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Analytical results and sample locality maps of stream-sediment and heavy-mineral-concentrate samples from Westwater Canyon (UT-060-118) and Black Ridge Canyons West (CO-070-113A, UT-060-116/117) Wilderness Study Areas, Grand County, Utah and Mesa County, Colorado

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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CONTENTS

	Page
Studies Related to Wilderness.....	1
Introduction.....	1
Methods of Study.....	1
Sample Media.....	1
Sample Collection.....	3
Stream-sediment samples.....	3
Heavy-mineral-concentrate samples.....	3
Sample Preparation.....	3
Sample Analysis.....	3
Spectrographic method.....	3
Chemical methods.....	4
Data Storage System.....	4
Description of Data Tables.....	4
Acknowledgements.....	5
References Cited.....	5

ILLUSTRATIONS

Figure 1. Index map of Westwater Canyon and Black Ridge Canyons West Wilderness Study Areas, Grand County, Utah and Mesa County, Colorado.....	2
Plate 1. Localities of stream-sediment and heavy-mineral-concentrate samples from Westwater Canyon Wilderness Study Area, Grand County, Utah.....in pocket	
Plate 2. Localities of stream-sediment and heavy-mineral- concentrate samples from Black Ridge Canyons West Wilderness Study Area, Mesa County, Colorado and Grand County, Utah.....in pocket	

TABLES

Table 1. Limits of determination for spectrographic analysis of stream-sediment and heavy-mineral-concentrate samples.....	6
Table 2. Chemical methods used.....	7
Table 3. Results of analyses of stream-sediment samples.....	8
Table 4. Results of analyses of heavy-mineral-concentrate samples.....	14

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 Westwater Canyon and Black Ridge Canyons West Wilderness Study Areas, Grand County, Utah and Mesa County, Colorado.

INTRODUCTION

In April, May, and July, 1986, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Westwater Canyon (UT-060-118) (31,160 acres, 48.7 mi²) and Black Ridge Canyons West (CO-070-113A, UT-060-116/117) (54,342 acres, 84.9 mi²) Wilderness Study Areas (WSA's) in Grand County, Utah and Mesa County, Colorado. These adjacent WSA's are on the northern and western flanks of the Uncompahgre Plateau (fig. 1) west of Grand Junction, Colorado. The Black Ridge Canyons West WSA eastern boundary is about 6 mi west of the Colorado National Monument. The northern and northwestern boundary is the Colorado River. The southwest part, which is in Utah, adjoins the Westwater Canyon WSA. Westwater Canyon WSA's southern boundary is along Dry Gulch and Coates Creek, and its eastern boundary is about a mile west of the Colorado-Utah border.

The study areas are in rugged desert terrain characterized by deep canyons and high mesas where cliff walls frequently overhang, and arches and pinnacles abound. Elevation ranges from 4,152 ft at the Colorado River near Cottonwood Wash, to 6,890 ft at the top of Black Ridge. Access to the WSA's is provided by the Colorado River and by dirt roads. An unimproved access road extends about 10 mi northwest along the southern boundary of Black Ridge Canyons West WSA from Colorado National Monument. County Road DS extends 22 mi west of Glade Park along the southern boundary of Westwater Canyon WSA to the Colorado River.

Precambrian crystalline rocks crop out in the canyon bottoms of the WSA's and are overlain by subhorizontal sedimentary rock ranging in age from Triassic to Cretaceous. The geology of the area is described by Cashion (1973).

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.

