UNITED STATES DEPARTMENT OF THE INTERIOR

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Analytical results and sample locality map of stream-sediment, heavy-mineral-concentrate, and rock samples from the Burnt Creek Wilderness Study Area, Custer County, Idaho

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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 their mineral values, if any. 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 Burnt Creek Wilderness Study Area (ID-045-012), Custer County, Idaho.

INTRODUCTION

In July and August, 1986, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Burnt Creek Wilderness Study Area, Custer County, Idaho.

The Burnt Creek Wilderness Study Area comprises about 13 mi^2 (34 km^2) in the eastern part of Custer County, Idaho, and lies about 14 mi (22 km) north of Mackey, Idaho (see fig. 1). Access to the study area is provided on the west side by an unimproved dirt road along Burnt Creek and on the east side by the dirt road leading to Dry Creek Reservoir (washed out). These roads originate in Pahsimeroi Valley where they connect to Pahsimeroi Road, the main highway through the valley. They also connect to gravel roads which traverse the Lost River Range via Pass Creek or Doublespring Pass and join U.S. Highway 93.

The study area is in the Mesozoic Cordilleran thrust belt and the Neogene basin-and-range extensional province. Rocks underlying the study area are chiefly Tertiary Challis volcanics with the most extensive units consisting of andesite flow breccias, interbedded air-fall tuffs, and unbrecciated flows and plugs and sills. Upper Paleozoic limestones crop out in the eastern and southwestern parts of the study area. Rocks present in the study area have been described in nearby areas in Mapel and Shropshire (1973) and in Ross (1947).

The topographic relief of the study area is about 2,358 ft (719 m) with a maximum elevation of 9,808 ft (2,989 m). The study area is cut by several generally northward flowing streams with moderately rugged valley sides. Annual precipitation averages between 16 and 20 in. per year.

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 certain 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.

