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Analytical results and sample location map of heavy-mineral concentrates from the Sierra Ladrones Wilderness Study Area, Socorro County, New Mexico

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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 Federal lands to determine their mineral values, if any. Results must be made available to the public and must be submitted to the President and the Congress. This report presents the results of the geochemical component of a mineral survey of the Sierra Ladrones Wilderness Study Area (NM-020-016), Socorro County, New Mexico.

INTRODUCTION

In November, 1984, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Sierra Ladrones Wilderness Study Area (WSA), Socorro County, New Mexico. Sampling was carried out by Robert Turner, Rick Graff, and Allen Phillips.

The Sierra Ladrones WSA comprises 31,804 acres or about 50 sq mi (136 km^2) in the northwest corner of Socorro County, about 50 mi northwest of Socorro (fig. 1). Access to the area is provided by numerous unimproved roads branching from a graded road. This graded road runs north from U.S. Highway 60 along the western and northern margins of the area.

The study area is located along the western margin of the Rio Grande depression and is dominantly comprised of a westward-dipping fault block bounded by Cenozoic high-angle faults. The core of the area is underlain by Precambrian rocks, while along the western margin Paleozoic sedimentary rocks unconformably overlie Precambrian rocks. The Precambrian rocks have been divided into 15 units by Condie (1976), which can be grouped into a metavolcanic sequence, a metasedimentary sequence, and younger granitic intrusive rocks. Paleozoic rocks of the area are dominantly of the Pennsylvanian age Magdalena Group including the Sandia Formation and the carbonate units of the Madera Formation. Known mineralization in the area includes conformable copper-bearing fissure veins in metasediments, believed to be related to intrusion of the granitic bodies, and copper-bearing quartz and barite veins associated with faults along the eastern margin of the area (Black, 1964). Detailed descriptions of the geology of the area are presented by Noble (1950), Black (1964), Haederle (1966), and Condie (1976).

The Sierra Ladrones WSA is characterized physiographically by the rugged Ladron Mountains. On the east side the Ladron Mountains rise abruptly from gently sloping alluvial fans at an elevation of 5,600 ft (1700 m) to an elevation of 9,176 ft (2794 m) on Ladron Peak. On the west side, the thick section of Paleozoic sedimentary rocks lap up onto the Precambrian, in places forming a prominent hogback. The Ladron Mountains are drained by a roughly radial pattern of intermittent streams which have cut deep steep-walled canyons. The climate of the area is arid to semiarid, with an average annual precipitation of less than 10 in (25.4 cm).

METHODS OF STUDY

Sample Medium

Analyses of stream sediment material ideally represent the chemical composition of rock material eroded from the drainage basin upstream from the