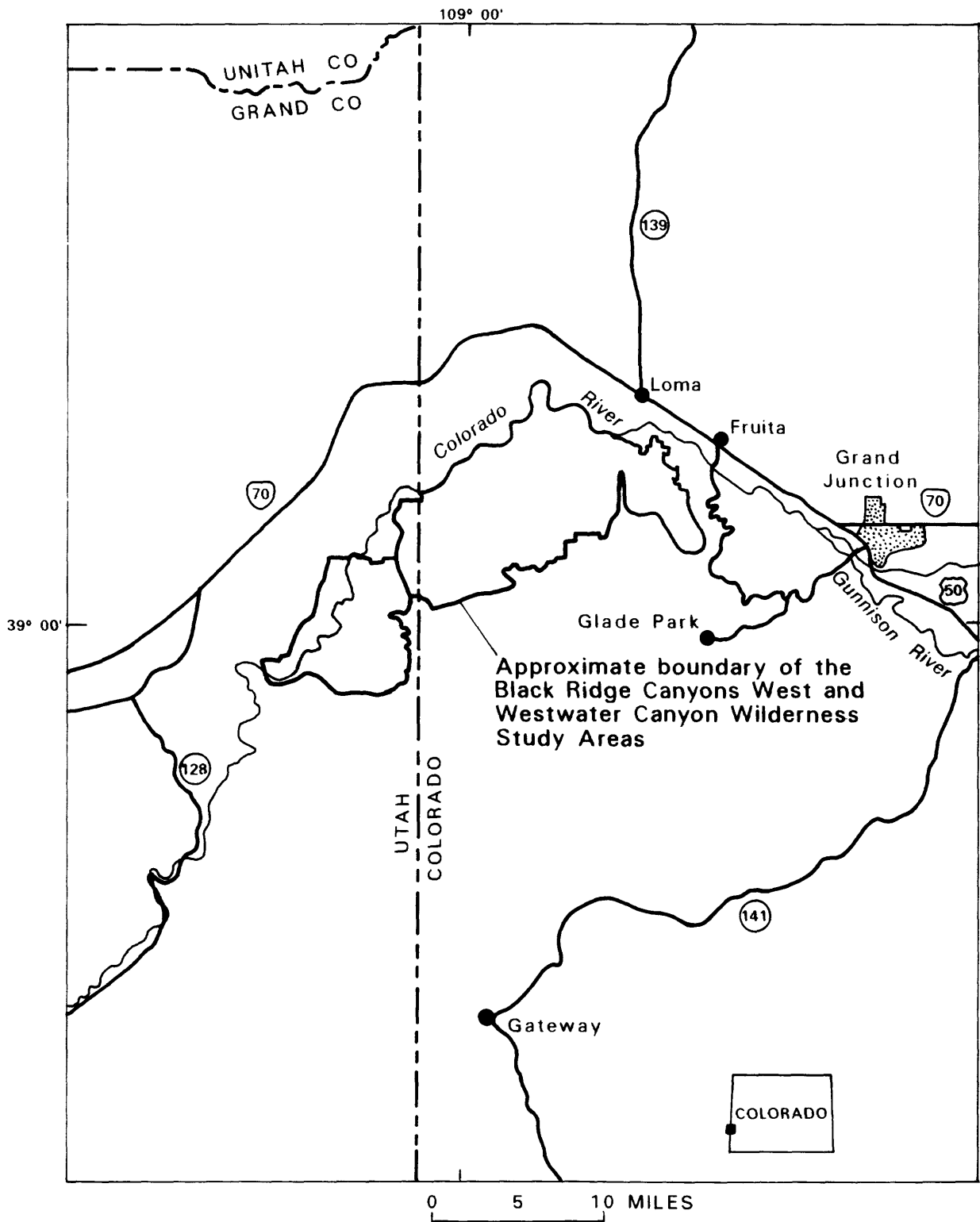


FIG. 1 Index map showing location of the Black Ridge Canyons West and Westwater Canyon Wilderness Study Area, Grand County, Utah and Mesa County, Colorado

Sample Collection

Samples were collected at a total of 58 sites. At all sites, both a stream-sediment sample and a heavy-mineral-concentrate sample were collected (an insufficient amount of sample WB057H was available for analysis). Sampling density was about one sample site per 2.3 mi². The area of the drainage basins sampled ranged from 0.2 to 2.0 mi².

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 ft 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 an 80-mesh (0.17-mm) stainless-steel sieve. The portion of the sediment passing through the sieve was saved for analysis.

After the samples were air dried, bromoform (specific gravity 2.8) was used to remove the remaining quartz and feldspar from the heavy-mineral-concentrate samples that had been panned in the field. The resultant heavy-mineral concentrate sample was separated into three fractions using a large electromagnet (in this case a modified Frantz Isodynamic Separator). The most magnetic material, primarily magnetite, was not analyzed. The second fraction, largely ferromagnesian silicates and iron oxides, was saved for archival storage. The third fraction (the least magnetic material which may include the nonmagnetic ore minerals and 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 0.1 ampere to remove the magnetite and ilmenite, and a current of 1.0 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.

Sample Analysis

Spectrographic method

The stream-sediment and heavy-mineral-concentrate 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 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, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from both WSA's (Westwater Canyon and Black Ridge Canyons West) are listed in tables 3 and 4 for stream-sediment and heavy-mineral-concentrate samples respectively.

Chemical Methods

Samples from the four study areas were also analyzed by inductively coupled plasma atomic emission spectroscopy (ICP), atomic absorption spectroscopy (AA), and delayed neutron analysis (DNA). Stream-sediment samples were analyzed by ICP for arsenic (As), antimony (Sb), bismuth (Bi), cadmium (Cd), and zinc (Zn), by AA for gold (Au) and by DNA for uranium (U) and thorium (Th). Limits of determination and references are listed in table 2.

Analytical results using these methods for stream-sediment samples are listed in table 3.

DATA STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into either the Branch of Geochemistry computer data based called PLUTO or RASS (Rock Analysis Storage System). These data bases contain 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 and 4 list the results of analyses for the stream-sediment and heavy-mineral concentrate samples for each of the four areas, respectively. For the 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 maps (plates 1 and 2). Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses; "aa" indicates atomic absorption analyses; "icp" indicates inductively coupled plasma-atomic emission spectroscopy; "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 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" (>) was entered in the

tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced tables 3 and 4, some of the elements listed in these tables (Fe, Mg, Ca, and Ti) 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 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 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; ICP = inductively coupled plasma spectroscopy;
DNA = delayed neutron analysis]

Element or constituent determined	Sample type	Method	Determination limit (micrograms/gram or ppm)	Analyst	Reference
Gold (Au)	sediments	AA	0.1	Kay Kennedy	<u>Modification of Thompson and others, 1968.</u>
Arsenic (As)	sediments	ICP	5	David Fey	Crock and others, 1983.
Antimony (Sb)	sediments	ICP	2		
Zinc (Zn)	sediments	ICP	2		
Bismuth (Bi)	sediments	ICP	2		
Cadmium (Cd)	sediments	ICP	0.1		
Thorium (Th)	sediments	DNA	--	R.B. Vaughn	McKown, 1987.
Uranium (U)	sediments	DNA	--	R.B. Vaughn	McKown, 1987.

