (miles) north of the small town of King Hill, Elmore County, Idaho, and is south of the Mount Bennett Hills (fig. 1). Rugged, brushy hills characterize the northern part of the area and change to grassy, gently sloping basalt-covered plateaus in the southern part of the study area. Access is by a well-maintained gravel road along the western side of the area and by four-wheel-drive roads which approach the study area from the north and south; there is no road access to the eastern side of the area.

No mines, claims, mineral leases, or identified resources are in the study area. The Volcano mining district is just north of the study area, and two mines in the district have records of past production of gold, silver, copper, and lead. Development work is currently (1987) in progress on the Old Glory mine 5 mi north of the study area.

The King Hill Creek Wilderness Study Area is on the northern edge of the Snake River Plain. Rocks of the Miocene (see geologic time chart in Appendix) Idavada Volcanics crop out in the northern part of the study area and are overlain in the southern part by basalt flows of the Miocene Banbury Basalt, of the Pliocene Glenns Ferry Formation, and of the Pliocene and Pleistocene Bruneau Formation. Outcrops of granite of the Idaho batholith are northeast of the area.

As a part of this study, rock and stream-sediment samples and a water sample were collected for geochemical analysis. One rock sample from the northwestern part of the study area had anomalous concentrations of arsenic and antimony. None of the other samples showed anomalous concentrations of any elements typical of mineral deposits.

The study area lies along a steep gravity gradient, between low-density granitic rocks to the north and higher density basalts of the Snake River Plain to the south. Granitic rocks may underlie the northern part of the study area. Aeromagnetic data are typical of Tertiary volcanic rocks of the southern part of Idaho.

A small area of the Idavada Volcanics in the northwestern part of the study area has many of the characteristics of volcanic-hosted disseminated gold deposits, and a rock sample from the area yielded anomalous concentrations of arsenic and antimony. The mineral resource potential for undiscovered arsenic, antimony, and gold resources in these rocks is therefore moderate.

The geologic environment, the lack of other geochemical anomalies in the rock, stream sediment, and water samples, and the lack of any mines or pros-

