UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of heavy-mineral-concentrate samples from the Jacumba/In-Ko-Pah Mountains Wilderness Study Area (CDCA 368), Imperial County, California

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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 mineral survey of the Jacumba/In-Ko-Pah Mountains Wilderness Study Area, California Desert Conservation Area, Imperial County, California.

INTRODUCTION

In April, 1984, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Jacumba/In-Ko-Pah Mountains Wilderness Study Area (WSA) Imperial County, California.

The Jacumba/In-Ko-Pah Mountains WSA comprises about 43 mi^2 (22,802 acres) in the southwest corner of Imperial County, California, and lies about 25 mi west of El Centro (see figure 1). Access to the study area is limited to sandy unpaved and 4-wheeldrive roads which run along the periphery of the Wilderness Study Area and traverse its interior through Davies Valley. These unimproved roads may be accessed at several locations off Interstate 8 which passes north and west of the study area.

The Wilderness Study Area is underlain by crystalline rocks of a post-tectonic batholith system which extends over much of southern and Baja California. These rocks are overlain by Tertiary volcanic and sedimentary deposits. Recent alluvial deposits locally cover the older units. The most prominent structural feature within the study area is the southernmost extension of the Elsinore Fault.

The study area is bordered by low desert terrain (Yuha Basin) to the east and high coastal chaparral on the west. Topographic relief is great, rising from roughly 600 feet along the eastern length of the study area, to over 4,000 feet at the summit of several peaks near the southwestern edge of the WSA. The major topographic feature in the study area is Davies Valley, which bisects the proposed wilderness in a north-south direction. The climate is arid to semiarid, with a wide range in temperatures. Desert vegetation is abundant.

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 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.

