UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of heavy-mineral-concentrate and rock samples from the Sierra de las Cañas 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 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 Sierra de las Cañas Wilderness Study Area, Socorro County, New Mexico.

INTRODUCTION

In October 1984, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Sierra de las Cañas Wilderness Study Area, Socorro County, New Mexico.

The Sierra de las Cañas Wilderness Study Area comprises about 20 mi^2 (52 km^2) in central New Mexico, and lies about 8 mi east-southeast of Socorro, New Mexico (see fig. 1). Access to the study area is provided by unpaved dirt roads on the north, south, and west, and by a graded gravel road on the east. These roads may be accessed by State Highways 60 and 380 on the north and south, respectively, and by Interstate Highway 25 on the east.

The study area occupies 12,798 acres (52 km^2) of north-trending hills and valleys. These hills and valleys consist of a series of eastward- and westward-dipping, tilted, faulted blocks and open folds of Paleozoic and Mesozoic sedimentary strata and Tertiary Datil volcanics. This faulted zone lies between the western margin of the Jornada de Muerto Basin and the eastern margin of the Rio Grande Trench. The north-northeast-trending block-faulted hills extend southward from the wilderness study area for about 12 mi, to the Carthage Coal mining district, and northeastward for about 20 mi into the Los Pines Mountains.

The greatest relief within the area is about 1,100 ft with a maximum elevation of 6,200 ft at Cañas Peak in the northeastern corner of the area. Drainages within the wilderness study area are intermittent in nature and generally trend northeast to southwest towards the Rio Grande River. The climate is arid to semiarid with a wide range in temperature (Sam Moore, oral comm., 1987).

METHODS OF STUDY

Sample Media

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.

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.