TABLE 3.--SPECTROGRAPHIC, AA, DHA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.
[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	B-ppm S	Ba-ppm S	Be-ppm S
WB001S	39 3 44	109 7 42	1.5	1.50	3.0	.10	500	N	N	N	50	500	<1
WB002S	39 2 28	109 7 31	1.0	2.00	1.5	.10	150	N	N	N	30	200	N
WB003S	39 2 17	109 7 23	2.0	3.00	5.0	.20	1,000	N	N	N	100	700	<1
WB004S	39 1 48	109 7 15	3.0	3.00	3.0	.20	500	N	N	N	50	100	<1
WB005S	39 1 29	109 7 28	2.0	2.00	5.0	.20	500	N	N	N	100	500	1
WB006S	39 1 27	109 7 47	5.0	2.00	3.0	.30	700	N	N	N	100	300	1
WB007S	39 1 18	109 8 38	1.5	1.00	2.0	.10	200	N	N	N	100	300	<1
WB008S	38 59 2	109 10 25	2.0	1.50	2.0	.20	200	N	N	N	70	300	<1
WB009S	38 58 47	109 10 24	1.0	1.00	2.0	.15	200	N	N	N	70	200	N
WB010S	38 58 13	109 13 5	.7	.70	1.5	.15	70	N	N	N	300	700	N
WB011S	38 57 58	109 8 52	1.5	2.00	2.0	.15	500	N	N	N	70	700	N
WB012S	38 58 2	109 8 49	1.0	1.00	2.0	.15	100	N	N	N	70	200	<1
WB013S	38 58 19	109 9 4	.7	1.00	1.5	.15	50	N	N	N	30	300	N
WB014S	38 59 30	109 9 5	1.0	1.50	3.0	.15	200	N	N	N	100	1,500	N
WB015S	38 59 32	109 8 33	1.0	1.00	2.0	.07	200	N	N	N	20	200	N
WB016S	38 59 59	109 7 49	1.0	.70	2.0	.10	150	N	N	N	30	300	N
WB017S	39 0 33	109 7 2	2.0	.50	1.0	1.00	700	N	N	N	50	200	N
WB018S	39 0 49	109 6 12	1.5	1.00	2.0	.50	500	N	N	N	30	500	N
WB019S	39 0 55	109 6 14	.7	.30	1.0	.20	70	N	N	N	50	300	N
WB020S	39 3 1	109 7 27	.7	.70	1.0	.05	100	N	N	N	70	300	N
WB021S	39 3 47	109 5 56	.7	.50	.7	.10	70	N	N	N	70	500	N
WB022S	39 3 55	109 4 33	.3	.20	.3	.05	30	N	N	N	50	300	N
WB023S	39 3 52	109 4 25	1.0	1.00	1.5	.15	200	N	N	N	50	300	N
WB024S	39 3 55	109 2 58	1.0	1.50	1.5	.10	200	N	N	N	50	500	N
WB025S	39 3 53	109 3 11	.7	.70	1.0	.10	50	N	N	N	70	500	N
WB026S	39 3 58	109 2 46	.5	.15	.2	.02	20	N	N	N	15	100	N
WB027S	39 4 2	109 0 56	.7	.70	3.0	.07	150	N	N	N	30	500	N
WB028S	39 3 52	109 1 0	.5	.70	1.0	.05	30	N	N	N	30	200	N
WB029S	39 3 52	109 0 52	1.0	1.00	3.0	.10	200	N	N	N	50	500	N
WB030S	39 5 58	109 3 50	1.0	.20	1.0	.10	50	N	N	N	30	500	N
WB031S	39 6 37	109 2 39	.7	.30	1.5	.07	70	N	N	N	70	300	N
WB032S	39 6 33	109 2 44	.7	.10	.7	.05	50	N	N	N	30	500	N
WB033S	39 6 18	108 56 54	.7	.70	1.5	.07	150	N	N	N	70	200	N
WB034S	39 6 15	108 56 13	1.0	1.00	5.0	.10	300	N	N	N	70	1,000	N
WB035S	39 5 46	108 55 53	.7	.50	2.0	.07	200	N	N	N	50	500	N
WB036S	39 5 49	108 55 47	1.0	1.00	3.0	.10	300	N	N	N	70	700	N
WB037S	39 4 35	108 54 27	1.0	.70	5.0	.05	300	N	N	N	50	300	N
WB038S	39 4 18	108 55 45	.7	.70	1.0	.10	100	N	N	N	50	200	N
WB039S	39 5 10	108 56 38	.7	1.00	1.5	.07	150	N	N	N	50	200	N
WB040S	39 5 8	108 56 54	.7	.70	1.0	.10	70	N	N	N	50	300	N
WB041S	39 10 57	108 53 55	1.0	.30	1.5	.07	100	N	N	N	30	700	N
WB042S	39 11 49	108 55 0	3.0	1.00	3.0	.15	200	N	N	N	50	1,000	N
WB043S	39 10 26	108 56 18	1.0	.70	3.0	.15	100	N	N	N	150	1,000	N
WB044S	39 9 8	108 56 58	1.0	1.00	2.0	.15	50	N	N	N	70	300	N
WB045S	39 9 3	108 56 32	.7	.70	1.5	.07	70	N	N	N	50	300	N

TABLE 3.--SPECTROGRAPHIC, AA, DNA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

