UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of heavy-mineral-concentrate and rock samples from the Fort Piute Wilderness Study Area (CDCA-267), San Bernardino County, California

By

B. M. Adrian, J. G. Frisken,

Paul H. Briggs, L. A. Bradley, and J. G. Crock

Open-File Report 86-584

1986

CONTENTS

ILLUSTRATIONS

TABLES

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 Fort Piute Wilderness Study Area (CDCA-267), California Desert Conservation Area, San Bernardino County, California.

INTRODUCTION

In the spring of 1984, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Fort Piute Wilderness Study Area, San Bernardino County, California.[1]

Mineral surveys were requested on 31,371 acres of the Fort Piute Wilderness Study Area which comprises about 49 mi^2 (127 km^2) of the Piute Range in the northeastern portion of San Bernardino County, California (fig. 1). The study area is 15 mi south of Searchlight, Nevada, and 25 mi north of Needles, California. Access to the area is from U.S. Highway 95, 6.5 mi south of the junction of Nevada State Highway 77. Off-highway access in and around the study area varies from improved dirt roads to foot trails.

About one quarter of the wilderness study area is of low relief, and lies east of the Piute Range. West of the range front the terrain is steep. In the central portion of the Wilderness Study Area elevations change from 2,800 to 4,800 ft above sea level over a horizontal distance of 2 mi. The region is arid and has large seasonal changes in temperature and precipitation.

Rocks of the Fort Piute Wilderness Study Area are predominantly dark-colored Tertiary (Miocene) volcanic deposits and interbedded sedimentary rocks that nonconformably overlie a crystalline basement complex of Precambrian (Proterozoic?) gneisses intruded by Mesozoic (Cretaceous) granitic plutons. Basement outcrops in the wilderness study area are restricted to the mouths of canyons along the eastern range front and to several small areas, surrounded by Quaternary fanglomerate and alluvium, that are exposed between the range front and the southeastern Wilderness Study Area boundary (plate 1). Remnants of Pliocene(?)-to-Holocene lake and playa deposits overlie the pre-Tertiary and the Tertiary rocks at the southwest and southeast margins of the range. Most of the area of low relief within the wilderness study area is buried by Quaternary alluvial fans that virtually surround the range (Nielson and others, unpublished report).

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 bulk stream-sediment samples.

[1]Throughout this report "wilderness study area" and "study area" refer to the area on which mineral surveys were requested.