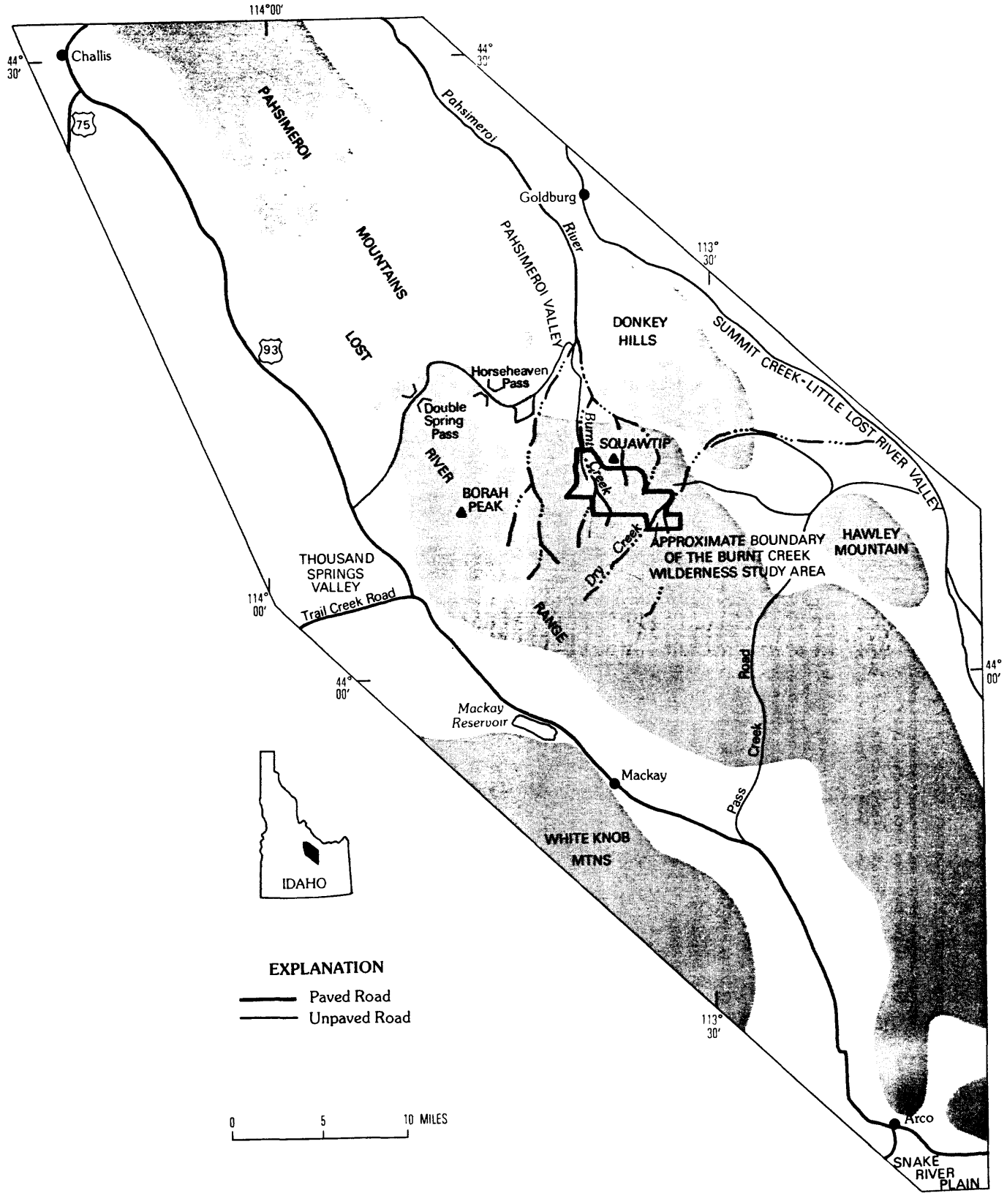

Figure 1. Location of the Burnt Creek Wilderness Study Area, Custer County, Idaho.

Analyses of unaltered or unmineralized rock samples provide background geochemical data for individual rock units. On the other hand, analyses of altered or mineralized rocks, where present, may provide useful geochemical information about the major- and trace-element assemblages associated with a mineralizing system.

Sample Collection

Stream-sediment sample were collected at 15 sites and heavy-mineral-concentrate samples were collected at 12 of those same sites. Rock samples were collected at two sites where stream sediments and heavy-mineral concentrates were collected and 27 rock samples were collected from 22 additional sites. Sampling density was about one sample site per 0.87 mi^2 for the stream sediments, one sample site per 1.1 mi^2 for the heavy-mineral concentrates, and about one sample site per 0.54 mi^2 for the rocks. The area of the drainage basins sampled ranged from 0.25 mi^2 to 2 mi^2.

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) streams as shown on USGS topographic maps (scale = 1:24,000) (plate 1). Each sample was composited from several localities within an area that may extend as much as 20 ft from the center of the site symbol 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.

Rock samples

Rock samples were collected from various types of occurrences in the vicinity of the plotted site location. Descriptions of rock samples are in table 9.

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 saved for analysis.

Samples that had been panned in the field were air dried and sieved to -35 mesh; 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 (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° and a tilt of 10° 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.)

Rock samples were crushed and then pulverized to minus 0.15 mm with ceramic plates. Four of the rock samples were split prior to crushing.

Sample Analysis

Spectrographic method

The stream-sediment, heavy-mineral-concentrate, and rock samples were analyzed for 31 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968). 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 interval 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, and titanium, are given in weight percent; all others are given in parts per million (micrograms/gram). Data from six-step emission spectrographic analysis for samples from the Burnt Creek Wilderness Study Area are listed in tables 3, 4, and 5.

Chemical methods

Samples from this study area were also analyzed by other analytical methods. Rocks and stream sediments were analyzed for arsenic, bismuth, cadmium, antimony, and zinc using inductively coupled plasma-atomic emission spectroscopy (ICP) and for gold and mercury using atomic absorption spectroscopy. Six selected rocks were analyzed for major and minor constituents by methods described in Taggart and others (1987) and in Jackson and others (1987). See table 2 for a more detailed summary of these other chemical methods used.

Analytical results for stream-sediment and rock samples are listed in tables 3 and 5, respectively. Tables 6 and 7 list the results for the six selected rock samples analyzed for major and minor constituents.

DATA STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into the Branch of Geochemistry's computer data base. 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 (VanTrump and Miesch, 1977).