Sample	Bi-dpm S	Cd-dpm S	Co-dpm S	Cr-dpm S	Cu-dpm S	La-dpm S	Mo-dpm S	Nb-dpm S	Ni-dpm S	Pb-dpm S	Sb-dpm S	Sc-dpm S	Sn-dpm S
WB001S	N	N	<5	<10	5	N	N	N	7	15	N	<5	N
WB002S	N	N	<5	100	5	N	N	N	15	<10	N	<5	N
WB003S	N	N	<5	10	7	50	N	N	50	15	N	5	N
WB004S	N	N	7	100	15	20	N	N	15	10	N	10	N
WB005S	N	N	<5	N	<5	N	N	N	5	20	N	<5	N
WB006S	N	N	10	20	20	20	N	N	15	<10	N	10	N
WB007S	N	N	N	100	<5	N	N	N	7	N	N	N	N
WB008S	N	N	5	N	5	N	N	N	5	<10	N	5	N
WB009S	N	N	N	N	<5	N	N	N	<5	<10	N	<5	N
WB010S	N	N	N	N	N	N	N	N	<5	N	N	N	N
WB011S	N	N	N	N	5	N	N	N	5	<10	N	<5	N
WB012S	N	N	<5	N	<5	N	N	N	5	N	N	N	N
WB013S	N	N	N	N	5	N	N	N	<5	N	N	N	N
WB014S	N	N	<5	N	5	N	N	N	5	<10	N	N	N
WB015S	N	N	<5	N	5	N	N	N	5	<10	N	N	N
WB016S	N	N	N	N	<5	N	N	N	<5	N	N	<5	N
WB017S	N	N	<5	10	5	N	N	N	<5	N	N	<5	N
WB018S	N	N	5	150	5	N	N	N	<5	<10	N	5	N
WB019S	N	N	N	50	<5	<20	N	N	<5	N	N	10	N
WB020S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB021S	N	<20	N	N	<5	N	N	N	<5	N	N	N	N
WB022S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB023S	N	N	N	N	<5	N	N	N	5	<10	N	N	N
WB024S	N	N	N	20	5	N	N	N	5	10	N	N	N
WB025S	N	N	N	N	N	N	N	N	<5	N	N	N	N
WB026S	N	N	N	150	<5	N	N	N	<5	N	N	N	N
WB027S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB028S	N	N	N	N	N	N	N	N	<5	N	N	N	N
WB029S	N	N	N	<10	<5	N	N	N	<5	N	N	N	N
WB030S	N	N	N	70	N	N	N	N	<5	N	N	N	N
WB031S	N	N	N	30	<5	N	N	N	<5	N	N	<5	N
WB032S	N	N	N	50	<5	N	N	N	<5	N	N	N	N
WB033S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB034S	N	N	<5	N	5	N	N	N	5	<10	N	N	N
WB035S	N	N	N	N	<5	N	N	N	<5	<10	N	N	N
WB036S	N	N	<5	N	<5	N	N	N	5	<10	N	N	N
WB037S	N	N	<5	N	5	N	N	N	5	10	N	N	N
WB038S	N	N	N	N	N	N	N	N	<5	N	N	N	N
WB039S	N	N	<5	N	<5	N	N	N	<5	N	N	N	N
WB040S	N	N	N	<10	5	N	N	N	5	<10	N	N	N
WB041S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB042S	N	N	<5	<10	5	20	N	N	7	<10	N	<5	N
WB043S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB044S	N	N	N	N	<5	N	N	N	<5	<10	N	N	N
WB045S	N	N	N	N	<5	N	N	N	<5	N	N	N	N

TABLE 3.--SPECTROGRAPHIC, AA, DNA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, HESA COUNTY, COLORADO.--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	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp	Th-ppm dna	U-ppm dna
WB001S	100	20	N	N	N	300	N	<.1	<5	<2	.1	<2	13	3.0	1.4
WB002S	N	15	N	20	N	200	N	<.1	<5	<2	<.1	<2	9	3.6	1.2
WB003S	150	15	N	20	N	300	N	<.1	<5	<2	<.1	<2	7	2.6	1.2
WB004S	100	50	N	20	N	150	N	<.1	<5	<2	<.1	2	20	5.0	1.9
WB005S	<100	15	N	15	N	150	N	<.1	<5	<2	<.1	<2	9	5.1	1.2
WB006S	100	100	N	20	N	200	N	<.1	<5	<2	<.1	<2	29	3.3	1.7
WB007S	N	20	N	10	N	300	N	<.1	<5	<2	<.1	<2	7	2.9	1.1
WB008S	<100	15	N	10	N	200	N	<.1	<5	<2	<.1	<2	8	3.8	1.3
WB009S	N	15	N	N	N	150	N	<.1	<5	<2	.1	<2	6	2.8	1.6
WB010S	100	<10	N	N	N	500	N	<.1	<5	<2	<.1	<2	4	3.9	.6
WB011S	100	15	N	200	N	200	N	<.1	<5	<2	<.1	<2	5	2.4	1.3
WB012S	N	10	N	N	N	150	N	<.1	<5	<2	<.1	<2	5	3.0	.7
WB013S	N	10	N	N	N	200	N	<.1	<5	<2	<.1	<2	4	3.1	.7
WB014S	100	15	N	10	N	500	N	<.1	<5	<2	<.1	<2	4	2.5	1.4
WB015S	N	15	N	N	N	200	N	<.1	<5	<2	<.1	<2	7	2.1	.9
WB016S	<100	10	N	N	N	70	N	<.1	<5	<2	<.1	<2	5	1.8	.8
WB017S	N	50	N	N	N	500	N	<.1	<5	<2	<.1	<2	6	2.9	1.3
WB018S	100	20	N	15	N	700	N	<.1	<5	<2	<.1	<2	5	3.2	1.2
WB019S	N	10	N	30	N	>1,000	N	<.1	<5	<2	<.1	<2	3	3.2	1.8
WB020S	N	10	N	N	N	500	N	<.1	<5	<2	<.1	<2	4	2.7	1.2
WB021S	N	10	N	<10	N	500	N	<.1	<5	<2	<.1	<2	6	3.2	1.5
WB022S	N	<10	N	N	N	200	N	<.1	<5	<2	<.1	<2	4	2.6	.5
WB023S	N	15	N	N	N	300	N	<.1	<5	<2	<.1	<2	5	2.1	1.0
WB024S	100	10	N	10	N	300	N	<.1	<5	<2	<.1	<2	13	2.8	1.1
WB025S	N	10	N	N	N	150	N	<.1	<5	<2	<.1	<2	4	1.8	1.0
WB026S	N	<10	N	N	N	200	N	<.1	<5	<2	<.1	<2	4	1.7	.8
WB027S	N	10	N	<10	N	500	N	<.1	<5	<2	<.1	<2	4	2.3	.9
WB028S	N	<10	N	N	N	100	N	<.1	<5	<2	<.1	<2	3	2.4	.9
WB029S	<100	15	N	15	N	700	N	<.1	<5	<2	<.1	<2	3	2.9	.9
WB030S	N	10	N	N	N	1,000	N	<.1	<5	<2	<.1	<2	6	2.7	2.2
WB031S	N	10	N	N	N	500	N	<.1	<5	<2	<.1	<2	3	2.1	1.6
WB032S	N	<10	N	N	N	500	N	<.1	<5	<2	<.1	<2	2	<1.4	1.0
WB033S	N	10	N	N	N	300	N	<.1	<5	<2	<.1	<2	6	3.0	1.4
WB034S	100	15	N	10	N	200	N	<.1	<5	<2	.1	<2	7	3.4	1.4
WB035S	N	10	N	N	N	200	N	<.1	<5	<2	<.1	<2	6	2.1	1.3
WB036S	100	10	N	10	N	150	N	<.1	<5	<2	<.1	<2	6	3.5	1.2
WB037S	N	15	N	N	N	500	N	<.1	<5	<2	.1	<2	8	4.8	1.6
WB038S	N	10	N	N	N	500	N	<.1	<5	<2	<.1	<2	4	2.3	.9
WB039S	N	10	N	<10	N	100	N	<.1	<5	<2	<.1	<2	4	3.0	1.0
WB040S	N	10	N	N	N	300	N	<.1	<5	<2	<.1	<2	5	2.8	1.0
WB041S	N	15	N	N	N	200	N	<.1	<5	<2	<.1	<2	5	3.0	1.2
WB042S	200	20	N	N	N	200	N	<.1	<5	<2	<.1	<2	7	2.5	1.5
WB043S	<100	15	N	N	N	300	N	<.1	<5	<2	.1	<2	4	4.0	.8
WB044S	N	10	N	<10	N	150	N	<.1	<5	<2	<.1	<2	4	11.5	1.3
WB045S	N	10	N	N	N	150	N	<.1	<5	<2	<.1	<2	4	3.3	1.3