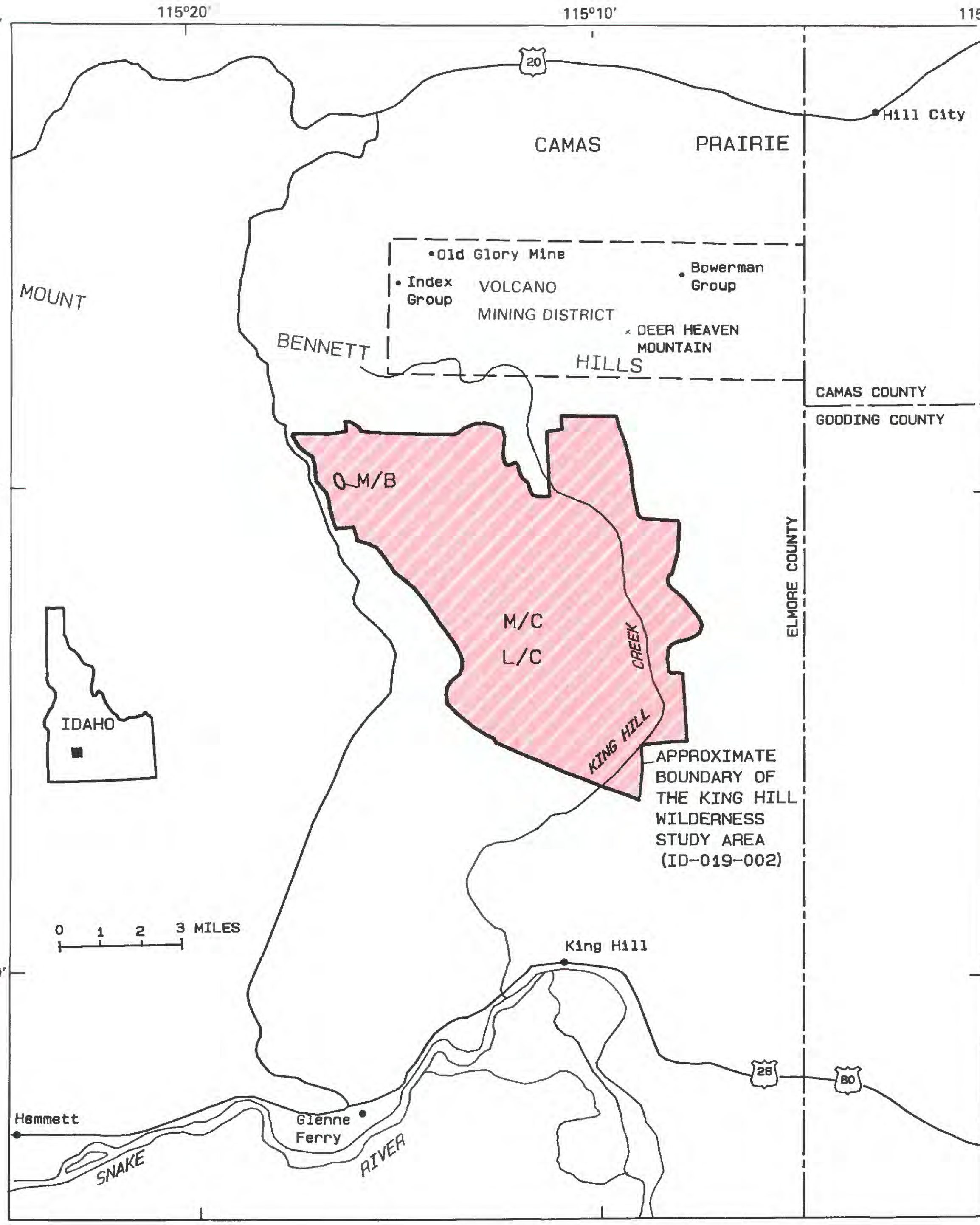

Figure 1 (above and facing page). Map showing mineral resource potential and location of the King Hill Creek Wilderness Study Area, Elmore County, Idaho.

pects indicate that the resource potential for all metals in the rest of the wilderness study area is low. The area also lacks host rocks and structures favorable for the occurrence of oil, gas, and coal. The resource potential for these commodities is therefore also low.

Although the study area is located between two geothermal resource areas, no surface manifestations of geothermal resources are presently known in the study area. The potential for undiscovered geothermal resources is therefore moderate.

EXPLANATION

M/B	Geologic terrane having moderate mineral resource potential for antimony, arsenic, and gold, with certainty level B
M/C	Geologic terrane having moderate mineral resource potential for geothermal energy, with certainty level C—Applies to entire study area
L/C	Geologic terrane having low mineral resource potential for all metals (except as noted above), and nonmetals, oil, gas, and coal, with certainty level C—Applies to entire study area
———	Road

LEVELS OF CERTAINTY

B	Data indicate geologic environment, and suggest level of resource potential
C	Data indicate geologic environment, indicate resource potential, but do not establish activity of resource-forming processes

INTRODUCTION

At the request of the U.S. Bureau of Land Management (BLM), 27,680 acres of the King Hill Creek Wilderness Study Area were studied by the U.S. Bureau of Mines and the U.S. Geological Survey. In this report the studied area is called the "wilderness study area" or simply "study area."

The King Hill Creek Wilderness Study Area in southeastern Elmore County is about 5 mi north of the small town of King Hill, and is just to the south of the Mount Bennett Hills (fig. 1). Elevations range from a high of 6,140 ft (feet) in the northwestern part of the area to a low of about 3,400 ft in the southeastern part of the area. Streams in the study area flow southeastward through steep, heavily vegetated canyons into King Hill Creek. Rugged, somewhat brushy hills characterize the northern part of the area and give way to grassy, gently sloping basalt-covered plateaus in the southern part of the study area.

Access to the study area is by a well-maintained gravel road along the western side of the study area which connects Glenns Ferry to U.S. Highway 20. Four-wheel-drive roads approach the study area from the north and south, but there is no access along the eastern side of the area.

This report presents an evaluation of the mineral endowment (identified resources and mineral resource potential) of the study area and is the product of several separate studies by the U.S. Bureau of Mines (USBM) and the U.S. Geological Survey (USGS). Identified resources are classified according to the system of the U.S. Bureau of Mines and U.S. Geological Survey (1980), which is shown in the Appendix of this report. Identified resources are studied by the USBM. Mineral resource potential is the likelihood of occurrence of undiscovered metals and nonmetals, industrial rocks and minerals, and of undiscovered energy sources (coal, oil, gas, oil shale, and geothermal sources). It is classified according to the system of Goudarzi (1984) and is shown in the Appendix of this report. Undiscovered resources are studied by the USGS.