DESCRIPTION OF DATA TABLES

Tables 3-5 list the results of analyses for the samples of stream sediment, heavy-mineral concentrate, and rock, respectively. Tables 6 and 7 list the results for the six selected rock samples analyzed for major and minor elements. For the four tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on the site location map (plate 1). Columns in which the element headings show the letter "s" below the element symbol are six-step emission spectrographic analyses; "aa" indicates atomic absorption analyses; and "icp" indicates inductively coupled plasma-atomic emission spectroscopy. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in table 1. For emission spectrographic analyses, a "less than" symbol (<) entered in the tables in front of the lower limit of determination indicates that an element was observed but was below the lowest reporting value. For AA and ICP analyses, a "less than" symbol (<) entered in the tables in front of the lower limit of determination 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. If an element was not looked for in a sample, two dashes (--) are entered in tables 3-7 in place of an analytical value. Because of the formatting used in the computer program that produced tables 3-7, some of the elements listed in these tables (Fe, Mg, Ca, Ti, Ag, and Be) 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.

Table 8 lists the normative composition for six volcanic rocks form the Burnt Creek Wilderness Study Area. The normative composition of a rock is determined by using the chemical analysis to compute simple mineral molecules that might theoretically have formed from a melt of the given composition. A name can be assigned to the rock according to the content of normative minerals.

ACKNOWLEDGMENTS

A number of our colleagues also participated in the collection, preparation and analyses of these samples. We would like to extend our appreciation to these colleagues -- collection: D. H. McIntyre, Betty Skipp, and Cliff Taylor; and preparation and analyses: Bryan Anderson, Ardith Bartel, Elaine Brandt, Suzi Erickson, Carol Gent, Phil Hageman, Dave Siems, Joe Taggart, and Eric Welsch.

REFERENCES CITED

Crock, J.G., Briggs, P. H., Jackson, L. L., and Lichte, F. E., 1987, Analytical methods for the analysis of stream sediments and rocks from wilderness study areas: U.S. Geological Survey Open-File Report 87-84, 35 p.

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Jackson, L. L., Brown, F. W., and Neil, S. T., 1987, Major and minor elements requiring individual determination, classical whole rock analysis, and rapid rock analysis, in Baedecker, P. A., ed., Methods for geochemical analysis: U.S. Geological Survey Bulletin 1770, p. G1-G23.

Koirtyohann, S. R., and Khalil, Moheb, 1976, Variables in the determination of mercury by cold vapor atomic absorption: Analytical Chemistry, 48, p. 136-139.

Mapel, W. J., and Shropshire, K. L., 1973, Preliminary geologic map and section of the Hawley Mountain Quadrangle, Custer, Butte, and Lemhi Counties, Idaho: U.S. Geological Survey Miscellaneous Field Studies MF-546, scale 1:62,500.

Motooka, J. M., and Grimes, D. J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analyses: U.S. Geological Survey Circular 738, 25 p.

Ross, C. P., 1947, Geology of the Borah Peak quadrangle, Idaho: Bulletin of the Geological Society of America, v. 53, p. 1085-1160, scale 1:125,000.

Taggart, J. E., Jr., Lindsay, J. R., Scott, B. A., Vivit, D. V., Bartel, E. ., and Stewart, K. C., 1987, Analysis of geologic materials be wavelength-dispersive X-ray fluorescence spectrometry, in Baedecker, P. A., ed., Methods for geochemical analysis: U.S., Geological Survey Bulletin 1770, p. E1-E19.

Thompson, C. E., Nakagawa, H. M., and Van Sickle, G. H., 1968, Rapid analysis for gold in geologic materials, in Geological Survey research 1968: U.S. Geological Survey Professional Paper 600-B, p. B130-B132.

VanTrump, George, Jr., and Miesch, A. T., 1977, The U.S. Geological Survey RASS-STATPAC system for management and statistical reduction of geochemical data: Computers and Geosciences, v. 3, p. 475-488.

TABLE 1.--Limits of determination for the spectrographic analysis of rocks and stream 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 for rocks and stream sediments]

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	20
Titanium (Ti)	.002	1
	Parts per million	
Manganese (Mn)	10	5,000
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)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
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
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

TABLE 2.--Chemical methods used

[AA = atomic absorption spectroscopy and
ICP = inductively coupled plasma-atomic emission spectroscopy]

Element constituent determined	Sample type	Method	Determination limit (micrograms/gram or ppm)	Reference
Gold (Au)	rock	AA	0.1	Modification of Thompson and others, 1968.
Mercury (Hg)	rock	AA	0.02	Koirtyohann and Khalil, 1976.
Arsenic (As)	rock	ICP	5	Crock and others, 1987.
Antimony (Sb)	rock	ICP	2	
Bismuth (Bi)	rock	ICP	2	
Cadmium (Cd)	rock	ICP	2	
Zinc (Zn)	rock	ICP	0.1	

Table 3. Results of analyses of stream-sediment samples from the Burnt Creek Wilderness Study Area, Custer County, Idaho.