TABLE 3.--SPECTROGRAPHIC, AA, DNA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

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	Re-ppm S
WB046S	39 9 10	108 56 9	1.5	1.50	3.0	.15	500	N	N	N	100	700	<1
WB047S	39 7 57	108 54 55	.7	.70	3.0	.05	200	N	N	N	30	1,000	N
WB048S	39 7 52	108 54 32	1.0	1.00	3.0	.10	200	N	N	N	50	700	N
WB049S	39 7 22	108 53 48	.5	.50	2.0	.03	100	N	N	N	70	1,000	N
WB050S	39 7 20	108 53 27	.7	.70	3.0	.07	300	N	N	N	15	300	N
WB051S	39 7 24	108 53 23	.5	.30	1.0	.03	50	N	N	N	15	1,000	N
WB052S	39 8 23	108 59 54	.5	.30	1.0	.10	50	N	N	N	50	200	N
WB053S	39 7 37	109 0 44	.5	.30	1.5	.10	100	N	N	N	50	500	N
WB054S	39 7 37	109 0 33	.5	.20	.7	.03	30	N	N	N	30	150	N
WB055S	39 7 12	108 59 22	.5	.50	1.5	.07	70	N	N	N	50	200	N
WB056S	39 6 41	108 59 23	.5	.20	.7	.05	50	N	N	N	70	300	N
WB057S	39 6 27	108 59 10	1.0	1.00	2.0	.20	70	N	N	N	200	500	<1
WB058S	39 7 1	109 1 59	.5	.50	1.5	.03	100	N	N	N	50	500	N

TABLE 3.--SPECTROGRAPHIC, AA, DNA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

Sample	Pi-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
WB046S	N	N	<5	<10	<5	20	N	N	10	10	N	<5	N
WB047S	N	N	N	N	<5	N	N	N	5	N	N	N	N
WB048S	N	N	<5	N	<5	N	N	N	5	<10	N	<5	N
WB049S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB050S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB051S	N	N	N	200	N	N	N	N	<5	N	N	N	N
WB052S	N	N	N	50	<5	N	N	N	<5	N	N	N	N
WB053S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB054S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB055S	N	N	N	N	<5	N	N	N	<5	N	N	N	N
WB056S	N	N	N	10	N	30	N	N	<5	N	N	N	N
WB057S	N	N	N	N	<5	N	N	N	<5	N	N	<5	N
WB058S	N	<20	N	N	<5	N	N	N	<5	N	N	N	N

TABLE 3.--SPECTROGRAPHIC, AA, DNA, & ICP ANALYSES OF STREAM-SEDIMENT SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA, GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, HESA COUNTY, COLORADO.--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	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp	Th-ppm dna	U-ppm dna
WB046S	100	20	N	15	N	700	N	<.1	<5	<2	<.1	<2	3	3.3	1.6
WB047S	N	10	N	N	N	50	N	<.1	<5	<2	.1	<2	5	8.8	1.1
WB048S	150	15	N	N	N	200	N	<.1	<5	<2	<.1	<2	6	2.9	1.2
WB049S	N	<10	N	N	N	100	N	<.1	<5	<2	<.1	<2	4	2.1	1.1
WB050S	N	10	N	N	N	100	N	<.1	<5	<2	<.1	<2	4	2.0	1.1
WB051S	N	<10	N	N	N	150	N	<.1	<5	<2	<.1	<2	4	2.1	1.4
WB052S	N	10	N	N	N	150	N	<.1	<5	<2	<.1	<2	4	2.2	.9
WB053S	<100	10	N	N	N	300	N	<.1	<5	<2	.2	<2	5	<1.4	1.0
WB054S	N	<10	N	N	N	150	N	<.1	<5	<2	<.1	<2	7	3.3	1.0
WB055S	N	10	N	N	N	200	N	<.1	<5	<2	<.1	<2	5	3.6	.8
WB056S	100	10	N	N	N	500	N	<.1	<5	<2	<.1	<2	3	2.3	1.1
WB057S	100	10	N	10	N	500	N	<.1	<5	<2	<.1	<2	3	2.5	1.1
WB058S	<100	<10	N	N	N	150	N	<.1	<5	<2	<.1	<2	7	1.7	.9