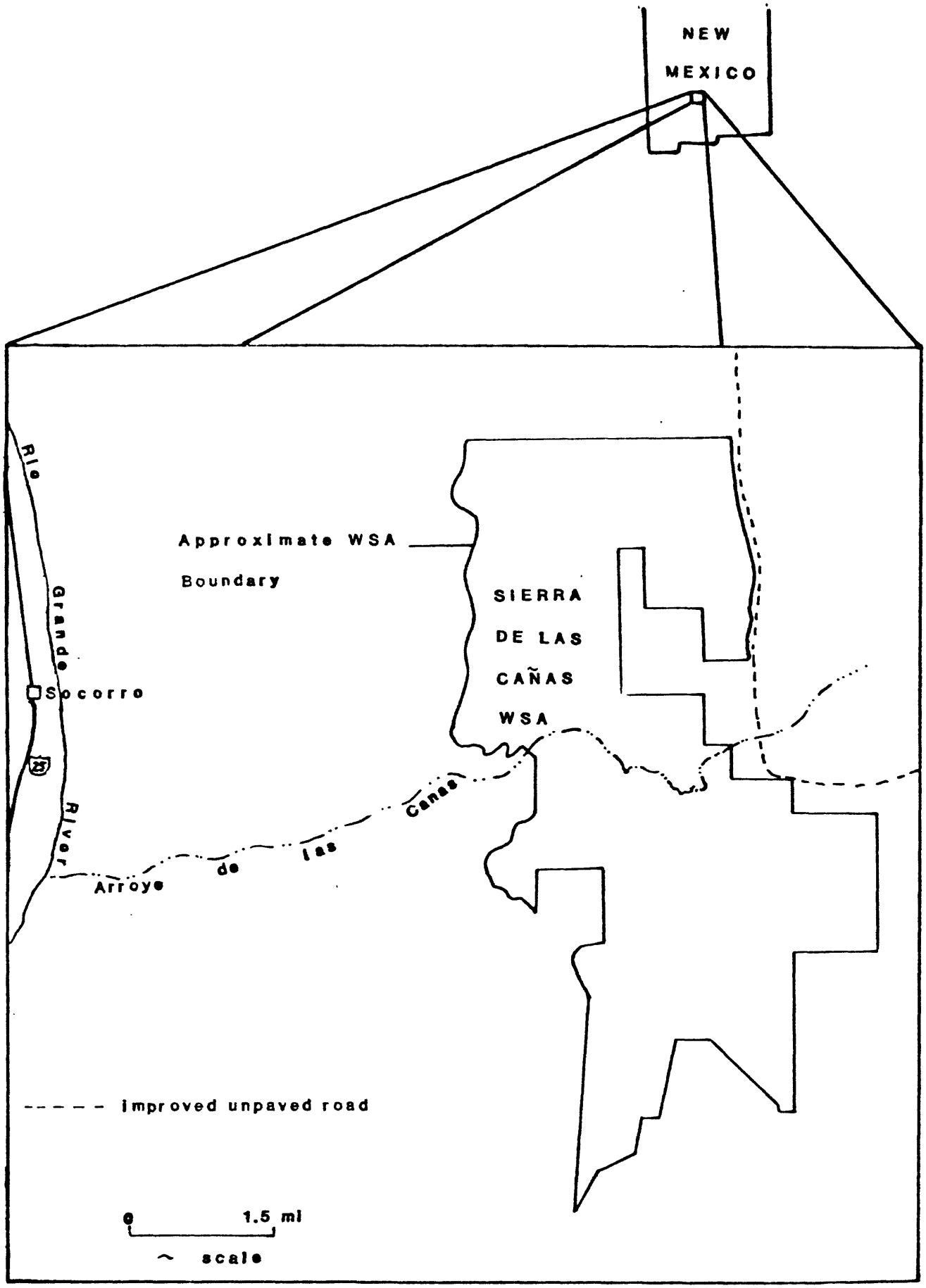

Figure 1. Index map of the Sierra de las Cañas Wilderness Study Area, Socorro County, New Mexico.

Sample Collection

Samples were collected at 27 sites (plate 1). At all of those sites, heavy-mineral-concentrate samples were collected. Where suitable outcrop was available, rock samples were collected. Sampling density was about one sample site per 1 mi^2 for the heavy-mineral concentrates, and about one sample site per 8 mi^2 for the rocks.

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples were collected from active alluvium taken from first- or second-order streams. 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 outcrops or exposures in the vicinity of the plotted site location. Samples were collected from unaltered and/or altered and/or mineralized rocks.

Sample Preparation

The heavy-mineral concentrates were air dried, then sieved using 35-mesh (0.12-mm) stainless-steel sieves. The portion of the concentrate passing through the sieve was saved for analysis.

After air drying, 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 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, 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.

Sample Analysis

Spectrographic method

The heavy-mineral-concentrate and rock samples were analyzed for 31 elements using semiquantitative, direct-current arc emission spectrographic methods. The analyses for heavy-mineral-concentrate samples were performed using a modification of the method of Grimes and Marranzino (1968); analyses for rock samples were performed using the method of Myers and others (1961).

The elements analyzed and their lower limits of determination are listed in table 1. For arsenic (As), gold (Au), cadmium (Cd), lanthanum (La), and thorium (Th), the lower limits of determination of the two analytical methods vary. The values in the parentheses are the limits of determination for Myers and others (1961). 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). Analytical data for samples from the Sierra de las Cañas Wilderness Study Area are listed in tables 3 and 4.

Chemical methods

Other analytical methods used on samples from the Sierra de las Cañas Wilderness Study Area are summarized in table 2.

ROCK ANALYSIS STORAGE SYSTEM

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

DESCRIPTION OF DATA TABLES

Tables 3 and 4 list the results of analyses for the samples of rock and heavy-mineral concentrate, respectively. For the two tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on the site location map (plate 1). The prefix "SC" and the suffixes "R" and "H" have been deleted from the map for simplicity. Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses, "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. If an element was observed but was below the lowest reporting value, a "less than" symbol (<) was entered in the tables in front of the lower limit of determination. If an element was observed but was above the highest reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced tables 3 and 4, 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.

ACKNOWLEDGMENTS

A number of our colleagues also participated in the collection and analyses of these samples: collection, Allen Phillips and Rick Graff; and analyses, Mollie Malcolm and Paul Briggs.