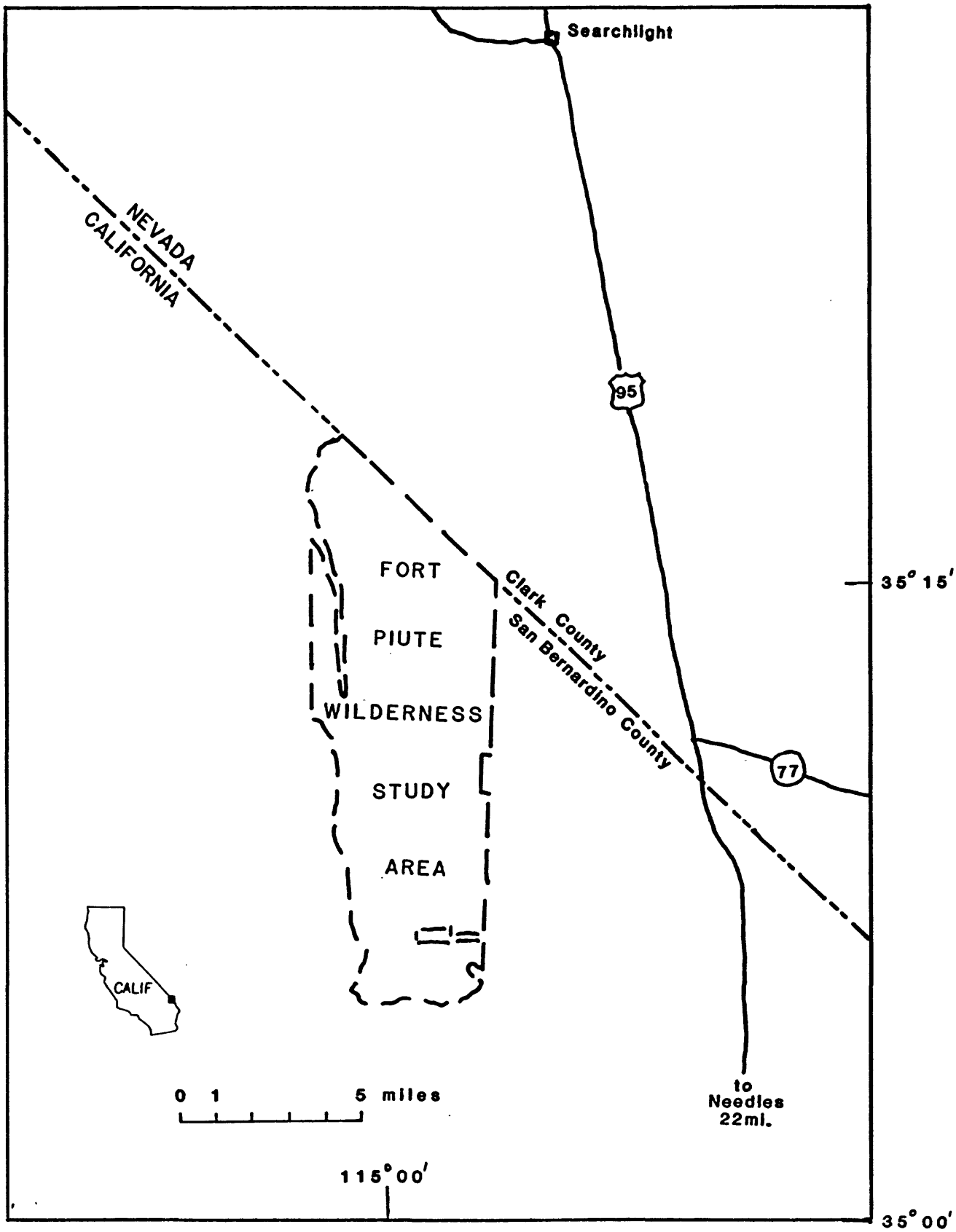

Figure 1. Location map of the Fort Piute Wilderness Study Area, San Bernardino County, California.

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

Sample Collection

Heavy-mineral-concentrate samples were collected at 31 sites (plate 1). Sampling density was about one sample site per 1.6 mi^2 for the heavy-mineral concentrates. The area of the drainage basins sampled ranged from 0.2 mi^2 to 3 mi^2 (.5 km^2 to 7.77 km^2).

Heavy-mineral-concentrate samples

Bulk stream-sediment samples were collected primarily from first-order (unbranched) and second-order (below the junction of two first-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 in the vicinity of the plotted site location. Samples were collected from unaltered, altered, and mineralized rocks. Altered and/or mineralized rocks were collected either from various types of occurrences (see table 5) or from nearby mines and prospects.

Sample Preparation

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^{o} and a tilt of 10^{o} 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.

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 by the Branch of Exploration Geochemistry using the method of Grimes and Marranzino, (1968); analyses for rock samples were performed by analysts in the Branch of Analytical Chemistry 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), and thorium (Th), the lower limit of determination is different for the two analytical methods. The values in parentheses are the limits of determination of the method of 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. Element concentrations in the standards 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 Fort Piute Wilderness Study Area are listed in tables 3 and 4.

Chemical methods

Other analytical methods used to provide additional geochemical data on samples from the Fort Piute Wilderness Study Area are listed in table 2. The analytical method used for determining As, Bi, Cd, Sb, and Zn is a modification and adaptation for the inductively coupled plasma method (ICP) based on the method of O'Leary and Viets (1986).

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

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 heavy-mineral concentrate and rock, 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

maps (plate 1). Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses; "aa" indicates atomic absorption analyses; and "icp" indicates inductively coupled plasma-atomic emission spectroscopy. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in table 1. 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. If an element was not looked for in a sample, two dashes (--) are entered in tables 3 and 4 in place of an analytical value. 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.

