UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of stream-sediment and heavy-mineral-concentrate samples from the Borah Peak Wilderness Study Area (ID-047-004), Custer County, Idaho

By

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CONTENTS

ILLUSTRATIONS

TABLES

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 their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Borah Peak Wilderness Study Area (WSA), Custer County, Idaho.

INTRODUCTION

In July 1988, the U.S. Geological Survey conducted a reconnaissance geochemical survey of Borah Peak Wilderness Study Area (ID-047-004) in Custer County, Idaho (fig 1). The entire area studied, hereby termed the "study area", includes the 3100 acres (4.8 square miles) WSA and the 780 acres (1.2 square miles) adjoining the WSA on the north, which were recommended as suitable for additional wilderness. The study area is on the west flank of the Lost River Range, east of US Highway 93 near its intersection with Trail Creek Road (Idaho Highway 75). The area is approximately 38 miles south of Challis and 16 miles north of Mackay. Borah Peak, the highest mountain in Idaho at 12,662 feet, is less than 2.5 miles east of the northeast corner of the WSA. Elevations within the WSA range from 6,360 feet near Elkhorn Creek to 9,360 feet east of Whiskey Springs. The WSA is accessible by gravel roads and jeep trails east from Highway 93.

Topography is characterized by well developed alluvial fans issuing from gullies deeply incised into the steep western slopes of the Lost River Range. At the lower elevations, vegetation is sparse, mostly grasses and sagebrush, but the incised valleys commonly host juniper thickets. At the higher elevations, the steep slopes support conifers.

The 1983 Borah Peak earthquake produced surface ground ruptures along the west side of the range front. These extend along more than two-thirds of the WSA and are highly visible. Current topography is primarily due to uplifting along the still-active, northwest-trending Lost River Fault. Rocks of the Lost River Range are sedimentary, predominantly quartzite and carbonate, deposited during Paleozoic time (Wilson and others, 1990).

METHODS OF STUDY

Sample Media

Analyses of the stream-sediment samples represent the chemistry of the rock material 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.

Heavy-mineral-concentrate samples provide information about the chemistry of a limited number of minerals in rock material eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which may be ore related, permits determination of some elements that are not easily detected in stream-sediment samples.