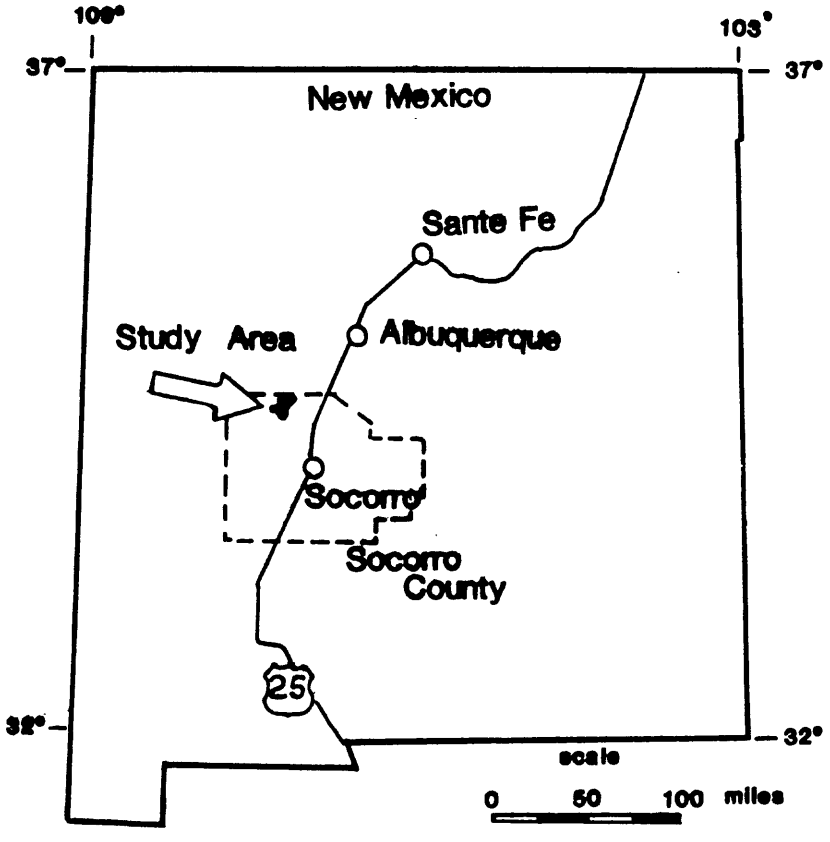

Figure 1. Location map of the Sierra Ladrones Wilderness Study Area, Socorro County, New Mexico.

sample site. Such information is useful in identifying basins which contain concentrations of elements that may be derived from mineral deposits. The heavy-mineral fraction of stream-sediment material is particularly suited for identifying anomalous concentrations of elements occurring in heavy, resistant minerals which are commonly concentrated in mineral deposits. In addition, the selective gravity separation of certain minerals permits determination of elements which are not easily detected in bulk stream sediment.

Sample Collection

Fifty-one sites were sampled in this reconnaissance study (fig. 2). The sites selected for sampling are along the mountain range front, high enough in the mountains such that sediment collected was representative of the active drainage. The drainage basins sampled ranged from 1 to 3 sq mi. Sample density was approximately one site every 1.5 sq mi.

Sample Preparation

The sample medium for this study was the nonmagnetic fraction of panned concentrates from drainage sediment. The heavy-mineral-concentrate samples were collected from active sediment in drainage channels. Each sample was a composite from several localities within an area that may extend as much as 30 feet from the site plotted on the map. Each sample was sieved through a 2-mm (10-mesh) screen to remove coarse material. The minus-2-mm material was panned to remove most of the quartz, feldspar, organic material, and clay-sized material.

After the panned concentrates were air dried, they were put through a bromoform (specific gravity 2.8) separation to remove remaining quartz and feldspar. The heavy fraction was then separated into three fractions using a modified Frantz Isodynamic Magnetic Separator. The three fractions produced include: the C1 - dominated by magnetite and limonite; the C2 - dominated by heavy rock-forming minerals, such as garnet and hornblende; and the C3 - dominated by heavy accessory minerals, such as zircon and apatite, and the majority of ore-related minerals. Only the C3 fraction was analyzed for this study. Due to insufficient quantities of sample collected, a split of the C3 fraction was not available for mineralogical analysis.

Sample Analysis

The C3 fraction was analyzed for 31 elements using a semiquantitative, direct-current arc emission-spectrographic method (Grimes and Marranzino, 1968). The elements analyzed and their lower detection limits are listed in table 1. Spectrographic results were obtained by visual comparison of sample spectra against standard-derived spectra, and are reported geometrically over any given order of magnitude in the series 10, 15, 20, 30, 50, 70, 100, etc. The precision of the method is approximately plus or minus one reporting interval at the 83 percent confidence level and plus or minus two intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the elements Fe, Mg, Ca, and Ti are reported in weight percent, while all others are reported in parts per million (micrograms/gram). Analytical data for samples from the Sierra Ladrones WSA are presented in table 2.