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s
BU001CS	44 10 26	113 39 6	5	5	5	1.0	700	N	N	N	20	700
BU002HS	44 10 12	113 38 39	5	5	5	.7	700	N	N	N	50	500
BU003CS	44 9 25	113 37 48	5	7	5	1.0	700	N	N	N	20	500
BU004HS	44 8 31	113 37 40	5	5	3	1.0	700	N	N	N	30	700
BU005CS	44 8 46	113 37 34	5	5	7	1.0	500	N	N	N	20	500
BU006HS	44 9 19	113 38 6	3	3	2	1.0	500	N	N	N	50	500
BU007CS	44 7 46	113 32 46	3	2	3	1.0	500	N	N	N	50	500
BU008HS	44 7 56	113 34 42	5	5	7	1.0	700	N	N	N	20	500
BU009HS	44 7 39	113 34 19	7	5	5	1.0	700	N	N	N	30	500
BU010CS	44 8 5	113 33 53	7	7	2	1.0	700	N	N	N	50	500
BU011CS	44 8 25	113 33 22	7	7	7	.5	1,000	N	N	N	30	500
BU012HS	44 9 38	113 34 8	5	7	7	.5	1,000	N	N	N	20	500
BU013CS	44 9 16	113 35 42	5	5	7	.5	1,000	N	N	N	30	500
BU014CS	44 10 0	113 35 55	5	7	7	.5	700	N	N	N	20	500
BU015CS	44 10 2	113 36 2	5	5	5	1.0	1,000	N	N	N	20	500

Sample	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s
BU001CS	1.0	N	N	30	1,000	20	30	N	N	100	20	N	20	N
BU002HS	1.0	N	N	30	700	50	N	N	N	100	15	N	20	N
BU003CS	1.0	N	N	30	1,000	20	N	N	N	100	10	N	30	N
BU004HS	1.5	N	N	30	700	50	30	N	<20	100	20	N	20	N
BU005CS	<1.0	N	N	30	700	20	30	N	<20	100	20	N	20	N
BU006HS	1.5	N	N	20	500	20	30	N	N	70	15	N	15	N
BU007CS	1.0	N	N	15	300	15	50	N	<20	20	20	N	10	N
BU008HS	<1.0	N	N	30	700	20	N	N	<20	100	10	N	20	N
BU009HS	1.0	N	N	30	1,000	20	N	N	N	150	<10	N	30	N
BU010CS	1.0	N	N	20	500	50	N	N	N	100	10	N	20	N
BU011CS	<1.0	N	N	30	1,500	30	N	N	N	150	10	N	30	N
BU012HS	1.0	N	N	20	1,000	15	N	N	N	100	10	N	30	N
BU013CS	1.0	N	N	20	700	20	N	N	N	100	10	N	30	N
BU014CS	1.0	N	N	20	700	20	N	N	N	100	10	N	20	N
BU015CS	1.0	N	N	20	500	30	N	N	N	100	10	N	20	N

Sample	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	Au-ppm aa	Hg-ppm aa	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp
BU001CS	500	150	N	15	N	100	N	<.1	<.02	<5	<2	.2	<2	41
BU002HS	500	100	N	15	N	100	N	<.1	<.02	<5	<2	.3	2	51
BU003CS	500	150	N	15	N	100	N	<.1	<.02	<5	<2	.1	<2	45
BU004HS	500	150	N	15	N	150	N	<.1	<.02	<5	<2	.5	<2	65
BU005CS	300	150	N	10	N	100	N	<.1	<.02	<5	<2	.2	<2	41
BU006HS	300	100	N	10	<200	150	N	<.1	<.02	<5	<2	.2	<2	74
BU007CS	700	100	N	10	N	700	N	<.1	<.02	<5	<2	.2	<2	51
BU008HS	300	150	N	15	N	100	N	<.1	<.02	<5	<2	.2	<2	46
BU009HS	300	200	N	15	N	100	N	<.1	<.02	<5	<2	<.1	<2	41
BU010CS	500	200	N	15	N	100	N	<.1	<.02	<5	<2	.2	<2	46
BU011CS	500	150	N	15	N	70	N	<.1	<.02	<5	<2	.1	<2	46
BU012HS	500	100	N	15	N	70	N	<.1	<.02	<5	<2	.1	<2	27
BU013CS	500	100	N	15	N	70	N	<.1	<.02	<5	2	<.1	<2	37
BU014CS	300	150	N	15	N	70	N	<.1	<.02	<5	<2	<.1	<2	32
BU015CS	300	150	N	15	N	70	N	<.1	<.02	<5	2	<.1	<2	45