Descriptions of rock samples are found in table 5. The table is arranged so that column 1 contains the USGS-assigned sample numbers. An "O" in column 2 indicates the rock was collected from an outcrop; "S" indicates stream cobble; "D" indicates a mine dump or prospect pit; and "F" indicates float.

ACKNOWLEDGMENTS

A number of our colleagues also participated in the collection, preparation, analyses, and data retrieval of these samples: collection, J. C. Gray, K. R. Greene, M. A. Mast, and A. D. McCollaum; preparation, W. W. Atkinson and William Hyde; analyses, H. W. Groeneboer; and data retrieval, J. L. Jones.

REFERENCES CITED

Crock, J. G., Lichte, F. E., and Briggs, P. H., 1983, Determination of elements in National Bureau of Standards Geological Reference Materials SRM278 Obsidian and SRM668 Basalt by Inductively Coupled Argon Plasma-Atomic Emission Spectrometry: Geostandards Newsletter, no. 7, p. 335-340.

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.

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

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.

Myers, A. T. , Havens, R. G., and Dunton, P. J., 1961, A spectrochemical method for the semiquantitative analyses of rocks, minerals, and ores: U.S. Geological Survey Bulletin 1084-I, p. 1207-1229.

Nielson, Jane E., Frisken, James G., and Jachens, Robert C. (U.S. Geological Survey) and McDonnell, John R., Jr. (U.S. Bureau of Mines), 1986, Unpublished report on the Fort Piute Wilderness Study Area, San Bernardino County, California.

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.

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

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

TABLE 1.--Limits of determination for the spectrographic analysis of rocks 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.--Chemical methods used

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

Element or constituent determined	Sample Type	Method	Determination limit (micrograms/ gram or ppm)	Reference
Gold (Au)	rock	AA	.1	Modification of Thompson and others, 1968.
Mercury (Hg)	rock	AA	0.02	Koirtyohann and Khalil, 1976.
Arsenic (As)	rock	ICP	5	Crock and others, 1983, and modification of O'Leary and Viets, 1986.
Antimony (Sb)	rock	ICP	2	
Zinc (Zn)	rock	ICP	2	
Bismuth (Bi)	rock	ICP	2	
Cadmium (Cd)	rock	ICP	0.1	

TABLE 3. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.

[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
FP032	35 5 31	115 0 3	1.0	.30	5	.5	300	N	N	N	70	1,000
FP035	35 1 29	115 2 0	.7	.30	5	.5	500	500	N	N	50	2,000
FP063	35 5 28	114 59 39	.5	.20	20	.3	700	N	N	N	50	1,000
FP064	35 8 29	115 1 5	1.0	.70	3	1.0	150	N	N	N	70	1,500
FP065	35 9 43	115 1 25	1.0	.50	3	1.5	150	N	N	N	70	1,000
FP066	35 15 14	115 3 30	.7	1.00	3	1.0	100	N	N	N	70	700
FP068	35 16 40	115 5 0	.5	1.00	3	1.5	100	N	N	N	70	700
FP069	35 6 53	114 58 40	.5	3.00	20	2.0	1,000	N	N	N	100	1,500
FP070	35 6 59	114 59 10	.5	.50	3	1.5	150	N	N	N	50	700
FP071	35 6 42	114 59 25	.5	.50	5	2.0	200	N	N	N	50	3,000
FP072	35 13 40	114 59 10	.7	.20	1	1.0	100	N	N	N	50	700
FP073	35 15 36	114 58 15	1.0	.50	15	2.0	300	N	N	N	50	700
FP154	35 5 46	114 58 22	.5	.30	20	1.0	1,000	N	N	N	20	300
FP155	35 8 29	115 0 35	.7	1.00	5	>2.0	200	N	N	N	30	500
FP156	35 14 10	115 2 0	.7	1.00	3	2.0	150	N	N	N	50	700
FP157	35 14 56	115 2 20	.7	1.00	3	2.0	100	N	N	N	50	500
FP244	35 16 59	114 59 52	.5	5.00	7	.5	300	N	N	N	50	500
FP245	35 16 0	114 59 35	.5	2.00	5	.5	200	N	N	N	50	500
FP246	35 15 0	114 59 33	.5	.50	3	.5	150	N	N	N	50	1,000
FP247	35 13 58	114 58 58	.5	1.00	7	.2	300	N	N	N	50	700
FP249	35 7 32	114 58 5	.5	.30	5	.5	300	N	N	N	30	500
FP250	35 9 50	114 58 58	.5	.30	5	.5	200	N	N	N	50	1,000
FP252	35 10 15	114 58 46	.5	.20	5	.5	300	N	N	N	50	1,500
FP344	35 4 52	114 58 43	1.0	.50	3	1.0	500	N	N	N	50	700
FP345	35 12 30	115 1 50	.7	.70	2	.3	100	N	N	N	50	500
FP346	35 8 51	114 58 22	.5	.50	5	.7	300	N	N	N	30	500
FP443	35 17 10	114 59 51	.5	.70	15	.7	300	N	N	N	20	200
FP444	35 16 38	114 59 53	.5	2.00	3	.5	150	N	N	N	50	300
FP445	35 15 17	114 58 50	.7	.70	10	1.0	300	N	N	N	30	300
FP447	35 12 3	114 58 56	.5	.20	5	.5	200	N	N	N	30	300
FP448	35 11 20	114 58 29	.5	.15	5	.2	200	N	N	N	30	300