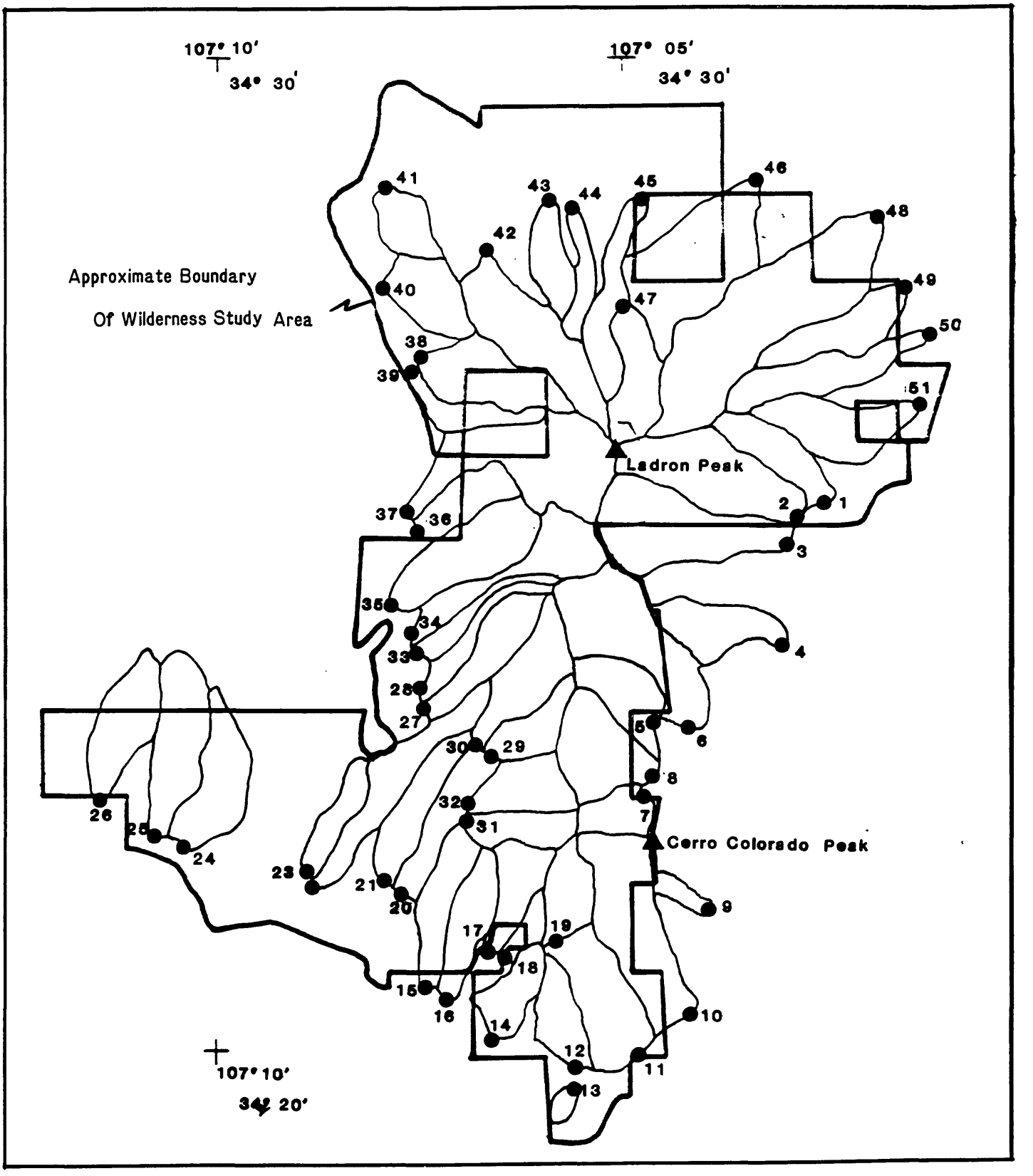

Figure 2. Sample location map of the Sierra Ladrones Wilderness Study Area (NM-020-016), Socorro County, New Mexico.

ROCK ANALYSIS STORAGE SYSTEM

Upon completion of the analytical work, the analytical results were entered into a computer-based file as part of the USGS Rock Analysis Storage System (RASS) data base. This data base contains both descriptive geological information and analytical data. Any of this information may be retrieved and converted to a binary form (STATPAC) for computerized analysis or publication (VanTrump and Miesch, 1976).

DESCRIPTION OF DATA TABLES

Table 2 contains the analytical results for the C3 fraction of heavy-mineral concentrates. The data are arranged such that the first column contains the USGS-assigned sample numbers. These numbers correspond to those shown in figure 2, except the prefix "SL" and the suffix "H" have been eliminated from figure 2. The designation "s" on element heading indicates spectrographic analysis. The letter "N" in the table indicates that an element was looked for but not observed. If an element was observed but was below the lowest reporting value, a "less than" symbol (<) was entered in the table in front of the lower limit of determination. If an element was observed but was above the upper reporting value, a "greater than" symbol (>) was entered in the table in front of the upper limit of determination. Because of the formatting used in the computer program that produced table 2, some of the elements listed in this table (Fe, Mg, Ca, and Ti) carry one or more nonsignificant digits to the right of the significant digits. The analyst did not determine these elements to the accuracy suggested by the extra zeros.

The spectrographic determinations for Au, As, Cd, and Sb were all not observed below the lower limits of determination shown in table 1, and therefore are not included in table 2.

REFERENCES CITED

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TABLE 1.--Limits of determination for the spectrographic analysis of heavy-mineral concentrates

[The values shown are the lower limits of determination assigned by the Grimes and Marranzino method, except for those values in parentheses, which are the lower values assigned by the Myers and others method. 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 which are given for rocks.]

