UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map for stream-sediment and heavy-mineral-concentrate samples from the Brokeoff Mountains Wilderness Study Area (NM-030-112), Otero County, New Mexico

By

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ERRATA SHEET

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On page 5, omit the reference by O'Leary and Viets (1986) and insert the following reference:

O'Leary, R. M. and Meier, A. L., 1986, Analytical methods used in geochemical exploration, 1984: U.S. Geological Survey Circular 948, 48 p.

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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 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 Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico.

INTRODUCTION

In July and September, 1987, the U.S. Geological Survey conducted a reconnaissance geochemical survey of approximately 21 mi^2 (13,236 acres), hereafter termed the "study area," of the Brokeoff Mountains Wilderness Study Area (NM-030-112), Otero County, New Mexico.

The study area (fig. 1) is located in the southeast corner of Otero County, New Mexico, and adjoins the north side of Guadalupe Mountains National Park. The study area is about 18 mi northeast of Dell City, Texas, and about 50 mi southwest of Carlsbad, New Mexico. The west side of the area may be reached by private ranch roads from New Mexico State Highway 506. The east side of the study area may be reached by private and county roads from New Mexico State Highway 137.

The study area occupies the New Mexico portion of northwest-trending Cutoff Ridge and northwesterly extensions of that ridge as far north as Humphrey Canyon (plate 1). The ridges are, in part, paralleled by and, in part, cut by West Dog and Panther Canyons. Elevations range from about 3,900 ft in Humphrey Canyon to 6,698 ft on Cutoff Ridge. The dominant types of vegetation are grass and desert shrubs. The study area is almost devoid of trees except along major stream courses where the trees are scattered and seldom attain heights of more than 15 ft. The streams are dry except after exceptionally heavy precipitation.

The geology of the nearby Guadalupe Mountains is detailed by King (1948) and Hayes (1964). The geology of most of the study area is included in a report by Boyd (1958). Bedrock geology is well exposed in the study area. Bedrock is predominantly dolomite and limestone with some sandstone, shale, and gypsum. These sedimentary rocks were deposited in Permian time along the northwest shelf of the oil-rich Delaware Basin. The present-day topography is largely the result of persistent normal faults that trend north to northwest; many of the faults may have formed as recently as early Pleistocene (King, 1948, p. 144; Boyd, 1958, p. 57).

No mineral deposits have been reported within the study area (Cruver and others, 1982, p. 39). Mineralized rocks associated with sandstone beds or faults in dolomite are found 6-8 mi east and southeast of the study area. These occurrences were prospected in the past and one produced about 70 tons of copper-silver ore (Hayes and others, 1983). Anomalous concentrations of arsenic, barium, cadmium, copper, lead, molybdenum, silver, and zinc occur in rock and heavy-mineral-concentrate samples in the region that includes the mineralized rocks (Light and others, 1985).