Investigations by the U.S. Bureau of Mines

Work by the USBM entailed prefield, field, and report-preparation phases that spanned the years 1985–86. Prefield studies included library research and examination of Elmore County and BLM mining and mineral-lease records. Reconnaissance study by foot and four-wheel-drive vehicle of the area in 1985 was undertaken to search for evidence of mining activity and mineralized zones that may not have been recorded.

Three grab samples of alluvium consisting of three 14-in. (inch) pans each were taken from the major drainages during this study. The samples were concentrated by hand panning in the field and further concentrated in the laboratory on a Wilfley table. The concentrates were examined microscopically for gold, other heavy metals, and mineral indicators of metal concentrations in the stream drainages.

Investigations by the U.S. Geological Survey

A mineral resource assessment of the study area by the USGS in the summer of 1985 consisted of geologic mapping, combined with stream-sediment and rock sampling and subsequent analyses of the samples. Aerial photographs were used extensively to supplement geologic mapping and to determine regional structures. Thin sections of representative rock samples were obtained for detailed petrographic studies.

Acknowledgments.—D. S. Hovorka, A. R. Wallace, B. B. Nevins, and D. J. Maloney assisted in geologic mapping. The geologic map of Malde and Powers (1972) provided information about the geology of the southern part of the study area.

APPRAISAL OF IDENTIFIED RESOURCES

By Andrew M. Leszcykowski
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There has been no mineral production from the study area. The Volcano mining district is just north of the study area, and USBM records indicate that two mines in the district have records of past production. The Index group (W½ sec. 22, T. 2 S., R. 10 E.) produced 60 tons of ore in 1943 containing 1 oz (ounce) of gold, 24 oz of silver, 175 lb (pounds) of copper, and 3,850 lb of lead. The Bowerman group (SE¼ sec. 15, T. 2 S., R. 11 E.) produced 41 tons of ore containing 10 oz of gold and 1,416 oz of silver in 1914–15 and 1940. Currently, some development work is in progress on the Old Glory (Jacobs) mine about 5 mi north of the study area. Rock types found in the Volcano mining district do not crop out in the study area.

Three samples of alluvium from the study area contained no gold or economically significant heavy minerals, nor did they contain any indicators of metal concentrations in the stream drainages. During traverses of the area, no mineralized zones were noted.

There are no identified mineral resources in the study area. County, state, and federal records indicate that no mines, claims, or mineral leases exist in the study area, and traverses through the area failed to reveal any mining-related activity. Oil and gas leases were offered for land within the study area, but no lease applications were filed.

Sand and gravel deposits in the study area are of negligible volume. Road metal and gravel for road bases are available from the King Hill and Glenns Ferry area.

ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES

By Margo I. Toth, Harley D. King, and Dolores M. Kulik
U.S. Geological Survey

Geology

The King Hill Creek Wilderness Study Area is on the northern edge of the Snake River Plain. The study area is in a southeast-dipping fault block bounded by the Camas Prairie graben (down-dropped fault block) on the north (Walton, 1962) and the Snake River Plain downwarp on the south (Smith, 1966). Rocks of the Idavada Volcanics are overlain in the southern part of the area by basalt flows of the Bruneau Formation and Banbury Basalt. Minor amounts of basalt of the Glenns Ferry Formation overlie the Banbury Basalt in the southern part of the study area. Granitic outcrops of the Idaho batholith occur to the northeast of the area and also several miles to the north.

The Idavada Volcanics (unit Tiv, pl. 1) are exposed in the northern part of the study area and in the lower parts of the stream canyons in the southern part of the study area. The Idavada Volcanics consist of several hundred feet of welded dacitic to rhyolitic tuff. Part of this tuff probably belongs to the City of Rocks Tuff of the Idavada Group of Savage (1968). The tuff is lithologically homogeneous and is characterized by plagioclase and orthopyroxene phenocrysts 0.25 to 0.5 in. (inch) long (10–15 percent of the rock), and the absence of quartz, biotite, and hornblende phenocrysts. The tuff is medium purple or gray, moderately to strongly welded, and commonly devitrified. A 5- to 10-ft-thick black vitrophyre (glassy rock) is commonly present at the bottom and top of the flow units.