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	(700)	10,000
Gold (Au)	10	(15)	500
Boron (B)	10		2,000
Barium (Ba)	20		5,000
Beryllium (Be)	1		1,000
Bismuth (Bi)	10		1,000
Cadmium (Cd)	20	(30)	500
Cobalt (Co)	5		2,000
Chromium (Cr)	10		5,000
Copper (Cu)	5		20,000
Lanthanum (La)	20	(30)	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	(200)	2,000

TABLE 2--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SIERRA LADRON BLM WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.

[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	B-ppm s	Ba-ppm s
SL001H	34 25 29	107 2 30	.5	.05	7.0	.50	500	N	20	2,000
SL002H	34 25 23	107 2 47	.2	<.05	15.0	.05	1,000	N	<20	>10,000
SL003H	34 25 7	107 2 55	.7	.05	15.0	.50	1,000	N	<20	700
SL004H	34 24 0	107 3 7	1.0	.07	10.0	.70	200	N	50	2,000
SL005H	34 23 17	107 4 35	.5	.10	10.0	2.00	200	N	70	5,000
SL006H	34 23 11	107 4 10	1.0	.10	10.0	1.00	200	N	50	2,000
SL007H	34 22 35	107 4 45	.5	.05	20.0	.15	200	N	<20	200
SL008H	34 22 40	107 4 37	2.0	.10	10.0	2.00	200	N	50	1,000
SL009H	34 21 23	107 3 55	.5	.05	20.0	1.50	200	N	20	10,000
SL010H	34 20 18	107 4 8	.5	.05	20.0	1.50	200	N	20	10,000
SL011H	34 19 55	107 4 50	1.0	.20	10.0	2.00	100	N	20	>10,000
SL012H	34 19 46	107 5 29	.5	.20	20.0	1.50	150	N	70	>10,000
SL013H	34 19 35	107 5 35	1.5	.07	5.0	1.00	150	N	20	>10,000
SL014H	34 20 3	107 6 37	.5	.20	10.0	1.00	100	N	<20	>10,000
SL015H	34 20 37	107 7 25	.5	.10	5.0	1.50	500	N	50	>10,000
SL016H	34 20 30	107 7 11	.5	.20	15.0	1.50	150	N	20	>10,000
SL017H	34 20 59	107 6 39	.5	.50	20.0	1.00	150	N	20	>10,000
SL018H	34 20 55	107 6 30	1.0	.50	10.0	.70	150	N	30	5,000
SL019H	34 21 4	107 5 45	.5	.10	7.0	1.00	50	N	20	>10,000
SL020H	34 21 37	107 7 47	1.0	.20	20.0	1.50	100	N	20	>10,000
SL021H	34 21 39	107 7 52	1.0	.20	10.0	1.50	200	N	20	>10,000
SL022H	34 21 42	107 8 49	1.0	.10	2.0	1.50	100	N	20	>10,000
SL023H	34 21 45	107 8 49	.2	.05	5.0	.10	50	N	<20	>10,000
SL024H	34 22 5	107 10 23	.3	.05	5.0	.10	200	N	<20	>10,000
SL025H	34 22 8	107 10 30	.5	.10	5.0	.20	500	N	20	>10,000
SL026H	34 22 31	107 11 30	1.0	.20	10.0	.10	1,000	N	20	>10,000
SL027H	34 23 25	107 7 25	.5	.05	5.0	1.50	50	N	<20	3,000
SL028H	34 23 32	107 7 29	1.0	.05	5.0	1.50	100	N	20	>10,000
SL029H	34 22 57	107 6 38	1.0	.05	5.0	2.00	100	N	20	10,000
SL030H	34 23 0	107 6 45	.5	<.05	.5	2.00	100	N	30	>10,000
SL031H	34 22 20	107 6 56	1.0	.50	50.0	.50	200	N	20	5,000
SL032H	34 22 25	107 6 54	.7	.10	20.0	.70	200	N	20	7,000
SL033H	34 24 1	107 7 33	.5	.05	.5	1.50	50	N	<20	700
SL034H	34 24 6	107 7 38	.5	.05	5.0	1.00	150	N	50	1,500
SL035H	34 24 28	107 7 52	.3	.10	5.0	1.00	100	N	<20	2,000
SL036H	34 25 17	107 7 31	1.0	.20	10.0	1.00	150	N	<20	7,000
SL037H	34 25 23	107 7 37	1.0	1.00	7.0	2.00	500	N	500	500
SL038H	34 26 53	107 7 29	.7	2.00	20.0	.50	500	N	20	1,500
SL039H	34 26 52	107 7 33	.3	.50	20.0	.20	100	N	20	1,500
SL040H	34 27 43	107 7 55	1.0	.20	7.0	.20	150	N	20	2,000
SL041H	34 28 42	107 7 54	.7	.50	20.0	.10	150	N	20	2,000
SL042H	34 28 0	107 6 38	1.0	.10	5.0	1.50	300	10	20	700
SL043H	34 28 30	107 5 50	.2	.05	10.0	.50	1,000	N	<20	700
SL044H	34 28 30	107 5 44	.3	.10	10.0	.70	1,000	N	<20	3,000
SL045H	34 28 33	107 4 43	.5	.10	5.0	.70	700	N	<20	500