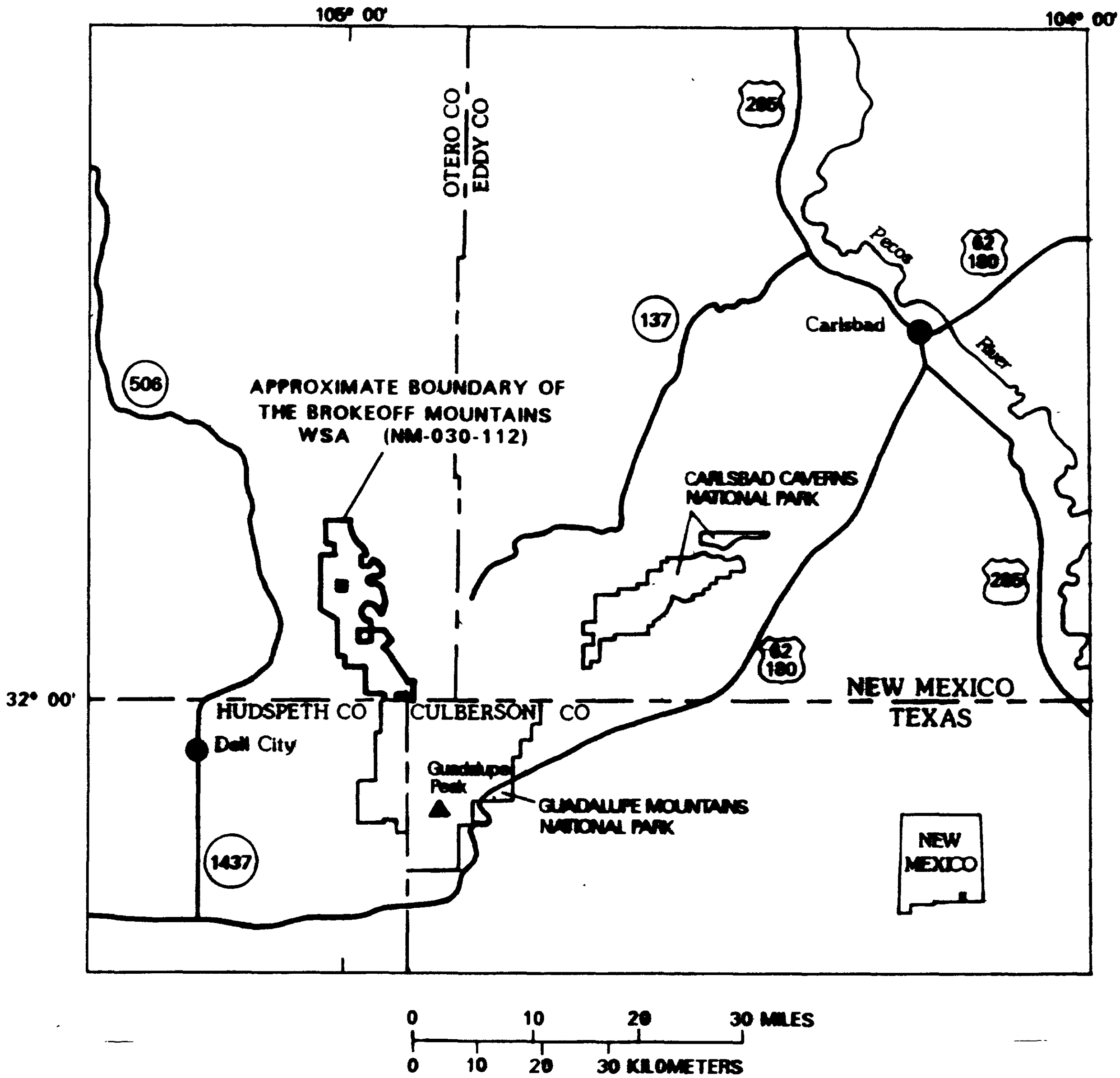

Figure 1. Index map showing location of the Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico.

METHODS OF STUDY

Sample Media

Analyses of stream-sediment samples represent the chemistry of rock material eroded from the drainage basin upstream from each sample site. Such information is useful in identifying those basins that contain concentrations of elements that may be related to mineral deposits. Heavy-mineral-concentrate samples derived from stream sediment 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.

Sample Collection and Preparation

Heavy-mineral-concentrate and stream-sediment samples were collected at 27 sites (plate 1). Sampling density was about one sample site per 0.75 mi^2. The area of the drainage basins sampled ranged from 0.2 mi^2 to 1.5 mi^2. Samples were collected by Gary A. Nowlan.

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 (plate 1). 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 approximately minus 100-mesh (0.15-mm) for analysis.

Heavy-mineral-concentrate samples

Active alluvium was screened with a 2.0-mm (10-mesh) screen to obtain about 20 lb of sample after the removal of the coarse material. The samples were then panned to remove most of the quartz, feldspar, organic material, and clay-sized material. The resulting concentrate samples weighed an estimated 1-2 oz.

After oven drying at 90 °C, bromoform (specific gravity 2.8) was used to remove the remaining quartz and feldspar from the samples. The resultant heavy-mineral sample was separated into two 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 may include nonmagnetic ore minerals, ferromagnesian silicates, iron and manganese oxides, and accessory minerals such as zircon, sphene, apatite, and rutile. The second fraction 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.

Sample Analysis

Spectrographic method

The stream-sediment and heavy-mineral-concentrate samples were analyzed using the semiquantitative, direct-current arc emission spectrographic method described by Grimes and Marranzino (1968). The elements analyzed and their 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). Emission spectrographic analyses were performed by John H. Bullock, Jr. and Olga Erlich.

Other methods

Stream sediment samples from the Brokeoff Mountains Wilderness Study Area were also analyzed by inductively coupled plasma-atomic emission spectroscopy (ICP) and ultraviolet fluorimetry. The samples were analyzed for arsenic (As), antimony (Sb), bismuth (Bi), cadmium (Cd), and zinc (Zn) using ICP and for uranium (U) using ultraviolet fluorimetry. Limits of determination, precision, and references for the methods are included in table 2. Analysts were Theodore A. Roemer and Brian A. Anderson.