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.
[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	Hg-pct. S	Ca-pct. S	Ti-pct. S	Mn-pdm S	Ag-pdm S	As-pdm S	Au-pdm S
WB001H	39 3 44	109 7 42	3.00	.05	.20	1.5	50	N	N	N
WB002H	39 2 28	109 7 31	.50	.50	5.00	.7	50	N	N	N
WB003H	39 2 17	109 7 23	1.50	.20	5.00	1.5	300	N	N	N
WB005H	39 1 29	109 7 28	2.00	.30	2.00	1.5	150	N	N	N
WB006H	39 1 27	109 7 47	.20	.30	5.00	.7	100	N	N	N
WB007H	39 1 18	109 8 38	.70	.15	.30	2.0	50	N	N	N
WB008H	38 59 2	109 10 25	1.00	.07	.50	2.0	30	N	N	N
WB009H	38 58 47	109 10 24	.50	.05	.70	.7	30	N	N	N
WB010H	38 58 13	109 13 5	3.00	.50	1.50	>2.0	200	N	N	N
WB011H	38 57 58	109 8 52	.50	.05	.20	1.0	20	N	N	N
WB012H	38 58 2	109 8 49	.30	.15	1.50	.7	50	N	N	N
WB013H	38 58 19	109 9 4	.70	.15	.70	1.5	30	N	N	N
WB014H	38 59 30	109 9 5	1.00	.20	1.00	2.0	50	N	N	N
WB015H	38 59 32	109 8 33	.20	.10	2.00	1.0	50	N	N	N
WB016H	38 59 59	109 7 49	.50	.10	3.00	1.0	70	N	N	N
WB018H	39 0 49	109 6 12	2.00	.15	5.00	2.0	200	N	N	N
WB019H	39 0 55	109 6 14	.70	<.05	.20	>2.0	50	N	N	N
WB020H	39 3 1	109 7 27	.50	.05	.10	>2.0	<20	N	N	N
WB021H	39 3 47	109 5 56	.70	<.05	<.10	2.0	<20	N	N	N
WB022H	39 3 55	107 4 33	2.00	.05	<.10	>2.0	50	N	N	30
WB023H	39 3 52	109 4 25	.20	<.05	.15	2.0	<20	N	N	N
WB024H	39 3 55	109 2 58	1.00	<.05	.20	1.0	20	N	N	N
WB025H	39 3 53	109 3 11	3.00	.05	<.10	2.0	50	N	N	N
WB026H	39 3 58	109 2 16	2.00	<.05	.15	2.0	200	N	N	N
WB027H	39 4 2	109 0 56	2.00	<.05	.10	1.0	<20	N	N	N
WB028H	39 3 52	109 1 0	3.00	.05	.20	.7	50	N	N	N
WB029H	39 3 52	109 0 52	.70	<.05	.10	>2.0	<20	N	N	N
WB030H	39 8 55	109 3 50	.50	<.05	.15	.5	<20	N	N	N
WB031H	39 6 37	109 2 39	.50	<.05	<.10	.7	<20	N	N	N
WB032H	39 6 33	109 2 44	.50	<.05	<.10	1.0	<20	N	N	N
WB033H	39 6 18	108 56 54	.10	.05	.70	.3	<20	N	N	N
WB034H	39 6 15	108 56 13	.10	<.05	.70	.5	<20	N	N	N
WB035H	39 5 46	108 55 53	.70	.05	.70	.7	20	N	N	N
WB036H	39 5 49	108 55 47	.15	<.05	.50	.5	<20	N	N	N
WB037H	39 4 35	108 54 27	.10	<.05	.70	.3	N	N	N	N
WB038H	39 4 18	108 55 45	1.50	<.05	.10	1.0	20	N	N	N
WB039H	39 5 10	108 56 38	1.50	.10	.50	1.0	<20	N	N	N
WB040H	39 5 8	108 56 54	.70	.05	.70	.7	50	N	N	N
WB041H	39 10 57	108 53 55	.30	<.05	.10	.3	N	N	N	N
WB042H	39 11 49	108 55 0	.50	<.05	.70	.3	N	N	N	N
WB043H	39 10 26	108 56 18	1.00	.05	.70	.7	30	N	N	N
WB044H	39 9 8	108 56 58	.50	<.05	.20	.7	<20	N	N	N
WB045H	39 9 3	108 56 32	.70	.05	.30	.7	50	N	N	N
WB046H	39 9 10	108 56 9	1.00	.05	1.00	.7	30	N	N	N
WB047H	39 7 57	108 54 55	1.50	.10	3.00	1.0	70	N	N	N