TABLE 3. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.--Continued

Sample	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s
FP032	<2	N	N	<10	N	N	300	N	N	15	100
FP035	2	300	N	<10	N	200	150	300	N	15	20,000
FP063	N	N	N	N	N	<10	1,000	N	N	10	100
FP064	<2	N	N	<10	N	<10	100	N	N	15	200
FP065	<2	N	N	<10	N	N	100	N	N	15	20
FP066	2	N	N	<10	N	N	100	N	N	10	20
FP068	3	N	N	<10	N	N	100	N	N	10	20
FP069	N	N	N	N	N	N	1,500	N	<50	10	2,000
FP070	5	N	N	N	N	30	100	N	N	15	10,000
FP071	N	N	N	<10	N	N	200	N	N	10	500
FP072	N	N	N	10	N	<10	300	N	N	15	50
FP073	N	N	N	<10	N	N	700	N	<50	10	20
FP154	N	N	N	N	N	N	1,000	N	N	10	50
FP155	N	N	N	N	N	N	200	N	N	15	100
FP156	<2	N	N	N	N	N	150	N	N	10	20
FP157	<2	N	N	<10	N	N	150	N	<50	10	20
FP244	10	N	N	N	N	N	150	N	N	10	50
FP245	2	N	N	<10	N	N	150	N	N	15	30
FP246	<2	N	N	<10	N	N	200	N	N	10	70
FP247	<2	N	N	N	N	N	300	N	N	10	50
FP249	3	N	N	N	N	N	150	N	N	15	50
FP250	<2	N	N	10	N	N	300	N	N	10	30
FP252	N	N	N	N	N	N	500	N	N	N	20
FP344	<2	N	N	<10	N	N	150	N	N	10	20
FP345	<2	N	N	N	N	N	100	N	N	10	50
FP346	3	N	N	N	N	N	300	N	N	15	70
FP443	N	N	N	N	N	N	200	N	N	<10	<20
FP444	N	N	N	<10	N	N	100	N	N	10	20
FP445	N	N	N	N	N	N	500	N	N	10	50
FP447	N	N	N	N	N	N	200	N	N	10	50
FP448	N	N	N	<10	N	N	200	N	N	10	70