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TABLE 1.--Limits of determination for the spectrographic analysis of rocks, based on a 10-mg sample

[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 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.--Commonly used chemical methods

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

Element or constituent determined	Sample type	Method	Determination limit (micrograms/ gram or ppm)	Reference
Arsenic (As)	rock	ICP	5	Crock and others, 1987.
Antimony (Sb)	rock	ICP	2	
Zinc (Zn)	rock	ICP	2	
Bismuth (Bi)	rock	ICP	2	
Cadmium (Cd)	rock	ICP	0.1	

TABLE 3. ANALYTICAL RESULTS OF ROCK SAMPLES COLLECTED FROM THE SIERRA DE LAS CANAS 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	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s
SC005R	34 2 5	106 45 40	10.0	.1	.2	.02	50	1.5	N	N	<10	300
SC013R	34 0 17	106 45 46	.7	.5	2.0	.15	200	N	N	N	10	1,500
SC018R	34 0 44	106 42 38	3.0	1.0	2.0	.30	300	N	N	N	N	1,000

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
SC005R	N	N	N	<5	<10	50	N	10	N	10	15	N	<5
SC013R	N	N	N	<5	30	5	N	N	N	5	<10	N	<5
SC018R	1.5	N	N	7	15	50	50	N	N	7	15	N	5

Sample	Sn-ppm s	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp
SC005R	N	<100	70	N	N	N	20	<200	38	<2	2.4	<2	28
SC013R	N	150	20	N	10	N	300	N	<5	<2	.2	<2	7
SC018R	N	1,500	70	N	15	N	100	N	<5	<2	.3	<2	35

TABLE 4. ANALYTICAL RESULTS OF HEAVY-MINERAL-CONCENTRATE SAMPLES COLLECTED FROM THE SIERRA DE LAS CANAS 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
SC001H	34 4 46	106 46 0	1.0	.50	2.0	.10	150	N	20
SC002H	34 4 42	106 46 2	.5	.10	.5	.10	100	N	<20
SC003H	34 3 23	106 46 18	1.0	1.00	2.0	.20	150	N	20
SC004H	34 3 4	106 46 19	1.0	.50	1.0	.10	70	N	<20
SC005H	34 2 5	106 45 40	.7	.50	1.0	.70	150	N	<20
SC006H	34 1 24	106 45 14	.2	.10	1.0	.20	150	N	<20
SC007H	34 1 35	106 44 50	5.0	.50	2.0	.70	150	N	20
SC008H	34 0 27	106 46 37	1.0	.20	1.0	.50	150	N	100
SC009H	33 58 4	106 46 7	.7	.05	.5	.20	70	N	<20
SC010H	33 57 14	106 45 58	.5	.05	1.0	.20	150	N	<20
SC011H	33 59 10	106 45 31	.5	.50	1.0	.50	70	N	<20
SC012H	33 59 40	106 45 45	1.0	1.00	1.0	.50	100	N	<20
SC013H	34 0 17	106 45 46	.2	.20	.2	.02	50	N	<20
SC014H	34 1 23	106 44 27	1.5	.20	5.0	.20	200	N	<20
SC015H	34 1 3	106 44 17	.2	.20	2.0	.05	200	N	<20
SC016H	34 1 18	106 43 46	.5	.10	10.0	.05	200	N	<20
SC017H	34 1 23	106 43 24	.3	<.05	20.0	.07	1,500	N	<20
SC018H	34 0 44	106 42 38	.2	.10	10.0	.05	200	N	<20
SC019H	34 2 36	106 44 27	2.0	2.00	2.0	.20	150	N	20
SC020H	34 3 32	106 43 34	.5	.10	1.0	.20	150	N	20
SC021H	34 4 31	106 43 39	.2	.20	5.0	.05	150	N	20
SC022H	34 5 17	106 44 55	.2	.20	5.0	.20	200	N	70
SC023H	33 57 50	106 44 38	2.0	5.00	5.0	.20	200	N	20
SC024H	33 57 30	106 42 37	7.0	.20	5.0	.15	200	N	50
SC025H	33 58 45	106 42 7	7.0	1.00	1.0	.70	200	N	70
SC026H	33 59 50	106 42 10	1.0	.10	20.0	1.00	700	15	20

TABLE 4. ANALYTICAL RESULTS OF HEAVY-MINERAL-CONCENTRATE SAMPLES COLLECTED FROM THE SIERRA DE LAS CANAS WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.--Continued