Analytical results for stream-sediment and heavy-mineral-concentrate samples are listed in tables 3 and 4, respectively.

DATA STORAGE SYSTEM

Upon completion of the analytical work, the results were entered into a U.S. Geological Survey Branch of Geochemistry computer data base called PLUTO. 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, VanTrump and Miesch, 1977) for computerized statistical analysis or publication.

DESCRIPTION OF DATA TABLES

The numeric part of each sample identification in tables 3-4 is the same as the corresponding sampling-site number on plate 1. Arsenic (As), cadmium, (Cd), and zinc (Zn-i) in stream-sediment samples (table 3) were analyzed by ICP. Uranium (U) in stream-sediment samples (table 3) was analyzed by ultraviolet fluorimetry. Zinc (Zn-s) in stream-sediment samples was also analyzed by emission spectrography (table 3). All remaining elements in table 3 and all elements in table 4 were analyzed by emission spectrography.

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 indicates that an element was observed but was below the lowest reporting value. For ICP analyses, a "less than" symbol (<) entered in the tables indicates that an element was below the lowest reporting value. If an element was above the highest reporting value, a "greater than" symbol (>) was entered in the tables. Because of the formatting used in the computer program that produced table 4, some of the elements (Ca, Fe, Mg, and Ti) carry one or more nonsignificant digits to the right of the significant digits.

Some elements were not detected in any sample by emission spectrography and are omitted from tables 3-4. These elements are P, As, Au, Bi, Cd, Ge, Mo, Nb, Sb, Sn, Th, and W in stream-sediment samples and Ag, As, Au, Bi, Cd, Ge, Sb, Th, W, Pd, and Pt in heavy-mineral-concentrate samples. Concentrations of Bi and Sb, as determined by ICP, are all less than the lower limits of determination and thus are omitted from table 3. Concentrations of Zr in heavy-mineral-concentrate samples are all greater than the upper limit of determination and are omitted from table 4.

REFERENCES CITED

Boyd, D.W., 1958, Permian sedimentary facies, central Guadalupe Mountains, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 49, 100 p.

Centanni, F.A., Ross, A.M., and DeSesa, M.A., 1956, Fluorometric determination of uranium: Analytical Chemistry, v. 28, p. 1651.

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.

Cruver, S.K., Wodzicki, A., and Krason, Jan, 1982, Geology, energy, and mineral resources of the Humphrey Canyon area, New Mexico: Geoexplorers International, Inc., Denver, Colorado, prepared for Bureau of Land Management, 47 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.

Hayes, P.T., 1964, Geology of the Guadalupe Mountains, New Mexico: U.S. Geological Survey Professional Paper 446, 69 p.

Hayes, P.T., Light, T.D., and Thompson, J.R., 1983, Mineral resource potential and geologic map of the Guadalupe Escarpment Wilderness Study Area, Eddy County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1560-A, scale 1:24,000.

King, P.B., 1948, Geology of the southern Guadalupe Mountains, Texas: U.S. Geological Survey Professional Paper 215, 183 p.

Light, T.D., Domenico, James A., and Smith, S.M., 1985, Geochemical map of the Guadalupe Escarpment Wilderness Study Area, Eddy County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1560-B, scale 1:24,000.

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.

O'Leary, R.M., and Viets, J.G., 1986, Determination of antimony, arsenic, bismuth, cadmium, copper, lead, molybdenum, silver, and zinc in geologic materials by atomic absorption spectrometry using a hydrochloric acid-hydrogen peroxide digestion: Atomic Spectroscopy, 7, p. 4-8.

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 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 listed, except as noted]

Elements	Lower determination limit	Upper determination limit
	Weight percent	
Calcium (Ca)	0.05	20
Iron (Fe)	.05	20
Magnesium (Mg)	.02	10
Sodium (Na)	.2	5
Phosphorus (P)	.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.--Analytical methods used other than emission spectrography

[ICP = inductively coupled plasma spectroscopy; F= ultraviolet fluorimetry]

Element determined	Sample type	Method	Lower determination limit, ppm	Precision, percent relative standard deviation	References
Arsenic (As)	stream sediment	ICP	5	3.5-20	Crock and others, 1987.
Antimony (Sb)	stream sediment	ICP	2	6.4-11	
Bismuth (Bi)	stream sediment	ICP	2	2.2-11.9	
Cadmium (Cd)	stream sediment	ICP	.1	2.8-8.8	
Zinc (Zn)	stream sediment	ICP	2	1.4-11.9	
Uranium (U)	stream sediment	F	0.1	6.9-14.2	Centanni and others, 1956; O'Leary and Meier, 1986.