TABLE 2--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SIERRA LADRON BLM WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.--Continued

Sample	Be-ppm s	Bi-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
SL001H	2	N	N	N	10	50	N	N	N	150
SL002H	2	1,000	N	N	<10	50	30	N	N	200
SL003H	2	1,000	N	70	<10	50	100	N	N	200
SL004H	2	1,000	N	70	<10	50	50	N	N	100
SL005H	7	2,000	N	70	15	150	15	150	N	100
SL006H	2	20	N	70	10	100	50	N	30	N
SL007H	N	20	N	N	<10	50	N	N	N	N
SL008H	2	20	N	70	15	200	N	150	N	50
SL009H	2	200	N	N	15	200	N	50	N	700
SL010H	2	20	N	20	10	150	15	N	N	500
SL011H	N	N	N	70	10	200	N	70	N	50
SL012H	N	N	N	50	<10	70	N	N	N	50
SL013H	N	N	N	70	<10	70	N	N	30	20
SL014H	N	N	N	50	<10	50	N	N	N	N
SL015H	N	N	10	70	10	100	N	50	N	20
SL016H	N	N	N	70	<10	150	N	<50	N	30
SL017H	N	N	N	50	<10	70	N	N	N	70
SL018H	N	N	N	50	<10	70	N	N	20	20
SL019H	N	N	N	50	<10	100	N	70	N	N
SL020H	N	N	N	70	15	200	N	<50	N	50
SL021H	N	N	N	50	<10	200	N	<50	N	50
SL022H	2	N	N	20	<10	100	N	<50	N	20
SL023H	N	N	N	20	<10	50	N	N	N	N
SL024H	2	N	N	70	<10	50	N	N	N	N
SL025H	N	N	N	20	10	50	N	N	N	20
SL026H	2	N	N	20	15	100	N	N	N	20
SL027H	2	20	N	20	10	100	N	N	N	30
SL028H	5	N	N	20	<10	50	N	N	N	20
SL029H	2	N	N	50	10	150	N	70	N	<20
SL030H	2	N	N	20	<10	200	N	50	N	100
SL031H	N	N	N	70	<10	100	N	N	N	50
SL032H	N	N	N	70	10	200	N	N	N	30
SL033H	N	N	N	20	<10	50	<10	N	N	<20
SL034H	15	30	N	20	<10	50	N	N	N	30
SL035H	N	N	N	20	10	100	N	N	N	N
SL036H	2	N	N	70	10	200	N	N	20	<20
SL037H	5	N	N	20	10	200	N	N	N	20
SL038H	15	300	N	50	10	200	N	N	N	100
SL039H	2	N	N	150	<10	200	N	N	N	20
SL040H	2	150	N	50	<10	100	15	N	20	20
SL041H	N	N	N	50	10	200	N	N	N	20
SL042H	5	>2,000	N	20	15	50	70	N	N	500
SL043H	2	>2,000	N	N	15	100	10	N	N	500
SL044H	2	1,500	N	N	<10	70	20	N	N	100
SL045H	5	20	N	N	<10	50	<10	N	N	20

TABLE 2--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SIERRA LADRON BLM WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.--Continued