Table 4. Results of analyses of heavy-mineral-concentrate samples from the Burnt Creek 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	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s
BU001CC3	44 10 26	113 39 6	2.0	5.0	20	2.0	700	N	N	N
BU004HC3	44 8 31	113 37 40	5.0	10.0	20	>2.0	1,500	N	N	N
BU005CC3	44 8 46	113 37 34	2.0	10.0	15	.5	1,000	N	N	N
BU006HC3	44 9 19	113 38 6	2.0	7.0	15	2.0	1,000	N	N	N
BU007CC3	44 7 46	113 32 46	.5	1.5	10	>2.0	200	N	N	N
BU008HC3	44 7 56	113 34 42	1.5	5.0	20	.2	500	N	N	N
BU009HC3	44 7 39	113 34 19	3.0	10.0	20	.3	1,000	N	N	N
BU011CC3	44 8 25	113 33 22	.7	1.5	10	.5	150	N	N	N
BU012HC3	44 9 38	113 34 8	1.5	3.0	7	.5	200	N	N	N
BU013CC3	44 9 16	113 35 42	.5	1.0	5	.2	150	N	N	N
BU014CC3	44 10 0	113 35 55	.7	.5	5	.2	100	N	N	N
BU015CC3	44 10 2	113 36 2	2.0	3.0	5	.3	500	N	N	N

Sample	B-ppm s	Ba-ppm s	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s
BU001CC3	20	200	<2	N	N	15	1,000	10	500	N	N
BU004HC3	50	10,000	<2	N	N	30	1,500	15	200	N	<50
BU005CC3	50	1,000	<2	N	N	30	1,000	15	100	N	N
BU006HC3	100	500	<2	N	N	30	1,500	15	200	N	<50
BU007CC3	70	>10,000	<2	N	N	<10	200	<10	300	N	N
BU008HC3	20	>10,000	<2	N	N	10	500	10	300	N	N
BU009HC3	50	2,000	<2	N	N	30	1,500	15	150	N	N
BU011CC3	100	1,000	<2	N	N	<10	200	10	70	N	N
BU012HC3	70	1,500	<2	N	N	<10	700	10	70	N	N
BU013CC3	50	1,000	<2	N	N	<10	150	10	50	N	N
BU014CC3	30	1,000	<2	N	N	<10	20	10	50	N	N
BU015CC3	30	1,000	<2	N	N	<10	300	10	50	N	N

Sample	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s
BU001CC3	70	N	N	50	500	1,000	100	N	700	N	>2,000	N
BU004HC3	100	N	N	50	N	1,000	200	100	200	N	>2,000	N
BU005CC3	100	N	N	30	N	1,000	100	<100	300	N	>2,000	N
BU006HC3	100	N	N	50	N	1,000	200	N	200	N	>2,000	N
BU007CC3	20	N	N	<10	N	7,000	70	N	300	N	>2,000	N
BU008HC3	70	N	N	<10	N	2,000	100	N	500	N	>2,000	N
BU009HC3	150	N	N	50	N	1,000	200	N	300	N	>2,000	N
BU011CC3	30	N	N	<10	N	1,000	70	N	100	N	>2,000	N
BU012HC3	30	70	N	<10	200	1,500	70	<100	70	N	>2,000	N
BU013CC3	20	N	N	<10	N	2,000	100	N	50	N	>2,000	N
BU014CC3	15	N	N	<10	N	2,000	70	N	30	N	>2,000	N
BU015CC3	30	N	N	30	N	1,500	100	<100	50	N	>2,000	N

Table 5. Results of analyses of rock samples from the Burnt Creek Wilderness Study Area, Custer County, Idaho.