TABLE 3.--Results of analyses of stream-sediment samples collected from the Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico

[N, not detected; <, less than value shown for As, detected below value shown for others. Methods: As, Cd, and Zn-i, inductively coupled plasma spectroscopy; U, ultraviolet fluorimetry; others, emission spectrography. Ca, Fe, Mg, Na, and Ti are weight percent; other elements are ppm]

Sample	Latitude	Longitude	Ca	Fe	Mg	Na	Ti	Ag	As	B	Ba	Be	Cd	Co
BKA111	32 2 29	104 56 2	7	1.0	3	.3	.15	.7	<5	10	200	N	.3	N
BKA112	32 2 32	104 56 16	5	1.0	5	.7	.15	N	<5	15	200	N	.3	N
BKA113	32 3 14	104 56 48	5	1.5	2	.5	.20	N	<5	10	200	N	.3	N
BKA114	32 3 29	104 57 48	7	1.0	5	.3	.10	N	<5	<10	200	N	.3	N
BKA115	32 3 45	104 57 22	5	2.0	3	2.0	.15	N	<5	10	300	N	.4	N
BKA116	32 3 49	104 56 29	10	1.5	5	.5	.20	N	<5	15	300	N	.2	N
BKA117	32 5 6	104 58 16	3	1.5	2	1.0	.15	N	<5	N	200	N	.4	N
BKA118	32 5 14	104 57 29	5	2.0	3	.7	.20	N	6	10	300	<1	.6	<10
BKA119	32 5 39	104 58 44	3	2.0	5	.7	.20	N	8	<10	300	N	.6	N
BKA120	32 4 17	104 58 30	2	2.0	2	1.5	.20	N	7	10	300	<1	.6	N
BKA121	32 4 40	104 58 45	7	3.0	5	1.5	.50	N	<5	15	700	N	.6	<10
BKA122	32 5 6	104 59 12	5	3.0	3	1.0	.30	N	<5	20	300	N	.6	N
BKA123	32 5 18	104 59 51	10	2.0	5	1.5	.30	N	5	10	500	N	.5	N
BKA124	32 5 19	105 0 2	15	2.0	5	1.0	.20	N	<5	20	500	N	.5	N
BKA125	32 3 34	105 1 11	7	1.5	2	1.0	.20	N	<5	10	300	N	.4	N
BKA126	32 3 2	105 0 27	10	1.5	5	.7	.20	N	<5	15	300	N	.4	N
BKA218	32 3 36	105 0 49	5	3.0	2	1.0	.20	N	6	10	300	N	.6	N
BKA219	32 3 14	105 0 39	7	3.0	3	1.0	.30	N	<5	<10	500	N	.5	<10
BKA220	32 2 42	105 0 9	10	2.0	5	.7	.20	N	<5	10	500	N	.6	N
BKA221	32 2 6	104 59 46	10	2.0	3	1.0	.20	N	<5	10	500	N	.5	N
BKA222	32 1 51	104 59 39	7	2.0	2	1.0	.15	N	<5	10	300	N	.5	N
BKA223	32 1 48	104 58 21	5	3.0	3	1.0	.20	N	<5	<10	200	N	.6	<10
BKA224	32 1 50	104 58 20	10	2.0	5	.7	.20	N	<5	30	300	N	.5	N
BKA225	32 1 51	104 58 23	7	2.0	3	.7	.20	N	<5	30	500	N	.6	N
BKA226	32 0 36	104 59 2	5	1.5	2	1.0	.20	N	<5	20	300	N	.5	N
BKA227	32 0 27	104 58 13	7	2.0	3	1.0	.20	N	<5	15	300	N	.4	N
BKA228	32 0 20	104 58 17	7	1.5	2	.7	.15	N	<5	10	200	N	.4	N

TABLE 3.--Results of analyses of stream-sediment samples collected from the Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico--Continued