Rocks of the Idavada Volcanics from the Mount Bennett Hills have not been dated, but samples from this unit collected east of the Mount Bennett Hills were dated at 9.7 m.y. (million years) and 8.4 to 8.5 m.y. (Armstrong and others, 1975).

Basalt flows of the Banbury Basalt (unit Tb, pl. 1) overlie the Idavada Volcanics and are as much as a few hundred feet thick. The basalt flows form flat-lying plateaus, and most of the rocks occur as rubble. The basalt is medium to dark gray and contains 8–15 percent phenocrysts of well-formed plagioclase 0.1 to 0.2 in. long and poorly formed olivine less than 0.1 in. across. Vesicles are common and are commonly filled with clays. The flows have variable phenocryst size and abundance.

The age of the Banbury Basalt in the study area is unknown, but Armstrong and others (1975) obtained ages ranging from 10 m.y. to 3 m.y. in other localities. They dated at 7.3 m.y. fresh samples of basalt from 20 mi south of the town of King Hill. The basalt in the study area therefore probably is of Miocene age.

In the southern part of the study area, the Banbury Basalt is overlain by basalt of the Pliocene Glenns Ferry Formation (unit Tg, pl. 1). Ash samples from the formation have been dated at 3.3 m.y. and 3.2 m.y. (Evernden and others, 1964). The Glenns Ferry basalts are medium gray and contain phenocrysts of olivine.

Pleistocene basalt of the Bruneau Formation (unit Qb, pl. 1) overlies the Idavada Volcanics just outside the western edge of the study area and overlies Banbury Basalt in the southeastern corner of the study area. The Bruneau basalt is dark gray, is extremely fresh, and contains 8–10 percent phenocrysts of olivine and well-formed plagioclase. In the southeastern part of the area, this basalt was dated at 1.36 m.y. (Evernden and others, 1964).

Geochemistry

Methods

The reconnaissance geochemical study of the King Hill Creek Wilderness Study Area included the collection, analysis, and evaluation of the analytical data of 43 minus-80-mesh (0.007 in.) stream-sediment samples, 28 nonmagnetic heavy-mineral-concentrate samples, 70 rock samples, and 1 water sample.

Both stream-sediment and heavy-mineral-concentrate samples were collected from the same stream alluvium at 43 sites; however, only 28 of the heavy-mineral concentrates contained sufficient amounts of the nonmagnetic fraction for analysis.

Analyses of the stream-sediment samples show the chemical composition of the rock eroded from the drainage basin upstream from each sample site. Such information is useful in identifying those basins which contain concentrations of elements that may be related to mineral deposits. Nonmagnetic heavy-mineral-concentrate samples provide information about the chemical composition of a limited number of minerals in rock eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which are ore related, permits detection of some elements that are not easily detected in stream-sediment samples. Analytical data are available from H. D. King, M.S. 973, Denver Federal Center, Denver, CO 80225.

Rock and stream-sediment samples were analyzed using semiquantitative direct-current arc emission spectrographic methods for 31 elements. Methods of analysis are described in Myers and others (1961) and Grimes and Marranzino (1968). Certain elements of special interest or which have high lower limits of determination by emission spectrography were also analyzed in rock and stream-sediment samples as follows: antimony, arsenic, bismuth, cadmium, and zinc were analyzed by an inductively coupled argon plasma-atomic emission spectroscopy (ICP-AES) method (from Crock and others, 1983) using a modification of the O'Leary and Viets (1986) digestion method. Rock and stream-sediment samples were also analyzed for gold by atomic absorption, using a modification of the method of Thompson and others (1968), and for mercury by a modified Koirtyohann and Khalil (1976) cold-vapor atomic-absorption method.

Hot springs indicated on the USGS King Hill and Mt. Bennett topographic quadrangle maps were investigated, but the only spring that contained hot water was at a ranch about 0.5 mi southwest of Latty Hot Spring (sample KMT026, pl. 1) about 3 mi west of the study area. The water sample was collected and analyzed by the method described by McHugh and others (1981).