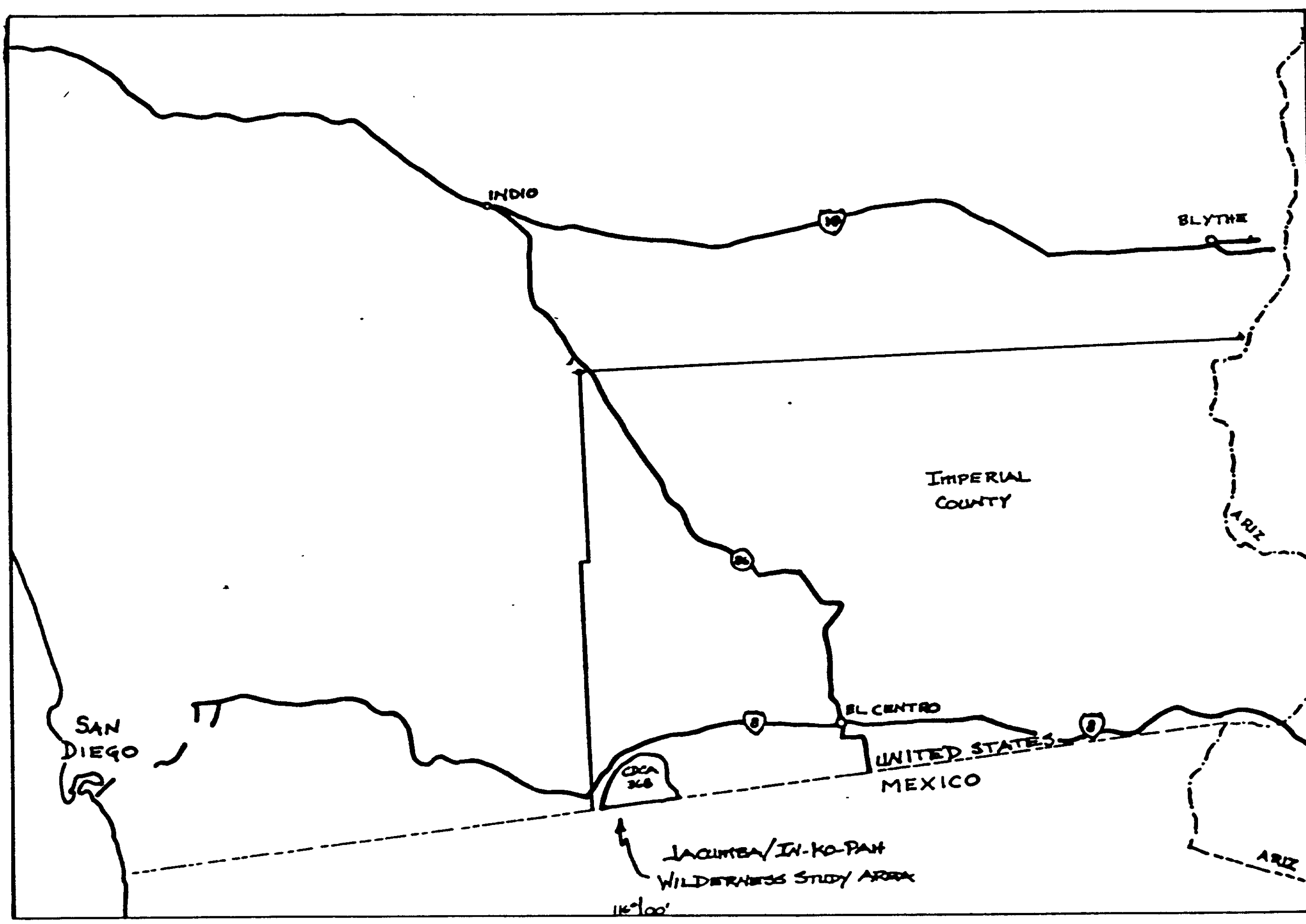

Figure 1. Location map of the Jacumba/In-Ko-Pah Mountains Wilderness Study Area, Imperial County, California.

Sample Collection

Samples were collected at 47 sites (plate 1). At all of those sites heavy-mineral-concentrate samples were collected. Sampling density was about 1 sample site per square mile for the heavy-mineral concentrates. The area of the drainage basins sampled ranged from .5 mi^2 to 4 mi^2.

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples consisted of active alluvium collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on the USGS topographic maps (scale = 1:62,500). 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

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 analysis/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 0.1 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 heavy-mineral-concentrate samples were analyzed for 30 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 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 Jacumba/In Ko Pa Mountains Wilderness Study Area are listed 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, 1976).

DESCRIPTION OF DATA TABLES

Table 2 lists the analyses for the samples of heavy-mineral concentrate. For the table, 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. 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 table 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 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, 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.

REFERENCES CITED

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.

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.

VanTrump, George, Jr., and Miesch, A. T., 1976, 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 heavy-mineral concentrates based on a 10-mg sample

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	.1	50
Magnesium (Mg)	.05	20
Calcium (Ca)	.1	50
Titanium (Ti)	.005	2
	Parts per million	
Manganese (Mn)	20	10,000
Silver (Ag)	1	10,000
Arsenic (As)	500	20,000
Gold (Au)	20	1,000
Boron (B)	20	5,000
Barium (Ba)	50	10,000
Beryllium (Be)	2	2,000
Bismuth (Bi)	20	2,000
Cadmium (Cd)	50	1,000
Cobalt (Co)	10	5,000
Chromium (Cr)	20	10,000
Copper (Cu)	10	50,000
Lanthanum (La)	50	2,000
Molybdenum (Mo)	10	5,000
Niobium (Nb)	50	5,000
Nickel (Ni)	10	10,000
Lead (Pb)	20	50,000
Antimony (Sb)	200	20,000
Tin (Sn)	20	2,000
Strontium (Sr)	200	10,000
Vanadium (V)	20	20,000
Tungsten (W)	100	20,000
Yttrium (Y)	20	5,000
Zinc (Zn)	500	20,000
Zirconium (Zr)	20	2,000
Thorium (Th)	200	5,000