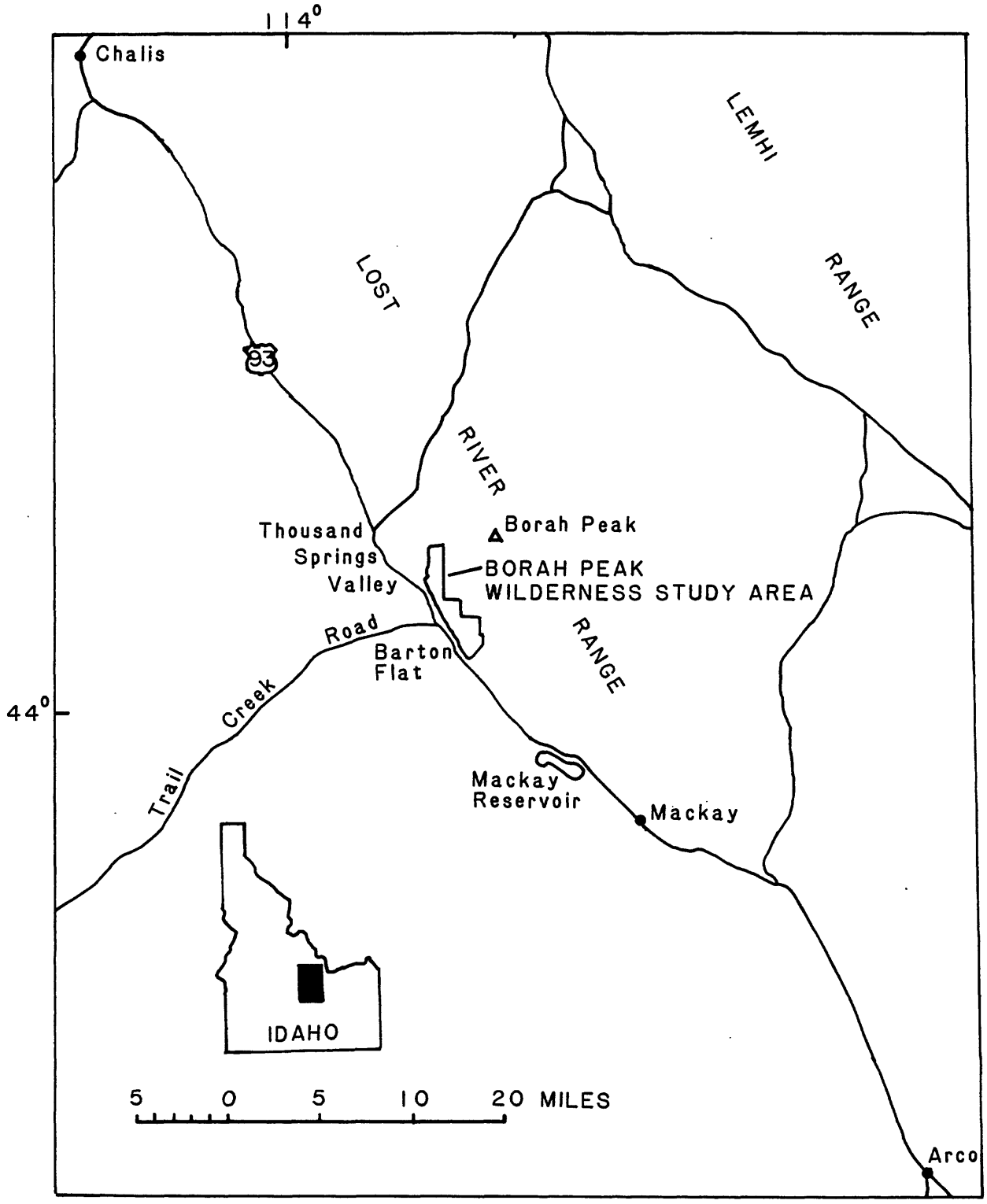

Figure 1. Location of the Borah Peak Wilderness Study area, Custer County, Idaho.

Sample Collection

Samples were collected at a total of 11 sites (plate 1). At all sites, both a stream-sediment sample and a heavy-mineral-concentrate sample were collected. Sampling density was about one sample site per 0.44 square miles. The area of the drainage basins sampled ranged from 0.1 to 2 square miles. Sufficient heavy-mineral-concentrate for spectrographic analysis (5 mg) was recovered from all sample sites.

Stream-sediment samples

The stream-sediment samples consisted of active alluvium collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) stream as shown on USGS topographic maps (scale = 1:24,000). Each sample was composited from several localities within an area that may extend as much as 50 feet from the site plotted on the map.

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples were collected from the same active alluvium as the stream-sediment samples. Each bulk sample was screened with a 2.0-mm (10-mesh) screen to remove the coarse material. The less than 2.0-mm fraction was panned until most of the quartz, feldspar, organic material, and clay-sized material were removed.

Sample Preparation

The stream-sediment samples were air dried, then sieved using 80-mesh (0.17-mm) stainless-steel sieves. The portion of the sediment passing through the sieve was pulverized to -100 mesh and saved for analysis.

Samples that had been panned in the field were air dried and sieved to -35 mesh (0.50 mm); bromoform (specific gravity 2.85) was used to remove the remaining quartz and feldspar. The resultant heavy-mineral sample was separated into three fractions using a large electromagnet by placing the sample in contact with the face of the magnet(in this case a modified Frantz Isodynamic Separator). The most magnetic material (removed at a setting of 0.25 ampere), primarily magnetite, was not analyzed. The second fraction (removed at a setting of 1.75 ampere), largely ferromagnesian silicates and iron oxides, was saved for archival storage. The third fraction (the nonmagnetic material which may include the nonmagnetic ore minerals, zircon, sphene, etc.) was split using a Jones splitter. One split was hand ground for spectrographic analysis; the other split was saved for mineralogical analysis. (These magnetic separates are the same separates that would be produced by using a Frantz Isodynamic Separator set at a slope of 15 degrees and a tilt of 10 degrees with a current of 0.2 ampere to remove the magnetite and ilmenite, and a current of 0.6 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.)

Sample Analysis

Spectrographic Method

Stream-sediment samples were analyzed for 35 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes

and Marranzino, 1968). Heavy-mineral-concentrate samples were analyzed for the same elements plus platinum and palladium by the same method. The elements analyzed and their lower limits of determination are listed in table 1. Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the analytical method is approximately plus or minus one reporting intervals at the 83 percent confidence level and plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, sodium, phosporus, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data are listed in tables 3 and 4 for stream-sediment and heavy-mineral-concentrate samples, respectively.