Semiquantitative spectrographic and ICP-AES analyses were performed by M. J. Malcolm, D. L. Fey, and L. A. Bradley for stream-sediment and rock samples. Nonmagnetic heavy-mineral-concentrate samples were analyzed by M. S. Erickson using semiquantitative spectrography. C. A. Gent, J. G. Crock, and T. M. McCollom performed the atomic-absorption analyses on rocks and sediments. R. W. Baker, D. W. Erskine, and K. R. Greene assisted in geochemical sampling. Analytical data were reported in Erickson and others (1987).

Results

A highly anomalous lead value, 3,000 ppm (parts per million), was detected in a nonmagnetic heavy-mineral concentrate sample from a site at the southern end of the study area. No other element was anomalous in this sample. This part of the study area is readily accessible, and a dirt road passes through the drainage area upstream from the sample site. The lead value probably resulted from contamination of the sample by an artifact such as a bullet fragment. No other concentrate or stream-sediment sample contained anomalous values for any element. Ore minerals were not found in any of the nonmagnetic heavy-mineral concentrates by visual examination using a binocular microscope.

The geochemical data from the rock samples show very little variation within each rock type; however, the basalts can be easily distinguished from the Idavada Volcanics using the data for several elements. Of the 70 samples collected, only one sample (described below) contained anomalous concentrations of any of the detected elements. Gold was not detected in any of the samples (detection limit 0.1 ppm), and mercury varied from less than 0.02 ppm to 0.06 ppm.

Sample KDH006, a sample from the Idavada Volcanics from the northwestern part of the study area (pl. 1), contained anomalous concentrations of arsenic (96 ppm) and antimony (3 ppm). The sample also contained slightly higher amounts of cobalt, chromium, nickel, lead, scandium, and vanadium, and lower amounts of yttrium, zirconium, and barium than other samples of Idavada Volcanics. The sample was taken from an outcrop of altered volcanic rock which covered an area of about 50 by 50 yards. Various forms of silica (chalcedony, jasper, and opal) filled fractures crosscutting the volcanic rock and occurred as float. A sample of the siliceous rock was analyzed and did not show anomalous concentrations of any elements. Two additional samples from this locality were analyzed for gold and mercury. Gold was not detected (detection limit 0.1 ppm), and mercury was present in one sample (0.03 ppm, detection limit 0.02 ppm).

The water sample (from southwest of Latty Hot Spring) showed no anomalous concentrations of any elements. The water temperature was 140 °F. Mabey (1983) reported temperatures of 100 °F at the nearby Latty Hot Spring. Latty Hot Spring was overgrown with vegetation, and no water was discharging from the spring at the time of our investigation.

Geophysics

Geophysical data provide information about the subsurface distribution of rock masses and the structural framework of the rocks. Existing aeromagnetic data (fig. 2; U.S. Geological Survey, 1978; Zietz and others, 1978)

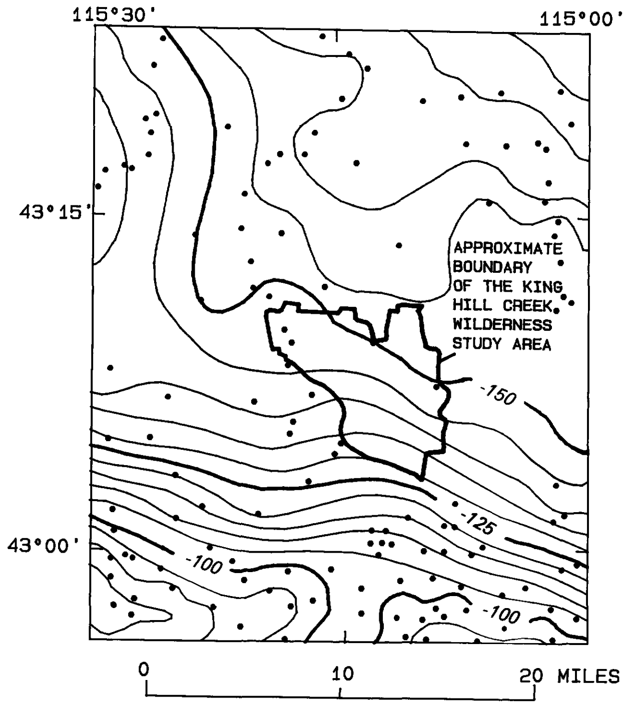

Figure 2. Complete Bouguer gravity anomaly map of the King Hill Creek Wilderness Study Area, Idaho. Dots indicate locations of gravity measurements. Contour interval 5 milligals.