Sample	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
SL001H	30	N	200	20	100	500	N	>2,000	N
SL002H	10	N	1,000	<20	10,000	500	N	1,500	N
SL003H	10	N	N	<20	2,000	500	N	>2,000	N
SL004H	10	N	1,000	<20	10,000	200	N	>2,000	N
SL005H	70	20	200	20	700	700	N	>2,000	N
SL006H	10	N	500	<20	20,000	150	N	>2,000	N
SL007H	10	N	500	<20	100	200	N	1,500	N
SL008H	70	20	200	50	100	700	N	>2,000	200
SL009H	30	N	700	150	N	1,500	N	>2,000	N
SL010H	30	N	700	20	150	500	N	>2,000	N
SL011H	50	N	1,000	50	N	300	N	>2,000	N
SL012H	10	N	1,000	<20	N	100	N	>2,000	N
SL013H	50	N	2,000	50	N	200	N	>2,000	N
SL014H	10	N	1,000	20	N	100	N	>2,000	N
SL015H	10	N	2,000	20	N	200	N	>2,000	N
SL016H	10	N	2,000	20	N	200	N	>2,000	N
SL017H	10	N	1,000	20	N	150	N	>2,000	N
SL018H	20	N	500	<20	N	150	700	>2,000	N
SL019H	N	N	700	<20	N	100	<500	2,000	N
SL020H	20	N	1,500	<20	N	500	<500	>2,000	N
SL021H	10	N	2,000	<20	N	100	N	>2,000	N
SL022H	30	N	2,000	<20	N	200	N	>2,000	N
SL023H	20	N	500	<20	N	70	N	>2,000	N
SL024H	10	N	2,000	<20	N	50	N	>2,000	N
SL025H	<10	N	10,000	<20	N	70	N	1,500	N
SL026H	<10	N	5,000	20	500	200	N	500	N
SL027H	70	N	200	<20	N	700	N	>2,000	N
SL028H	50	N	5,000	<20	N	500	N	>2,000	N
SL029H	50	N	1,000	<20	N	300	N	>2,000	N
SL030H	70	1,500	2,000	<20	200	500	N	>2,000	N
SL031H	10	N	1,000	<20	N	150	N	>2,000	N
SL032H	10	N	2,000	<20	N	300	1,000	>2,000	N
SL033H	20	N	200	<20	200	200	N	>2,000	N
SL034H	70	N	200	<20	100	1,500	N	>2,000	N
SL035H	10	N	500	<20	N	200	N	>2,000	N
SL036H	30	N	1,500	<20	N	500	N	>2,000	N
SL037H	30	<20	N	70	100	1,500	500	>2,000	N
SL038H	10	N	1,000	<20	N	300	N	2,000	N
SL039H	10	N	1,000	<20	200	500	<500	>2,000	N
SL040H	10	N	1,000	<20	200	200	N	>2,000	N
SL041H	15	N	1,000	<20	N	200	500	>2,000	N
SL042H	10	N	200	50	2,000	500	N	>2,000	N
SL043H	10	N	200	50	500	500	N	>2,000	N
SL044H	15	N	200	50	1,000	500	N	>2,000	N
SL045H	N	N	200	<20	1,000	200	N	500	N

TABLE 2--SPECTROGRAPHIC ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SIERRA LADRON BLM WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.--Continued

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	B-ppm s	Ba-ppm s
SL046H	34 28 44	107 3 18	.5	.05	7.0	.20	1,000	N	<20	500
SL047H	34 27 29	107 4 55	.2	<.05	10.0	.10	1,000	N	<20	700
SL048H	34 28 24	107 1 55	7.0	.20	20.0	1.50	1,500	N	<20	700
SL049H	34 27 37	107 1 30	3.0	.10	20.0	1.00	700	N	<20	7,000
SL050H	34 27 8	107 1 16	2.0	<.05	2.0	.20	200	N	<20	>10,000
SL051H	34 26 26	107 1 23	1.0	.20	10.0	2.00	700	N	<20	10,000

Sample	Be-ppm s	Bi-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
SL046H	5	N	N	N	<10	50	N	N	N	<20
SL047H	2	1,000	N	20	<10	100	30	N	N	70
SL048H	2	N	N	70	15	150	N	N	50	<20
SL049H	2	50	N	N	<10	50	N	N	N	30
SL050H	2	N	N	N	<10	50	N	N	N	50
SL051H	N	N	N	N	15	300	N	70	N	70

Sample	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
SL046H	N	N	200	<20	<100	200	N	200	N
SL047H	N	N	200	<20	2,000	500	N	>2,000	N
SL048H	10	N	200	50	200	700	N	2,000	N
SL049H	10	N	200	20	150	500	N	2,000	N
SL050H	N	N	1,500	<20	N	100	N	300	N
SL051H	10	20	1,000	50	100	500	N	1,000	N