TABLE 3. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.--Continued

Sample	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
FP032	N	N	N	500	50	N	1,000	N	>2,000	N
FP035	N	N	500	500	700	700	300	700	>2,000	N
FP063	N	N	N	N	50	N	1,500	N	>2,000	N
FP064	N	N	N	500	50	N	200	N	>2,000	1,000
FP065	N	N	N	500	70	N	500	N	>2,000	300
FP066	N	N	N	500	50	N	300	N	>2,000	<200
FP068	N	N	N	500	50	N	500	N	>2,000	N
FP069	N	N	N	500	100	N	1,000	N	>2,000	N
FP070	N	N	N	500	70	N	700	N	>2,000	<200
FP071	N	N	N	500	70	N	500	N	>2,000	700
FP072	N	N	N	N	70	N	700	N	>2,000	300
FP073	N	N	N	500	70	N	700	N	>2,000	N
FP154	N	10	N	N	50	N	1,500	N	>2,000	N
FP155	N	50	N	N	100	N	1,000	N	>2,000	200
FP156	N	N	N	500	50	N	500	N	>2,000	200
FP157	N	N	N	500	70	N	500	N	>2,000	N
FP244	N	N	N	700	50	N	500	N	>2,000	N
FP245	N	N	N	500	50	N	500	N	>2,000	<200
FP246	N	N	N	700	50	N	500	N	>2,000	N
FP247	N	N	N	500	30	N	1,000	N	>2,000	N
FP249	N	N	N	500	20	N	700	N	>2,000	N
FP250	N	N	N	500	50	N	700	N	>2,000	200
FP252	N	N	N	700	50	N	500	N	>2,000	N
FP344	N	N	N	500	70	N	500	N	>2,000	N
FP345	N	N	N	500	20	N	200	N	>2,000	N
FP346	N	20	N	500	30	N	1,000	N	>2,000	N
FP443	N	N	N	1,000	50	N	300	N	>2,000	<200
FP444	N	N	50	500	30	N	200	N	>2,000	N
FP445	N	N	N	500	70	N	1,000	N	>2,000	N
FP447	N	<10	N	500	50	N	1,000	N	>2,000	<200
FP448	N	<10	N	N	30	N	1,000	N	>2,000	N

TABLE 4. RESULTS OF ANALYSES OF ROCK SAMPLESS FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.