Other Methods

The stream-sediment samples from the WSA were also analyzed by inductively coupled plasma emission spectroscopy (ICP), flame atomic absorption spectroscopy (AA), and delayed neutron analysis (DNA). Arsenic (As), bismuth (Bi), cadmium (Cd), antimony (Sb), and zinc (Zn) were analyzed by ICP, gold (Au) was analyzed by AA, and uranium (U) and thorium (Th) by DNA. Limits of determination and references are listed in table 2.

Analytical results using these methods are listed in table 3.

ROCK ANALYSIS STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into a computer-based file called Rock Analysis Storage System (RASS). This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC) for computerized statistical analysis or publication (Van Trump and Miesch, 1977).

DESCRIPTION OF DATA TABLES

Tables 3 and 4 list the results of analyses for the stream-sediment and heavy-mineral-concentrate samples, respectively. For the two tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on plate 1. Columns in which the element headings show the letter "s" following the element symbol are emission spectrographic analyses, "icp" indicates inductively couple plasma analyses, "aa" indicates graphite furnace atomic absorption analyses, and "dna" indicates delayed neutron analyses. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination (LLD) shown for that element in table 1. For emission spectrographic analyses, a "less than" symbol (<) entered in the tables in front of the LLD indicates that an element was observed but was below the lowest reporting value. For ICP analyses, a "less than" symbol (<) entered in the tables in front of the LLD indicates that an element was below the lowest reporting value. If an element was observed but was above the highest

reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced the data tables, some of the elements listed in these tables (Fe, Ca, and Ti) may carry one or more nonsignificant digits to the right of the significant digits. The analysts did not determine these elements to the accuracy suggested by the extra zeros.

ACKNOWLEDGEMENTS

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TABLE 1.--Limits of determination for the spectrographic analysis of rocks, stream sediments, and moss-trap sediments, based on a 10-mg sample

[The spectrographic limits of determination for heavy-mineral-concentrate samples are based on a 5-mg sample, and are therefore two reporting intervals higher than the limits given below]

Elements	Lower determination limit	Upper determination limit
	Percent	
Calcium (Ca)	.05	20
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Sodium (Na)	0.2	5
Phosphorus (P)	0.2	10
Titanium (Ti)	.002	1
	Parts per million	
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	10	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Gallium (Ga)	5	500
Germanium (Ge)	10	100
Lanthanum (La)	50	1,000
Manganese (Mn)	10	5,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Thorium (Th)	100	2,000
Vanadium (V)	10	10,000
Tungsten (W)	20	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Palladium (Pd)*	5	1,000
Platinum (Pt)*	20	1,000

*Determined in heavy-mineral-concentrate samples only. Limits are for heavy-mineral-concentrate samples.

TABLE 2.--Other Methods Used

(AA, flame atomic absorption spectroscopy; ICP, inductively coupled plasma emission spectroscopy; DNA, delayed neutron analysis)

Element determined	Sample type	Method	LLD (PPM)	References
Arsenic (As)	Stream-sed	ICP	5	Crock and others, 1987.
Bismuth (Bi)	"	"	2	"
Cadmium (Cd)	"	"	0.1	"
Antimony (Sb)	"	"	2	"
Zinc (Zn)	"	"	2	"
Gold (Au)	"	AA	0.05	O'Leary and Meier, 1986.
Thorium (Th)	"	DNA	--[1]	McKown, 1987.
Uranium (U)	"	"	--[1]	"