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s
100S86	44 7 53	113 35 8	5.00	5.0	7	1.000	1,000	N	N	N	20	1,000
102S86	44 7 40	113 34 48	5.00	3.0	5	.700	700	N	N	N	50	1,000
105S86	44 8 30	113 32 34	.10	1.0	>20	.015	100	N	N	N	N	N
20S86	44 8 45	113 38 30	5.00	7.0	7	.500	1,000	N	N	N	<10	1,000
29S86A	44 9 0	113 37 0	5.00	3.0	5	1.000	700	N	200	N	15	1,000
29S86B	44 9 0	113 37 0	3.00	1.5	1	.500	300	N	N	N	30	1,000
32S86	44 8 26	113 37 25	.10	1.0	>20	.005	<10	N	N	N	N	N
35S86	44 8 10	113 37 3	7.00	5.0	7	1.000	700	N	<200	N	30	2,000
42S86	44 10 20	113 38 20	7.00	5.0	5	1.000	500	N	N	N	20	1,000
5S86A	44 8 45	113 39 0	7.00	5.0	10	1.000	1,000	N	N	N	30	1,000
5S86B	44 8 45	113 39 0	5.00	5.0	7	.700	1,000	N	N	N	50	1,000
66S86	44 9 30	113 38 20	5.00	5.0	5	1.000	1,000	N	N	N	50	1,000
6S86	44 9 30	113 38 7	5.00	3.0	2	1.000	500	N	<200	N	15	1,000
71S86A	44 9 38	113 37 15	2.00	2.0	2	.500	300	N	N	N	15	1,000
71S86B	44 9 38	113 37 15	3.00	2.0	3	.700	300	N	N	N	20	1,000
73S86	44 9 57	113 36 50	7.00	5.0	7	1.000	1,000	N	N	N	70	1,000
75S86A	44 9 30	113 36 50	7.00	7.0	5	.700	1,000	N	N	N	10	1,500
75S86B	44 9 30	113 36 50	7.00	5.0	2	1.000	700	N	N	N	15	1,000
87S86	44 7 29	113 32 40	5.00	5.0	7	1.000	500	N	N	N	50	1,500
8S86A	44 9 50	113 37 40	3.00	1.0	2	.300	200	N	N	N	50	2,000
8S86B	44 9 50	113 37 40	2.00	1.5	2	.300	200	N	N	N	70	1,500
97S86	44 8 15	113 34 50	5.00	5.0	7	1.000	1,000	N	N	N	20	1,000
98S86	44 8 25	113 35 10	1.50	2.0	2	.200	300	N	N	N	30	500
9S86	44 9 50	113 37 50	7.00	5.0	5	1.000	1,000	N	N	N	20	1,000
BU004HR	44 8 31	113 37 40	.07	.5	>20	.015	50	N	N	N	N	N
BU008HR	44 7 56	113 34 42	3.00	3.0	10	1.000	500	N	N	N	10	1,500
MB10	44 8 55	113 34 0	5.00	5.0	2	1.000	300	N	N	N	20	1,000
MB12	44 9 30	113 36 0	7.00	10.0	5	.700	1,000	N	N	N	50	1,000
MB7	44 9 15	113 34 20	5.00	5.0	5	.700	700	N	N	N	50	1,000

Table 5. Results of analyses of rock samples from the Burnt Creek Wilderness Study Area, Custer County, Idaho.--Continued