Sample	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	Ni-ppm s
SC001H	>10,000	N	N	N	N	50	10	50	N	N	N
SC002H	>10,000	N	N	N	N	70	<10	<50	N	N	N
SC003H	>10,000	N	N	N	N	70	<10	<50	N	N	N
SC004H	>10,000	N	N	N	N	70	<10	<50	70	N	N
SC005H	>10,000	N	N	N	N	70	<10	<50	N	N	N
SC006H	>10,000	N	N	N	N	N	<10	50	N	N	N
SC007H	>10,000	N	N	N	N	70	15	<50	N	N	N
SC008H	>10,000	N	N	N	N	70	<10	50	N	N	N
SC009H	>10,000	N	N	N	N	N	<10	50	N	N	N
SC010H	>10,000	N	N	N	N	70	<10	50	N	N	N
SC011H	>10,000	N	N	N	N	N	<10	<50	N	N	N
SC012H	>10,000	N	N	N	N	N	<10	<50	N	N	N
SC013H	>10,000	N	N	N	N	N	<10	50	N	N	N
SC014H	>10,000	N	N	N	N	N	15	70	N	N	N
SC015H	>10,000	N	N	N	N	N	<10	70	N	N	N
SC016H	7,000	2	N	N	N	70	<10	50	N	N	N
SC017H	>10,000	2	>2,000	N	N	N	10	70	N	N	N
SC018H	>10,000	N	N	N	N	N	<10	200	N	N	N
SC019H	>10,000	N	N	N	N	50	10	N	15	N	N
SC020H	>10,000	N	N	N	N	N	10	<50	N	N	N
SC021H	>10,000	N	N	N	N	N	<10	150	N	N	N
SC022H	>10,000	N	N	N	N	N	<10	<50	N	N	N
SC023H	>10,000	N	N	N	N	50	10	<50	N	N	N
SC024H	>10,000	2	N	N	N	50	<10	150	N	N	N
SC025H	>10,000	N	N	N	N	70	50	150	N	N	30
SC026H	7,000	N	30	150	N	50	150	70	N	N	N

TABLE 4. ANALYTICAL RESULTS OF HEAVY-MINERAL-CONCENTRATE SAMPLES COLLECTED FROM THE SIERRA DE LAS CANAS WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO.--Continued

Sample	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
SC001H	N	N	20	N	10,000	<20	N	50	N	>2,000	N
SC002H	N	N	50	N	10,000	<20	N	100	N	>2,000	N
SC003H	20	N	50	N	>10,000	20	N	300	N	>2,000	N
SC004H	200	N	50	N	>10,000	<20	N	150	N	>2,000	N
SC005H	70	N	20	N	10,000	<20	N	70	N	>2,000	N
SC006H	N	N	30	N	10,000	<20	N	100	N	>2,000	N
SC007H	20	N	70	N	5,000	50	N	150	N	>2,000	N
SC008H	20	N	30	N	10,000	<20	N	100	N	>2,000	N
SC009H	N	N	20	N	10,000	<20	N	70	N	>2,000	N
SC010H	<20	N	30	N	10,000	20	N	100	N	>2,000	N
SC011H	<20	N	70	N	>10,000	<20	N	150	N	>2,000	N
SC012H	<20	N	70	N	>10,000	<20	N	150	N	>2,000	N
SC013H	N	N	20	N	>10,000	<20	N	70	N	>2,000	N
SC014H	<20	N	20	N	10,000	20	N	70	N	>2,000	N
SC015H	N	N	N	N	10,000	50	N	30	N	1,500	N
SC016H	<20	N	15	N	1,000	<20	500	150	N	>2,000	N
SC017H	200	N	N	N	1,000	<20	20,000	700	N	700	N
SC018H	N	N	10	N	1,000	<20	N	200	N	>2,000	N
SC019H	20	N	10	N	5,000	50	N	300	N	>2,000	N
SC020H	N	N	20	N	7,000	20	N	70	N	>2,000	N
SC021H	N	N	10	N	1,500	<20	N	70	N	>2,000	N
SC022H	N	N	15	N	10,000	20	N	70	N	>2,000	N
SC023H	N	N	10	N	>10,000	50	N	100	N	>2,000	N
SC024H	30	N	20	N	7,000	150	N	100	N	>2,000	N
SC025H	50	N	10	N	10,000	70	N	300	N	>2,000	N
SC026H	300	N	10	150	1,000	50	<100	500	5,000	>2,000	N

TABLE 5.--Description of rock samples collected from the Sierra de las Cañas Wilderness Study Area

Sample Number	Description
SC005R	Sandstone
SC013R	Siltstone
SC018R	Sandstone