[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
FP030A	35 6 59	114 9 21	.70	.15	.30	.150	300	N	N	N	<10	500	1.5
FP030B	35 6 59	114 9 22	.50	<.02	.05	.007	30	N	N	N	<10	30	N
FP031A	35 6 54	114 59 8	.30	.07	.30	.030	100	N	N	N	10	150	3.0
FP031B	35 6 54	114 59 7	5.00	7.00	3.00	.700	700	N	N	N	<10	1,000	1.5
FP031C	35 6 54	114 59 9	2.00	1.50	2.00	.500	200	N	N	N	<10	1,000	1.5
FP032	35 5 31	115 0 3	2.00	.70	1.50	.300	300	N	N	N	<10	700	3.0
FP033A	35 6 16	115 5 4	2.00	.30	2.00	.150	300	5.0	N	15	<10	300	1.5
FP033B	35 6 7	115 4 48	.70	.15	15.00	.030	700	<.5	N	N	<10	150	1.5
FP033C	35 6 8	115 4 46	1.00	.20	.30	.150	200	<.5	N	N	<10	500	1.5
FP033D	35 5 45	115 5 5	1.50	.15	.30	.150	150	2.0	N	N	<10	500	1.5
FP034A	35 0 42	115 2 15	.70	<.02	<.05	.003	30	20.0	N	N	<10	70	1.5
FP034B	35 0 42	115 2 14	.20	.07	1.50	.020	100	.5	N	N	<10	200	1.5
FP035A	35 1 29	115 2 0	3.00	<.02	<.05	.030	150	150.0	N	N	<10	100	1.5
FP035B	35 1 31	115 2 0	7.00	<.02	.15	.010	30	500.0	N	15	<10	300	1.0
FP035C	35 1 40	115 1 58	.50	.10	<.05	.030	100	7.0	N	N	<10	200	2.0
FP035D	35 2 55	115 2 45	1.50	.10	1.50	.030	300	5.0	N	N	<10	150	1.5
FP035E	35 3 9	115 2 50	.70	.07	.15	.030	500	50.0	N	N	<10	150	1.5
FP062	35 5 3	114 58 39	3.00	3.00	3.00	.500	700	N	N	N	<10	500	1.0
FP064	35 8 29	115 1 5	.30	.03	.20	.020	70	N	N	N	10	100	3.0
FP066B	35 15 14	115 3 30	1.00	1.50	2.00	.150	300	N	N	N	<10	500	1.5
FP067A	35 16 40	115 5 10	.15	.03	3.00	.007	300	2.0	N	N	<10	70	1.5
FP067B	35 16 41	115 5 10	.30	.15	.30	.050	100	.7	N	N	<10	150	2.0
FP069	35 6 53	114 58 40	5.00	.50	.30	.030	1,500	15.0	N	N	<10	300	N
FP070	35 6 59	114 59 10	2.00	1.50	.70	.300	100	N	N	N	<10	700	1.5
FP073	35 15 36	114 58 15	2.00	.15	.30	.300	300	N	N	N	<10	700	1.5
FP153	35 6 48	114 59 15	3.00	.70	1.50	.300	300	N	N	N	<10	700	1.5
FP154	35 5 46	114 58 22	1.50	.70	.70	.300	300	N	N	N	<10	300	1.5
FP158	35 16 46	115 6 17	.30	.03	.15	.030	70	N	N	N	15	<20	1.5
FP159A	35 16 57	115 6 7	.30	.03	.10	.030	20	N	N	N	15	<20	1.5
FP160	35 16 43	115 6 20	.15	.05	.10	.015	10	N	N	N	10	<20	N
FP247	35 13 57	114 58 57	5.00	.15	.05	.070	70	N	N	N	10	150	3.0
FP251	35 10 7	114 58 55	2.00	1.50	2.00	.300	300	N	N	N	<10	700	1.0
FP448A	35 11 20	114 58 29	2.00	.30	3.00	.300	300	N	N	N	<10	700	1.5
FP448B	35 11 20	114 58 30	1.50	.15	.15	.300	70	N	N	N	<10	500	2.0
FP448C	35 11 20	114 58 31	.70	.07	.15	.150	150	N	N	N	<10	300	N
FP1-1	35 16 40	115 5 10	.30	.15	15.00	.002	7,000	5.0	N	N	N	700	1.5
FP1-2	35 16 40	115 5 10	.70	.15	15.00	<.002	10,000	7.0	N	N	N	500	3.0
FP1-5	35 17 5	115 6 20	.15	.05	.15	.030	300	.7	N	N	10	70	1.5
FP1-6	35 17 5	115 6 20	.20	.02	<.05	.020	100	<.5	N	N	<10	50	N
FP2-1	35 19 45	115 2 30	.50	.15	.15	.070	150	.7	N	N	<10	150	5.0
FP448D	35 11 20	114 58 32	.10	.02	.50	.020	100	15.0	N	N	10	150	150.0

TABLE 4. RESULTS OF ANALYSES OF ROCK SAMPLESS FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.--Continued