Sample	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s
100S86	1.0	N	N	30	500	70	50	N	N	70	30	N	20	N
102S86	1.5	N	N	20	70	50	70	N	N	30	30	N	15	N
105S86	N	N	N	N	N	<5	N	N	N	5	N	N	<5	N
20S86	1.0	N	N	30	300	50	50	N	N	150	50	N	20	N
29S86A	1.0	N	N	15	50	30	70	N	N	20	20	N	20	N
29S86B	1.0	N	N	10	50	10	50	N	N	20	20	N	10	N
32S86	N	N	N	N	N	<5	N	N	N	<5	N	N	N	N
35S86	1.5	N	N	30	100	70	100	N	N	20	70	N	30	N
42S86	1.0	N	N	20	200	50	70	N	<20	50	30	N	30	N
5S86A	1.0	N	N	30	300	100	100	N	<20	70	20	N	30	N
5S86B	1.0	N	N	20	300	70	50	N	N	100	10	N	20	N
66S86	1.0	N	N	20	200	70	70	N	<20	30	20	N	20	N
6S86	1.5	N	N	20	100	70	70	N	N	20	15	N	20	N
71S86A	1.0	N	N	15	70	20	100	N	<20	30	30	N	10	N
71S86B	1.5	N	N	15	100	20	100	N	<20	30	50	N	10	N
73S86	2.0	N	N	30	300	70	70	N	N	50	50	N	20	N
75S86A	1.5	N	N	30	150	70	150	N	N	100	20	N	20	N
75S86B	2.0	N	N	30	300	50	50	N	N	100	30	N	20	N
87S86	2.0	N	N	30	150	70	70	N	N	30	50	N	20	N
8S86A	1.5	N	N	5	50	10	150	N	20	15	50	N	15	N
8S86B	2.0	N	N	5	50	7	100	N	<20	10	50	N	15	N
97S86	1.0	N	N	30	500	50	50	N	N	100	20	N	20	N
98S86	3.0	N	N	10	15	10	50	N	<20	50	15	N	5	N
9S86	1.0	N	N	30	300	70	70	N	<20	150	20	N	30	N
BU004HR	N	N	N	N	10	<5	N	N	N	<5	N	N	<5	N
BU008HR	1.0	N	N	7	150	50	70	N	N	20	20	N	20	N
MB10	1.0	N	N	20	300	50	50	N	N	150	20	N	20	N
MB12	1.0	N	N	50	500	50	50	N	N	500	20	N	20	N
MB7	1.0	N	N	20	150	50	50	N	N	15	20	N	20	N

Table 5. Results of analyses of rock samples from the Burnt Creek Wilderness Study Area, Custer County, Idaho.--Continued

Sample	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	Au-ppm aa	Hg-ppm aa	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp
100S86	1,000	150	N	20	N	150	N	<.10	<.02	<5	<2	.7	<2	47
102S86	1,000	150	N	30	N	150	N	<.10	<.02	<5	<2	.5	<2	30
105S86	1,000	<10	N	10	N	<10	N	<.10	<.02	<5	<2	.2	<2	13
20S86	1,500	100	N	15	N	100	N	<.10	<.02	<5	<2	.2	<2	67
29S86A	1,500	150	N	30	N	300	N	<.10	<.02	<5	<2	.4	<2	45
29S86B	500	100	N	10	N	100	N	--	--	--	--	--	--	--
32S86	1,500	<10	N	N	N	N	N	<.10	<.02	<5	<2	.5	<2	18
35S86	1,000	150	N	50	N	200	N	<.10	<.02	<5	<2	.9	<2	50
42S86	1,500	150	N	50	N	200	N	<.10	.02	<5	<2	.8	<2	57
5S86A	700	200	N	30	N	200	N	--	--	--	--	--	--	--
5S86B	1,000	150	N	20	N	100	N	<.10	<.02	<5	<2	.2	<2	28
66S86	2,000	200	N	30	N	200	N	<.10	<.02	<5	<2	.4	<2	25
6S86	500	150	N	20	N	150	N	<.10	<.02	<5	<2	.6	<2	53
71S86A	700	70	N	20	N	150	N	--	--	--	--	--	--	--
71S86B	1,000	100	N	30	N	200	N	<.10	<.02	<5	<2	.5	<2	46
73S86	1,000	200	N	30	N	200	N	<.10	<.02	<5	<2	.1	<2	8
75S86A	1,000	150	N	30	N	150	N	--	--	--	--	--	--	--
75S86B	1,000	150	N	30	N	200	N	<.10	<.02	<5	<2	.8	3	48
87S86	1,500	200	N	30	N	200	N	<.10	<.02	<5	<2	.8	<2	38
8S86A	1,000	50	N	30	N	300	N	--	--	--	--	--	--	--
8S86B	1,500	70	N	50	N	300	N	<.10	<.02	<5	<2	.2	<2	31
97S86	1,500	150	N	30	N	200	N	<.10	<.02	<5	<2	.6	<2	44
98S86	700	50	N	10	N	200	N	<.10	<.02	<5	<2	.2	<2	20
9S86	1,000	200	N	30	N	150	N	<.10	<.02	5	<2	.4	<2	36
BU004HR	500	15	N	N	N	N	N	N	<.02	<5	<2	.2	2	18
BU008HR	1,500	200	N	30	N	150	N	N	<.02	<5	<2	.3	<2	60
MB10	500	150	N	15	N	200	N	--	--	--	--	--	--	--
MB12	700	200	N	30	N	150	N	<.10	<.02	<5	<2	.4	3	19
MB7	1,500	200	N	20	N	500	N	<.10	<.02	<5	<2	.6	<2	50