[1]Variable

TABLE 3--ANALYTICAL RESULTS OF STREAM-SEDIMENT SAMPLES FROM THE BORAH PEAK WILDERNESS STUDY AREA, CUSTER COUNTY, IDAHO

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longtude	Ca-pct.	Fe-pct.	Mg-pct.	Na-pct.	P-pct.	Ti-pct.	Ag-ppm	As-ppm
			s	s	s	s	s	s	s	s
BP001 S	44 2 20	113 47 50	1.5	3.0	2	1.5	N	.20	N	N
BP002 S	44 2 24	113 47 56	.7	5.0	1	1.0	N	.30	N	N
BP003 S	44 3 2	113 48 49	.7	3.0	1	1.0	N	.30	N	N
BP004 S	44 3 46	113 49 26	.5	2.0	1	1.5	N	.20	N	N
BP005 S	44 3 54	113 49 12	5.0	2.0	3	.3	N	.20	N	N
BP006 S	44 5 46	113 50 49	10.0	1.0	7	.5	N	.10	N	N
BP007 S	44 6 2	113 51 21	3.0	2.0	2	1.0	N	.20	N	N
BP008 S	44 6 34	113 51 13	5.0	1.0	5	1.0	N	.10	N	N
BP009 S	44 7 8	113 50 40	5.0	2.0	5	1.5	N	.20	N	N
BP010 S	44 7 45	113 50 31	10.0	1.0	7	.2	N	.10	N	N
BP011 S	44 7 59	113 50 19	7.0	1.5	7	1.0	N	.15	N	N

Sample	Au-ppm	B-ppm	Ba-ppm	Be-ppm	Bi-ppm	Cd-ppm	Co-ppm	Cr-ppm	Cu-ppm	Ga-ppm	Ge-ppm	La-ppm
	s	s	s	s	s	s	s	s	s	s	s	s
BP001 S	N	30	700	1	N	N	15	70	30	30	N	50
BP002 S	N	70	1,000	<1	N	N	15	200	20	20	N	50
BP003 S	N	20	700	<1	N	N	10	70	30	20	N	<50
BP004 S	N	15	500	N	N	N	<10	50	20	30	N	N
BP005 S	N	20	300	N	N	N	<10	70	10	10	N	N
BP006 S	N	15	300	N	N	N	N	30	7	5	N	N
BP007 S	N	20	1,000	<1	N	N	<10	50	20	20	N	<50
BP008 S	N	15	200	N	N	N	N	30	5	10	N	N
BP009 S	N	20	700	<1	N	N	<10	30	15	20	N	<50
BP010 S	N	10	150	N	N	N	N	15	<5	<5	N	N
BP011 S	N	20	1,500	<1	N	N	<10	50	10	15	N	N

TABLE 3--ANALYTICAL RESULTS OF STREAM-SEDIMENT SAMPLES FROM THE BORAH PEAK WILDERNESS STUDY AREA, CUSTER COUNTY, IDAHO--Continued

Sample	Mn-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s	Th-ppm s	V-ppm s
BP001 S	700	N	<20	50	15	N	5	N	<100	N	100
BP002 S	300	N	<20	50	<10	N	5	N	<100	N	100
BP003 S	500	N	N	30	15	N	<5	N	<100	N	100
BP004 S	200	N	N	20	15	N	<5	N	N	N	70
BP005 S	150	N	N	30	20	N	<5	N	N	N	50
BP006 S	200	N	N	10	15	N	N	N	<100	N	20
BP007 S	500	N	<20	30	15	N	5	N	100	N	100
BP008 S	150	N	N	15	10	N	N	N	N	N	20
BP009 S	300	N	N	20	15	N	<5	N	<100	N	70
BP010 S	70	N	N	10	20	N	N	N	N	N	20
BP011 S	300	N	N	15	30	N	<5	N	<100	N	30

Sample	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp	Au-ppm aa	Th-ppm dna	U-ppm dna
BP001 S	N	10	N	150	<5	<2	.5	<2	58	N	16.0	4.28
BP002 S	N	10	N	500	<5	<2	.4	<2	61	N	17.7	4.10
BP003 S	N	<10	N	150	7	<2	.6	<2	95	N	13.0	4.02
BP004 S	N	N	N	70	<5	<2	.7	<2	89	N	9.8	3.51
BP005 S	N	<10	N	150	8	<2	.5	<2	37	N	11.5	3.05
BP006 S	N	N	N	50	5	<2	.4	<2	28	N	3.4	1.72
BP007 S	N	10	N	200	5	<2	.7	<2	82	N	6.7	2.80
BP008 S	N	N	N	30	<5	<2	.5	<2	44	N	6.1	1.91
BP009 S	N	<10	N	70	<5	<2	.6	<2	60	N	8.7	2.23
BP010 S	N	N	N	20	6	<2	.3	<2	47	N	<2.2	1.51
BP011 S	N	<10	N	50	<5	<2	.5	<2	54	N	6.7	1.98