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

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
WB001H	150	>10,000	N	N	N	N	200	<10	N	N	N
WB002H	70	>10,000	N	N	N	N	N	<10	N	N	<50
WB003H	70	>10,000	N	N	N	N	20	<10	300	N	N
WB005H	70	>10,000	N	N	N	N	200	<10	70	N	N
WB006H	20	>10,000	N	N	N	N	N	N	50	N	N
WB007H	100	>10,000	N	N	N	N	20	<10	50	N	<50
WB008H	100	>10,000	N	N	N	N	70	N	N	N	<50
WB009H	50	>10,000	N	N	N	N	N	N	N	N	N
WB010H	1,500	>10,000	N	N	N	<10	200	10	70	<10	50
WB011H	<20	>10,000	<2	N	N	N	70	N	N	N	N
WB012H	70	>10,000	N	N	N	N	N	<10	N	N	N
WB013H	70	>10,000	N	N	N	N	70	<10	N	N	N
WB014H	200	>10,000	N	N	N	N	150	10	N	N	N
WB015H	70	>10,000	N	N	N	N	20	N	N	N	N
WB016H	50	>10,000	N	N	N	N	N	N	N	N	N
WB018H	100	>10,000	N	N	N	N	300	N	200	N	N
WB019H	100	>10,000	N	N	N	N	300	N	50	N	N
WB020H	100	>10,000	N	N	N	N	N	20	<50	N	N
WB021H	50	>10,000	N	N	N	N	30	N	50	N	50
WB022H	100	>10,000	N	N	N	N	150	N	70	N	50
WB023H	20	>10,000	N	N	N	N	50	N	50	N	<50
WB024H	50	>10,000	N	N	N	N	100	N	200	N	N
WB025H	200	>10,000	N	N	N	N	150	N	50	N	N
WB026H	200	>10,000	N	N	N	N	200	<10	N	N	N
WB027H	50	>10,000	N	N	N	N	20	N	N	N	N
WB028H	70	>10,000	N	N	N	N	300	N	50	N	N
WB029H	70	>10,000	N	N	N	N	N	N	N	N	N
WB030H	50	>10,000	<2	N	N	N	50	N	50	N	N
WB031H	50	>10,000	N	N	N	N	150	N	N	N	N
WB032H	100	>10,000	N	N	N	N	N	N	<50	N	N
WB033H	<20	>10,000	N	N	N	N	20	<10	N	N	N
WB034H	70	>10,000	N	N	N	N	100	N	N	N	N
WB035H	70	>10,000	N	N	N	N	100	N	N	N	N
WB036H	100	>10,000	N	N	N	N	20	N	<50	N	N
WB037H	N	>10,000	N	N	N	N	N	N	N	N	N
WB038H	50	>10,000	<2	N	N	N	20	N	N	N	N
WB039H	50	>10,000	N	N	N	N	70	N	150	N	N
WB040H	N	>10,000	N	N	N	N	20	N	N	N	N
WB041H	70	>10,000	N	N	N	N	--	N	50	N	N
WB042H	20	>10,000	N	N	N	N	N	N	N	N	N
WB043H	50	>10,000	N	N	N	N	150	N	N	N	N
WB044H	50	>10,000	N	N	N	N	70	N	N	N	N
WB045H	20	>10,000	N	N	N	N	20	N	N	N	N
WB046H	20	>10,000	N	N	N	N	50	<10	N	N	N
WB047H	100	>10,000	N	N	N	N	50	N	N	N	N

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

Sample	Ni-ppm S	Pb-ppm S	Sb-ppm S	Sc-ppm S	Sn-ppm S	Si-ppm S	V-ppm S	W-ppm S	Y-ppm S	Zn-ppm S	Zr-ppm S	Th-ppm S
WB001H	<10	<20	N	20	N	2,000	50	N	300	N	>2,000	N
WB002H	10	N	N	N	N	500	<20	N	100	N	>2,000	N
WB003H	<10	20	N	20	N	10,000	20	N	200	N	>2,000	N
WB005H	<10	<20	N	20	N	3,000	50	N	500	N	>2,000	N
WB006H	N	<20	N	N	N	2,000	<20	N	100	N	>2,000	N
WB007H	N	<20	N	N	N	500	20	N	300	N	>2,000	N
WB008H	<10	100	N	N	N	1,500	30	N	300	N	>2,000	N
WB009H	N	N	N	N	N	3,000	<20	N	150	N	>2,000	N
WB010H	10	20	N	N	N	1,500	30	N	200	N	>2,000	N
WB011H	<10	N	N	N	N	1,500	20	N	500	N	>2,000	N
WB012H	N	<20	N	N	N	5,000	<20	N	150	N	>2,000	N
WB013H	N	<20	N	20	N	1,500	20	N	300	N	>2,000	N
WB014H	N	<20	N	20	N	3,000	30	N	1,000	N	>2,000	N
WB015H	N	<20	N	20	N	2,000	<20	N	300	N	>2,000	N
WB016H	N	<20	N	N	N	1,000	<20	N	200	N	>2,000	N
WB018H	<10	20	N	20	N	1,000	50	N	1,000	N	>2,000	N
WB019H	N	<20	N	20	N	500	30	N	700	N	>2,000	N
WB020H	N	<20	N	N	N	1,500	20	N	500	N	>2,000	N
WB021H	<10	<20	N	N	N	1,000	30	N	200	N	>2,000	N
WB022H	<10	20	N	N	N	200	30	N	700	N	>2,000	N
WB023H	N	<20	N	N	N	700	20	N	300	N	>2,000	N
WB024H	<10	<20	N	20	N	5,000	30	N	200	N	>2,000	N
WB025H	<10	<20	N	N	N	500	30	N	500	N	>2,000	N
WB026H	<10	<20	N	20	N	700	50	N	1,000	N	>2,000	N
WB027H	<10	N	N	20	N	1,000	30	N	700	N	>2,000	N
WB028H	<10	N	N	N	N	1,500	30	N	150	N	>2,000	N
WB029H	N	<20	N	N	N	500	20	N	1,000	N	>2,000	N
WB030H	N	20	N	N	N	1,500	<20	N	500	N	>2,000	N
WB031H	N	<20	N	N	N	1,000	<20	N	700	N	>2,000	N
WB032H	N	<20	N	N	N	500	20	N	700	N	>2,000	N
WB033H	<10	N	N	N	N	5,000	<20	N	150	N	>2,000	N
WB034H	<10	N	N	20	N	5,000	<20	N	150	N	>2,000	N
WB035H	N	N	N	N	N	1,500	<20	N	300	N	>2,000	N
WB036H	N	N	N	N	N	5,000	<20	N	200	N	>2,000	N
WB037H	N	N	N	N	N	3,000	<20	N	150	N	>2,000	N
WB038H	N	<20	N	N	N	500	20	N	700	N	>2,000	N
WB039H	N	<20	N	20	N	2,000	30	N	700	N	>2,000	N
WB040H	N	<20	N	20	N	2,000	20	N	500	N	>2,000	N
WB041H	N	N	N	N	N	5,000	<20	N	200	N	>2,000	N
WB042H	N	N	N	20	N	3,000	20	N	150	N	>2,000	N
WB043H	<10	70	N	N	N	5,000	20	N	300	N	>2,000	N
WB044H	N	<20	N	N	N	5,000	20	N	500	N	>2,000	N
WB045H	<10	N	N	N	N	2,000	<20	N	200	N	>2,000	N
WB046H	N	<20	N	20	N	3,000	20	N	200	N	>2,000	N
WB047H	<10	<20	N	20	N	3,000	20	N	150	N	>2,000	N