are of a regional nature. Gravity data were obtained from files maintained by the Defense Mapping Agency of the U.S. Department of Defense; no additional stations were established. A complete Bouguer anomaly map of the study area and vicinity is shown on figure 3. Bouguer gravity-anomaly values were computed using the 1967 gravity formula (International Association of Geodesy, 1967) and a reduction density of 2.67 grams per cubic centimeter. Terrain corrections were made by computer for a distance of 100 mi from the station using the method of Plouff (1977).

The study area lies within an aeromagnetic low (fig. 2) whose wavelength and amplitude are characteristic of anomalies associated with Tertiary volcanic rocks of southern Idaho.

Volcanics of intermediate composition are present throughout most of the study area beneath the basalt units (pl. 1). For this reason, the different units in the study area cannot be differentiated at the contour interval and station spacing of the gravity data shown on figure 3. The study area lies along a steep gravity gradient. Lower gravity values to the north are associated with granitic rocks of the Idaho batholith which may underlie the study area, particularly in the northern part. Higher gravity values to the south are associated with the basalt terrane of the Snake River Plain. Faults mapped in the area are not expressed in the gravity data and probably do not have major offsets.

Mineral and Energy Resources

Volcanic-Hosted Disseminated Gold Deposits

Volcanic-hosted disseminated gold deposits are related to surficial and near-surface processes that result in extensive silicification, hydrothermal brecciation, and veining of the host rock (Berger, 1985). Tooker (1985) summarized the characteristics of volcanic-hosted disseminated gold deposits in Nevada. These characteristics include the following: volcanogenic-sediment, ash-flow-tuff, or lava host rock; a heat source of intrusive plugs, hot-spring activity, or a caldera center; silicification and argillization of rock; persistent association of gold, silver, mercury, arsenic, antimony, and thallium; and a deposit size of less than 1 square mile to tens of square miles.

A small area of the Idavada Volcanics in the study area has many of the characteristics of volcanic-hosted disseminated gold deposits: the host rock is ash-flow tuff; a heat source could be (1) the eruption of younger basalts, (2) hot-spring activity, some of which occurs in the vicinity today, or (3) the caldera source for the ash-flow tuffs; the source rock has been altered, including extensive silicification; and a rock sample from the area contained

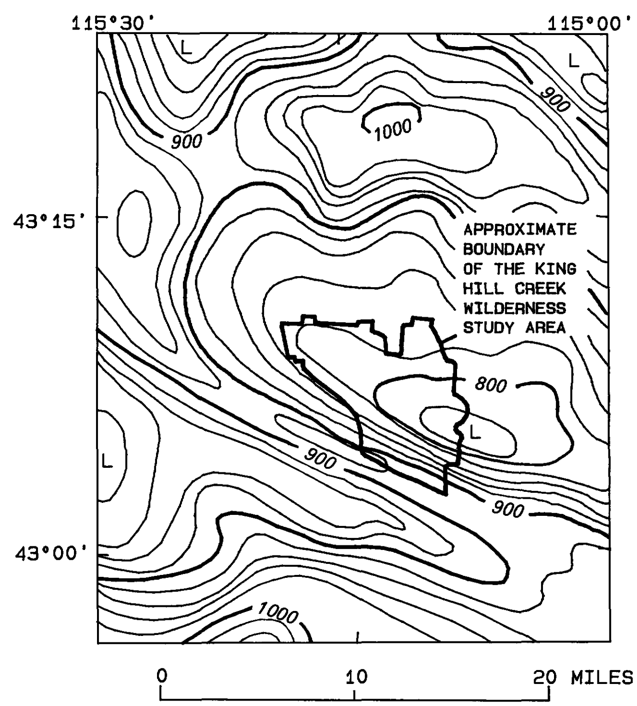

Figure 3. Aeromagnetic map of the King Hill Creek Wilderness Study Area, Idaho. Contour interval 20 gammas.

anomalous concentrations of arsenic and antimony. The mineral resource potential for antimony, arsenic, and gold in this small area is therefore rated moderate. A certainty level of B is assigned to the rating because the extent of the mineralization is not very well known.