Sample	Cr	Cu	Ga	La	Mn	Ni	Pb	Sc	Sr	U	V	Y	Zn-i	Zn-s	Zr
BKA111	N	7	<5	N	150	<5	150	N	100	.30	20	N	8	<200	70
BKA112	<10	<5	10	N	150	5	<10	N	<100	.35	20	N	15	N	150
BKA113	<10	<5	5	N	100	<5	<10	N	<100	.45	20	N	18	N	200
BKA114	<10	5	<5	N	100	<5	<10	N	100	.50	20	N	14	N	70
BKA115	15	10	30	N	100	5	10	N	<100	.70	30	<10	37	N	50
BKA116	10	<5	10	N	150	<5	10	N	100	.50	30	<10	13	N	150
BKA117	<10	<5	15	N	70	<5	15	N	N	.45	15	N	23	N	100
BKA118	20	7	20	N	200	7	15	<5	<100	.40	50	10	31	N	150
BKA119	10	5	15	N	150	5	15	N	N	.60	50	<10	30	N	200
BKA120	10	10	30	N	200	5	20	N	<100	.60	50	<10	35	N	200
BKA121	30	20	50	N	500	10	30	N	150	.90	70	10	33	N	200
BKA122	20	10	20	N	200	5	15	N	150	.70	30	<10	35	N	100
BKA123	15	10	30	N	300	7	15	N	200	.75	50	<10	23	N	300
BKA124	15	15	15	N	300	5	15	N	300	1.10	50	10	22	N	700
BKA125	10	<5	7	N	200	<5	<10	N	100	.70	30	N	19	N	100
BKA126	<10	5	15	N	200	<5	10	N	150	.90	30	N	22	N	150
BKA218	20	10	30	N	150	<5	10	N	150	.70	20	15	29	N	700
BKA219	20	10	30	50	200	7	15	<5	200	.75	30	10	22	N	500
BKA220	20	10	20	N	200	<5	10	N	200	.75	50	<10	17	N	200
BKA221	<10	5	10	N	300	<5	10	N	700	.65	30	N	22	N	300
BKA222	10	5	15	N	200	5	10	N	150	.80	30	N	32	N	200
BKA223	20	7	10	N	150	15	10	N	150	.85	30	N	37	N	70
BKA224	10	7	10	N	200	20	10	N	200	.65	50	10	24	N	200
BKA225	20	15	15	N	200	10	15	N	200	.90	50	10	27	N	100
BKA226	20	5	10	N	150	5	10	N	100	.70	30	N	30	N	70
BKA227	15	10	7	N	150	5	<10	N	200	.45	50	<10	22	N	150
BKA228	<10	7	5	N	100	<5	<10	N	500	.65	30	N	21	N	100

TABLE 4.--Results of analyses of heavy-mineral-concentrate samples collected from the Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico

[N, not detected; <, detected below value shown; >, greater than value shown. Analyses by emission spectrography. Ca, Fe, Mg, Na, P, and Ti are weight percent; other elements are ppm]