Table 6. **Results of analyses of selected rock samples for major and minor constituents by wavelength dispersive x-ray fluorescence spectrometry**

[All values are percent]

Sample	SiO2	Al2O3	Fe2O3	MgO	CaO	LOI (900°)
5S86B	57.0	13.6	7.82	5.52	6.71	1.86
MB-10	57.6	13.1	7.05	5.76	4.76	3.80
29S86B	62.8	15.0	5.34	2.26	3.96	1.29
71S86B	66.5	13.9	3.91	1.93	2.92	1.89
75S86B	55.6	11.2	7.36	6.72	4.85	5.05
8S86B	65.8	14.3	3.09	0.93	2.39	4.27

Sample	Na2O	K2O	TiO2	P2O5	MnO
5S86B	2.67	3.51	0.77	0.45	0.12
MB-10	2.85	3.76	0.64	0.38	0.04
29S86B	3.69	3.94	0.65	0.34	0.06
71S86B	3.12	4.35	0.54	0.27	0.04
75S86B	1.65	5.59	0.74	0.54	0.10
8S86B	1.60	6.38	0.34	0.09	< .02

Table 7. Results of analyses of selected rock samples for major and minor constituents by classical whole-rock analysis methods

[All values are percent.]

Sample	FeO	H20+	H20-	CO2
5S86B	4.83	0.88	0.37	0.46
MB-10	1.09	1.17	1.08	0.52
29S86B	1.58	0.55	0.37	0.05
71S86B	0.69	0.68	0.62	0.01
75S86B	1.56	1.53	1.84	0.09
8S86B	0.64	2.38	1.08	<.01

Table 8. CIPW norms for six volcanic rocks

Normative composition calculated by D. H. McIntyre.

[Q=quartz; C=croundum; Or=orthoclase; Ab=albite; An=anorthite; Di-wo=diopside-wollastonite; Di-en=diopside-enstatite; Di-fs=diopside-forsterite; Hy-en=hypersthene-enstatite; Hy-fs=hypersthene-forstertits; Mt=magnetite; Hm=hematite; Il=ilmenite; Ap=apatite, and Cc=calcite.]

Sample	5S86B	MB-10	29S86B	71S86B	75S86B	8S86B
Q	8.21	12.08	16.79	24.67	9.38	27.22
C	0.00	0.00	0.00	0.00	0.00	0.67
Or	21.14	23.06	23.78	26.49	35.03	39.75
Ab	23.03	25.03	31.88	27.21	14.81	14.27
An	15.04	12.29	13.00	10.29	7.05	11.88
Di-wo	5.40	2.60	1.87	1.15	5.90	0.00
Di-en	3.53	2.25	1.61	0.99	5.10	0.00
Di-fs	1.49	0.00	0.00	0.00	0.00	0.00
Hy-en	10.48	12.64	4.13	3.96	12.65	2.44
Hy-fs	4.42	0.00	0.00	0.00	0.00	0.00
Mt	3.62	1.86	3.48	0.81	3.40	1.14
Hm	0.00	4.78	1.26	2.68	3.62	1.73
Il	1.49	1.26	1.26	1.06	1.49	0.68
Ap	1.09	0.93	0.82	0.66	1.36	0.22
Cc	1.07	1.23	0.12	0.02	0.22	0.00

Table 9. Description of rock samples

100S86	rhyodacite
102S86	andesite
105S86	limestone
20S86	rhyodacite
29S86A,B	rhyodacite
32S86	limestone
35S86	rhyodacite
42S86	rhyodacite
59S86	rhyodacite plug
5S86A,B	basalt
66S86	andesite lava flow
6S86	rhyodacite dike
71S86A,B	rhyodacite dike
73S86	vitrophyre
75S86A,B	andesite lava flow
87S86	andesite lava flow
8S86A,B	quartz latitic ash-flow tuff
97S86	latite flow
98S86	tuff
9S86	andesite flow
BU004HR	limestone breccia and calcite
BU008HR	andesite flow
MB 10	latite flow
MB 12	andesite flow
MB 7	andesite flow