Base-Metal Resources

The rest of the King Hill Creek Wilderness Study Area has low mineral resource potential for all metals, with certainty level C. This certainty level is supported by the geologic environment in which the study area is located, the lack of mines or prospects, the lack of any mineralized rock, and the lack of any geochemical anomalies in the stream-sediment samples and all but one of the rock samples.

Energy Resources

The study area lacks host rocks and structures favorable for the occurrence of oil, gas, and coal. The resource potential for these commodities is therefore low, with certainty level C. The study area is on the northern edge of the Snake River Plain physiographic province, south of the Idaho batholith. Few test holes have been drilled in this region, but those that have been drilled did not penetrate Cenozoic rocks at 11,125 ft depth (Breckenridge, 1982). Rocks of the Idaho batholith may be present beneath the volcanic rocks of the study area (Taubeneck, 1971), but their presence is not indicated in the geophysical data. The potential for oil, gas, and coal is also rated low in the underlying rocks, with certainty level C.

The King Hill Creek Wilderness Study Area adjoins two geothermal resource areas: Camas Prairie on the north and Mount Bennett Hills on the west (Mitchell, 1976; Mitchell and others, 1980). These two geothermal areas may be related to faulting along the northern edge of the Snake River Plain (Mabey, 1983). Sammel (1979) indicated large areas favorable for the discovery and development of low-temperature geothermal resources northwest and directly south of the study area.

Numerous springs are in the study area, and one hot spring is 3 mi west of the study area, indicating an environment favorable for geothermal resources. However, no surface manifestations of hot springs are known at present in the study area. For these reasons, the potential for geothermal resources in the King Hill Creek Wilderness Study Area is rated moderate, with certainty level C.

Recommendations for Future Work

Detailed mapping of the Idavada Volcanics is required to determine the extent of the mineralized rock. Because silica occurs in veins with the mineralized rock, all areas with silica veins or float should be sampled in detail for analysis.

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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.

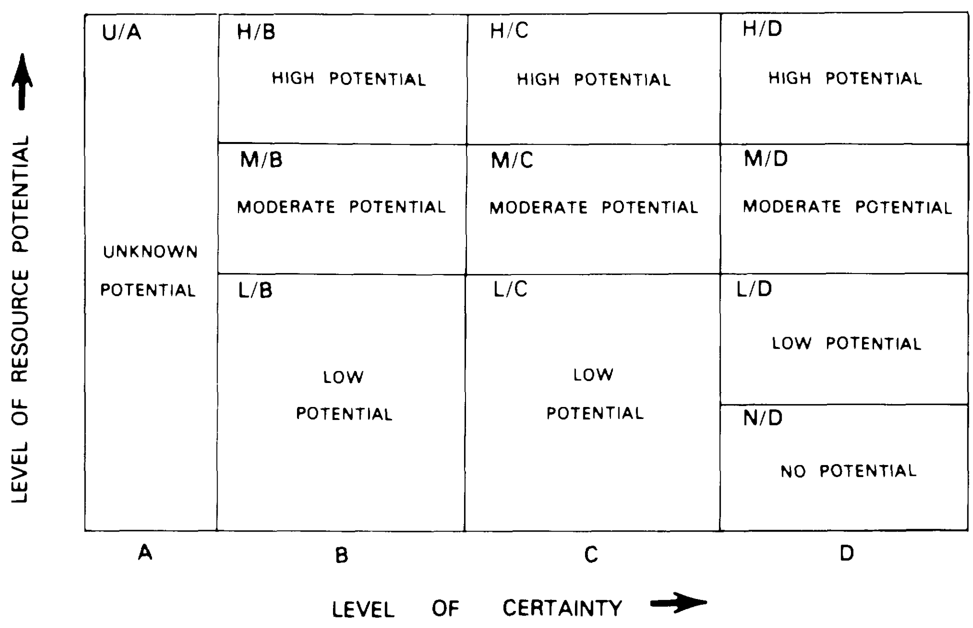
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application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

Abstracted with minor modifications from:

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RESOURCE / RESERVE CLASSIFICATION

	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	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 in this report

EON	ERA	PERIOD		EPOCH	BOUNDARY AGE IN MILLION YEARS
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 m.y. also called Precambrian, a time term without specific rank.

[2] Informal time term without specific rank.

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