Sample	Latitude	Longitude	Ca	Fe	Mg	Na	P	Ti	B	Ba	Be	Co	Cr
BKH111	32 2 29	104 56 2	5.0	10	10.0	N	N	1.0	70	150	N	<20	200
BKH112	32 2 32	104 56 16	3.0	20	3.0	N	N	>2.0	300	500	3	30	1,500
BKH113	32 3 14	104 56 48	1.0	20	2.0	N	N	2.0	200	100	<2	50	1,000
BKH114	32 3 29	104 57 48	5.0	15	7.0	N	N	1.5	150	200	N	20	1,000
BKH115	32 3 45	104 57 22	3.0	20	3.0	N	N	>2.0	100	500	2	50	700
BKH116	32 3 49	104 56 29	3.0	10	3.0	N	N	>2.0	200	300	<2	20	1,500
BKH117	32 5 6	104 58 16	3.0	20	5.0	N	N	2.0	100	500	<2	70	1,000
BKH118	32 5 14	104 57 29	5.0	20	5.0	N	N	>2.0	300	150	<2	50	2,000
BKH119	32 5 39	104 58 44	7.0	15	7.0	N	N	2.0	70	700	N	30	700
BKH120	32 4 17	104 58 30	2.0	20	2.0	N	N	>2.0	150	200	2	70	1,500
BKH121	32 4 40	104 58 45	5.0	20	7.0	N	N	2.0	100	100	<2	20	200
BKH122	32 5 6	104 59 12	7.0	20	10.0	N	<.5	2.0	70	100	<2	30	500
BKH123	32 5 18	104 59 51	3.0	20	3.0	N	N	>2.0	200	300	3	50	1,000
BKH124	32 5 19	105 0 2	3.0	15	5.0	N	N	2.0	100	300	<2	20	500
BKH125	32 3 34	105 1 11	7.0	15	7.0	N	N	>2.0	150	700	<2	30	700
BKH126	32 3 2	105 0 27	5.0	15	1.5	N	N	>2.0	200	1,500	<2	50	700
BKH218	32 3 36	105 0 49	1.5	20	1.0	N	N	>2.0	100	500	2	70	500
BKH219	32 3 14	105 0 39	1.0	15	1.5	N	N	>2.0	150	700	3	70	700
BKH220	32 2 42	105 0 9	1.0	20	2.0	N	N	>2.0	200	500	<2	50	500
BKH221	32 2 6	104 59 46	1.5	30	1.0	N	N	>2.0	100	2,000	2	70	700
BKH222	32 1 51	104 59 39	1.0	20	1.0	<.5	N	>2.0	70	1,000	<2	70	200
BKH223	32 1 48	104 58 21	1.0	20	2.0	<.5	N	2.0	150	1,500	3	30	300
BKH224	32 1 50	104 58 20	3.0	20	1.0	N	N	2.0	200	700	3	50	700
BKH225	32 1 51	104 58 23	1.5	30	2.0	N	N	1.5	150	3,000	3	20	200
BKH226	32 0 36	104 59 2	3.0	20	1.5	N	N	>2.0	200	200	<2	50	1,000
BKH227	32 0 27	104 58 13	2.0	15	3.0	N	N	>2.0	150	500	<2	50	1,000
BKH228	32 0 20	104 58 17	2.0	20	2.0	N	N	2.0	100	500	<2	50	700

TABLE 4.--Results of analyses of heavy-mineral-concentrate samples collected from the Brokeoff Mountains Wilderness Study Area, Otero County, New Mexico--Continued

Sample	Cu	Ga	La	Mn	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn
BKH111	30	10	N	700	10	N	15	50	N	N	N	100	30	N
BKH112	100	70	100	2,000	10	<50	100	70	30	30	N	500	300	N
BKH113	100	30	100	1,500	15	<50	100	<20	<10	<20	N	300	150	N
BKH114	70	20	N	1,000	15	<50	70	<20	N	N	N	200	70	N
BKH115	300	70	150	3,000	30	50	200	<20	20	N	200	500	200	N
BKH116	50	20	100	2,000	20	50	30	<20	20	N	N	200	200	N
BKH117	200	50	<100	3,000	20	<50	100	20	N	N	N	500	150	N
BKH118	100	30	200	3,000	15	<50	100	N	50	N	N	500	500	N
BKH119	200	20	100	2,000	50	N	100	<20	<10	N	N	300	150	N
BKH120	200	50	500	2,000	20	50	200	50	50	20	N	500	500	N
BKH121	150	30	100	1,000	70	50	150	50	N	N	N	500	70	N
BKH122	200	50	150	2,000	30	<50	100	20	N	N	N	500	150	N
BKH123	150	70	150	2,000	20	70	150	70	<10	N	N	1,000	200	N
BKH124	150	30	<100	1,500	15	<50	70	30	N	N	1,000	300	70	N
BKH125	150	50	200	2,000	15	70	70	20	15	N	3,000	300	200	N
BKH126	100	30	200	2,000	20	<50	100	20	15	N	N	200	200	N
BKH218	300	50	150	2,000	50	<50	150	50	<10	N	N	500	200	700
BKH219	300	50	200	3,000	50	70	150	50	15	N	N	700	200	1,000
BKH220	150	20	100	2,000	30	50	100	30	10	N	N	500	150	500
BKH221	200	70	300	3,000	20	<50	150	<20	15	N	7,000	700	200	700
BKH222	150	50	100	2,000	50	50	500	20	N	N	200	300	70	700
BKH223	300	70	N	2,000	50	<50	500	100	N	N	10,000	700	100	1,000
BKH224	200	70	<100	2,000	70	<50	300	30	N	N	200	500	100	1,500
BKH225	300	100	N	1,500	70	<50	200	<20	N	N	7,000	1,000	70	1,000
BKH226	150	70	150	5,000	20	70	100	30	<10	<20	N	300	150	500
BKH227	100	50	100	1,500	30	N	100	<20	<10	N	<200	200	200	<500
BKH228	150	50	150	2,000	20	N	150	20	<10	N	5,000	300	200	<500