Sample	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s
FP030A	N	N	<5	<10	5	30	N	<20	<5	20	N	<5	N	150
FP030B	N	N	N	<10	30	N	15	<20	<5	N	N	N	N	<100
FP031A	N	N	N	<10	<5	30	<5	<20	<5	15	N	N	N	<100
FP031B	N	N	20	150	30	50	N	<20	70	10	N	20	N	1,000
FP031C	N	N	7	20	15	50	N	<20	15	10	N	15	N	1,000
FP032	N	N	7	<10	7	70	N	<20	<5	20	N	7	N	300
FP033A	N	N	5	15	300	30	N	<20	5	1,000	N	7	N	100
FP033B	N	70	N	10	100	30	<5	N	<5	1,000	N	7	N	<100
FP033C	N	N	<5	<10	30	70	N	<20	<5	300	N	7	N	150
FP033D	150	30	7	<10	2,000	50	30	<20	<5	150	150	5	N	150
FP034A	100	N	N	<10	700	N	70	N	<5	300	N	N	N	<100
FP034B	N	N	N	<10	10	30	5	<20	<5	50	N	N	N	150
FP035A	70	N	N	<10	700	N	50	<20	<5	3,000	700	N	N	100
FP035B	100	50	<5	<10	1,000	N	150	<20	<5	7,000	3,000	N	N	<100
FP035C	N	N	N	<10	300	N	N	<20	<5	70	N	N	N	<100
FP035D	50	N	N	<10	700	N	<5	<20	<5	150	100	N	N	<100
FP035E	70	N	N	<10	300	N	15	<20	<5	500	500	N	N	<100
FP062	N	N	15	15	30	70	N	<20	20	15	N	15	N	700
FP064	N	N	N	<10	<5	30	5	<20	<5	15	N	N	N	<100
FP066B	N	N	5	10	30	30	N	<20	5	10	N	7	N	300
FP067A	N	N	<5	<10	7	N	N	<20	<5	N	N	N	N	<100
FP067B	N	N	<5	<10	7	30	N	20	<5	15	N	<5	N	150
FP069	<10	N	10	30	7,000	N	N	<20	15	10,000	N	5	N	<100
FP070	N	N	7	15	30	30	N	<20	7	150	N	7	N	2,000
FP073	N	N	<5	<10	15	150	<5	20	<5	30	N	7	N	150
FP153	N	N	10	<10	20	50	N	<20	10	15	N	7	N	1,500
FP154	N	N	5	<10	7	70	N	<20	<5	20	N	7	N	300
FP158	N	N	N	<10	<5	30	N	20	<5	20	N	N	N	<100
FP159A	N	N	N	<10	<5	N	N	20	<5	20	N	N	N	<100
FP160	N	N	N	<10	<5	30	N	<20	<5	15	N	N	N	<100
FP247	N	N	<5	<10	<5	70	<5	<20	5	20	N	7	N	<100
FP251	N	N	10	15	15	50	N	<20	15	15	N	7	N	700
FP448A	N	N	<5	<10	15	150	N	30	<5	10	N	15	N	700
FP448B	N	N	<5	<10	7	70	N	<20	<5	15	N	7	N	150
FP448C	N	N	<5	<10	<5	30	N	<20	<5	15	N	<5	N	150
FP1-1	N	N	7	<10	30	N	15	N	20	15	N	N	N	150
FP1-2	N	N	15	<10	30	30	20	N	30	15	N	N	N	300
FP1-5	N	N	<5	150	15	30	15	<20	500	30	300	N	N	150
FP1-6	N	N	N	<10	10	30	15	<20	<5	70	200	N	N	150
FP2-1	N	N	7	15	10	30	N	30	5	50	N	<5	N	<100
FP448D	N	N	N	<10	5	N	N	N	5	15	N	N	N	100

TABLE 4. RESULTS OF ANALYSES OF ROCK SAMPLESS FROM THE FORT PIUTE WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA.--Continued