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

Sample	Latitude	Longitude	Fe-pct. S	Hg-pct. S	Ca-pct. S	Tl-pct. S	Mn-ppm S	Ag-ppm S	As-ppm S	Au-ppm S
WB048H	39 7 52	108 54 32	.30	.05	.70	1.0	30	N	N	N
WB049H	39 7 22	108 53 48	1.00	.05	1.00	1.0	50	N	N	N
WB050H	39 7 20	108 53 27	.20	<.05	.50	.2	20	N	N	N
WB051H	39 7 24	108 53 23	.20	<.05	.15	.3	<20	N	N	N
WB052H	39 8 23	108 59 54	.50	<.05	.10	.3	N	N	N	N
WB053H	39 7 37	109 0 44	.20	<.05	<.10	.7	N	N	N	N
WB054H	39 7 37	109 0 33	1.50	.05	.15	1.0	100	N	N	N
WB055H	39 7 12	108 59 22	1.50	<.05	.10	1.5	<20	N	N	N
WB056H	39 6 41	108 59 23	2.00	<.05	.30	1.0	30	N	N	N
WB057H	39 6 27	108 59 10	1.50	.05	.15	1.0	150	N	N	N
WB058H	39 7 1	109 1 59	.10	<.05	<.10	.5	N	N	N	N
WB147H	39 0 33	109 7 2	.70	.05	2.00	1.0	100	N	N	N

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, HESA COUNTY, COLORADO.--Continued

Sample	B-ppm S	Ba-ppm S	Re-ppm S	Ri-ppm S	Cd-ppm S	Co-ppm S	Cr-ppm S	Cu-ppm S	La-ppm S	Mo-ppm S	Nb-ppm S
WB048H	100	>10,000	N	N	N	N	20	N	50	N	N
WB049H	150	>10,000	N	N	N	N	150	<10	N	N	N
WB050H	20	>10,000	N	N	N	N	N	N	N	N	N
WB051H	50	>10,000	N	N	N	N	20	N	N	N	N
WB052H	20	>10,000	N	N	N	N	200	N	N	N	N
WB053H	20	>10,000	N	N	N	N	N	N	N	N	N
WB054H	150	>10,000	N	N	N	N	200	N	100	N	N
WB055H	500	>10,000	N	N	N	N	500	N	N	N	N
WB056H	70	>10,000	<2	N	N	N	150	N	N	N	N
WB057H	150	>10,000	N	N	N	N	200	N	<50	N	N
WB058H	20	>10,000	N	N	N	N	50	N	N	N	N
WB147H	N	>10,000	N	N	N	N	N	N	<50	N	N

TABLE 4.--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM WESTWATER CANYON WILDERNESS STUDY AREA,
GRAND COUNTY, UTAH AND BLACK RIDGE CANYONS WEST WILDERNESS STUDY AREA, MESA COUNTY, COLORADO.--Continued

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
WB048H	N	<20	N	20	N	5,000	20	N	200	N	>2,000	N
WB049H	<10	<20	N	20	N	5,000	20	N	150	N	>2,000	N
WB050H	N	N	N	N	N	3,000	<20	N	100	N	>2,000	N
WB051H	N	N	N	N	N	7,000	<20	N	150	N	>2,000	N
WB052H	N	<20	N	N	N	2,000	<20	N	200	N	>2,000	N
WB053H	N	<20	N	N	N	700	<20	N	300	N	>2,000	N
WB054H	<10	<20	N	N	N	1,000	20	N	1,000	N	>2,000	N
WB055H	<10	<20	N	20	N	200	20	N	700	N	>2,000	N
WB056H	N	<20	N	N	N	700	30	N	1,000	N	>2,000	N
WB057H	N	<20	N	N	N	500	20	N	500	N	>2,000	N
WB058H	N	N	N	N	N	1,500	<20	N	300	N	>2,000	N
WB147H	N	N	N	N	N	1,500	20	N	500	N	>2,000	N