Sample	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	Au-ppm aa	Hg-ppm aa	As-ppm icp	Zn-ppm icp	Cd-ppm icp	Bi-ppm icp	Sb-ppm icp
FP030A	15	N	20	N	150	N	<.1	--	<5	22	<.1	<2	<2
FP030B	<10	N	N	N	10	N	<.1	---	<5	3	<.1	<2	<2
FP031A	<10	N	15	N	70	N	<.1	--	17	5	<.1	<2	4
FP031B	200	N	15	N	150	N	<.1	--	<5	28	.9	<2	3
FP031C	150	N	15	N	150	N	<.1	--	13	28	.5	<2	<2
FP032	70	N	30	N	150	N	<.1	--	<5	60	.5	<2	2
FP033A	30	N	20	300	100	N	73.0	--	12	310	4.3	<2	<2
FP033B	30	N	30	300	70	N	4.4	--	<5	410	79.0	<2	<2
FP033C	30	N	15	N	200	N	<.1	--	<5	170	3.1	<2	<2
FP033D	30	N	15	700	300	N	12.0	--	100	1,100	24.0	200	210
FP034A	15	N	N	500	20	N	.3	--	9	280	1.0	140	21
FP034B	10	N	<10	N	30	N	<.1	--	<5	17	.3	<2	3
FP035A	150	100	N	1,000	30	N	1.3	--	66	690	5.1	81	160
FP035B	30	N	N	700	15	N	38.0	--	270	370	13.0	95	1,600
FP035C	<10	N	N	700	30	N	<.1	--	<5	380	.3	<2	35
FP035D	15	200	<10	300	70	N	<.1	--	28	190	2.4	85	95
FP035E	30	500	<10	N	30	N	.4	--	180	47	3.8	61	160
FP062	100	N	15	N	150	N	<.1	--	<5	39	.7	<2	21
FP064	<10	N	10	N	30	N	<.1	--	53	6	.2	<2	12
FP066B	30	N	15	N	100	N	<.1	--	<5	12	.2	<2	7
FP067A	<10	N	<10	N	30	N	11.0	--	8	10	.3	<2	5
FP067B	20	N	10	N	70	N	<.1	--	25	13	.3	<2	8
FP069	15	N	<10	300	30	N	<.1	--	81	170	1.2	4	25
FP070	30	N	15	N	100	N	<.1	--	<5	56	.5	<2	7
FP073	50	N	50	N	200	N	<.1	--	36	58	.5	<2	8
FP153	70	N	15	N	150	N	<.1	--	13	61	.7	<2	3
FP154	50	N	20	N	150	N	<.1	--	<5	59	.4	<2	4
FP158	<10	N	15	N	70	N	<.1	--	<5	5	<.1	<2	3
FP159A	<10	N	10	N	70	N	<.1	--	15	5	<.1	<2	3
FP160	<10	N	30	N	30	N	<.1	--	<5	30	<.1	<2	<2
FP247	15	N	<10	N	70	N	<.1	--	190	82	.8	<2	42
FP251	100	N	<10	N	100	N	<.1	--	<5	38	.3	<2	5
FP448A	50	N	70	N	300	N	<.1	--	<5	11	.2	<2	2
FP448B	30	N	20	N	150	N	<.1	--	8	27	.2	<2	3
FP448C	30	N	N	N	150	N	<.1	--	<5	<2	.2	<2	3
FP1-1	50	N	<10	N	N	N	.4	1.80	68	57	.8	<2	10
FP1-2	70	N	15	N	N	N	1.8	3.00	218	208	3.0	<2	29
FP1-5	<10	N	10	N	50	N	<.1	.03	49	10	.2	<2	7
FP1-6	<10	N	<10	N	30	N	<.1	.02	37	5	.1	<2	8
FP2-1	15	N	15	N	100	N	<.1	.24	14	14	.1	<2	5
FP448D	<10	N	<10	N	<10	N	8.0	--	--	--	--	--	--

TABLE 5.--Description of rock samples

[O = outcrop; S = stream cobble; D = mine dump; F = float]

FP 030A	O	Granite; pegmatitic quartz
30B	O	Fe-stained quartz
31A	S	Rhyolitic stream cobbles
31B	S	Andesite, pyritic(?)
31C	O	Andesite, pyroclastic
32	S	Composite granitic rocks
33A	O	Rattlesnake gold mine vein
33B	O	Rattlesnake gold mine sericitic quartz veins
33C	O	Rattlesnake gold mine Fe-stained quartz
33D	D	Copper-stained felsic volcanic
34A	D	Fe, Cu, Mo sulfides in quartz veins
34B	D	Brecciated quartz vein
35A	D	Signal Hill mines composite sample, mineralized
35B	D	Signal Hill mines composite sample, mineralized
35C	D	Signal Hill mines quartz and chloritic granite
35D	D	Sericitic quartz veins
35E	D	Quartz veins
62	O	Volcanic tuff-breccia
64	S	Volcanic breccia
66B	F	Disseminated pyrite in andesite
67A	D	Quartz vein, platy
67B	D	Volcanic breccia
69	D	Cu ore pile--source unknown
70	O	Volcanic breccia, bright colored
73	S	Fe-stained; granitic
153	O	Volcanic breccia, bright colored
154	S	Red-black, biotite-rich; granitic
158	O	Chalcedony
159A	O	Tuff--open pit mine
160	O	Kaolinite--open pit mine
247	S	Gossan
251	O	Granitic rock--dark vug
448A	S	Propylitically altered intrusive(?)
448B	S	Altered intrusive(?)
448C	S	Silicified rhyolite
448D	S	Brecciated quartz
1-1	D	Propylitically altered limestone
1-2	D	Propylitically altered quartzite
1-5	D	Propylitically altered chert
1-6	D	Propylitically altered chert
2-1	O	Propylitically altered chert