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, 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
JB300	32 37 25	116 4 46	.3	.10	20	>2	1,000	50	N	300	20
JB301	32 38 5	116 3 56	.3	.10	50	>2	2,000	N	N	N	70
JB302	32 40 47	115 57 0	.2	.70	20	>2	1,000	N	N	N	30
JB303	32 39 35	115 56 12	.2	.70	7	>2	700	N	N	N	30
JB304	32 39 27	115 55 49	.3	1.00	20	>2	1,000	N	N	N	50
JB305	32 41 55	115 57 38	.5	.50	20	>2	1,000	N	N	N	70
JB306	32 40 8	116 2 57	.2	.10	20	>2	700	N	N	N	20
JB307	32 40 46	116 3 10	.2	.30	30	>2	1,000	N	N	N	20
JB308	32 41 56	115 59 16	.2	.70	15	>2	700	N	N	N	20
JB309	32 41 19	115 59 15	.3	.30	30	>2	700	N	N	N	20
JB310	32 40 58	115 58 41	.2	.50	15	>2	700	N	N	N	50
JB311	32 39 2	115 57 17	.2	10.00	20	>2	1,000	N	N	N	70
JB312	32 39 17	115 58 23	.2	.50	10	>2	500	N	N	N	30
JB313	32 39 56	115 58 26	.2	.50	10	>2	700	N	N	N	50
JB315	32 39 51	116 4 20	.2	.07	30	>2	1,500	N	N	N	20
JB316	32 42 27	116 1 26	.3	.15	20	>2	1,500	N	N	N	70
JB317	32 43 6	116 1 18	.3	.20	20	>2	1,000	5	N	N	30
JB318	32 42 8	115 59 36	.5	.30	10	>2	300	N	N	N	50
JB319	32 41 56	116 0 23	.3	.10	20	>2	1,000	N	N	N	20
JB320	32 41 47	115 59 37	.5	.50	15	>2	500	N	N	N	30
JB321	32 40 56	116 1 42	.5	.50	30	>2	1,500	N	N	N	20
JB322	32 39 52	116 1 11	.7	1.00	30	>2	1,000	N	N	N	150
JB323	32 38 28	116 3 4	.3	.10	20	>2	1,000	N	N	N	30
JB324	32 38 48	116 2 29	.5	.15	20	>2	700	N	N	N	20
JB325	32 38 52	116 2 18	.5	.20	20	>2	700	N	N	N	50
JB326	32 38 17	116 1 5	.3	.50	30	>2	1,500	N	N	N	20
JB327	32 40 5	115 58 18	.7	1.50	50	>2	500	N	N	N	20
JB400	32 38 33	116 4 41	.1	.05	20	>2	1,500	N	N	N	20
JB401	32 38 31	116 4 45	.2	.07	30	>2	1,500	N	N	N	20
JB402	32 40 31	115 57 8	.2	1.00	15	>2	700	N	N	N	30
JB403	32 39 35	115 56 12	.3	5.00	20	>2	1,000	N	N	N	100
JB404	32 38 33	115 55 25	.1	1.00	10	>2	500	N	N	N	100
JB405	32 41 33	115 57 25	.7	.50	10	>2	1,000	N	N	N	70
JB406	32 40 25	116 2 38	.5	.10	10	>2	700	N	N	N	70
JB407	32 41 53	116 3 15	.7	.15	20	>2	1,000	N	N	N	20
JB408	32 41 33	115 59 3	.5	.70	15	>2	1,000	N	N	N	100
JB409	32 41 25	115 59 8	.7	.70	10	>2	1,000	N	N	N	150
JB410	32 40 8	115 58 57	.3	.30	10	>2	700	N	N	N	50
JB411	32 39 17	115 58 20	.3	1.00	15	>2	1,000	N	N	N	30
JB412	32 39 54	115 58 23	.5	1.50	15	>2	1,000	N	N	N	50
JB413	32 39 52	116 4 34	.3	.10	30	>2	1,500	N	N	N	20
JB414	32 42 38	116 1 42	1.0	.30	20	>2	1,500	N	N	N	20
JB415	32 42 42	116 0 56	.7	.20	20	>2	1,000	N	N	N	30
JB416	32 42 6	115 58 13	.5	.30	15	>2	700	N	N	N	20
JB417	32 41 28	116 1 52	.3	.10	20	>2	1,000	N	N	N	20

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, CALIFORNIA.--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
JB300	200	<2	300	N	10	500	10	50	50	200	N
JB301	700	N	N	N	N	50	N	2,000	70	50	50
JB302	7,000	<2	N	N	10	500	N	200	N	500	N
JB303	>10,000	2	N	N	N	200	N	100	N	200	10
JB304	5,000	<2	N	N	N	150	N	150	N	150	N
JB305	>10,000	<2	N	N	15	700	<10	100	N	500	10
JB306	2,000	<2	N	N	N	70	N	300	N	100	N
JB307	1,500	<2	N	N	10	100	N	200	N	100	N
JB308	10,000	<2	N	N	10	150	N	100	N	150	N
JB309	1,500	N	N	N	10	100	N	300	N	100	N
JB310	>10,000	N	N	N	10	200	N	100	N	300	N
JB311	7,000	<2	N	N	10	150	N	100	N	150	10
JB312	5,000	<2	N	N	10	100	N	50	N	150	15
JB313	10,000	<2	N	N	10	500	N	50	N	500	15
JB315	1,000	<2	N	N	N	50	N	1,000	N	<50	N
JB316	1,500	N	N	N	10	70	20	500	N	50	N
JB317	1,000	<2	N	N	10	70	N	300	N	100	N
JB318	>10,000	<2	N	N	10	50	N	100	N	100	10
JB319	700	<2	N	N	15	70	N	200	N	100	N
JB320	3,000	2	N	N	N	70	N	100	N	70	10
JB321	2,000	<2	N	N	20	100	N	300	N	100	N
JB322	1,500	<2	N	N	10	100	N	300	N	100	N
JB323	1,500	<2	N	N	10	70	N	300	N	100	N
JB324	1,000	<2	N	N	15	50	N	1,500	N	70	N
JB325	1,000	<2	N	N	10	100	N	200	50	150	20
JB326	700	<2	N	N	10	70	N	500	N	100	N
JB327	1,500	5	N	N	10	300	70	100	N	100	15
JB400	500	N	N	N	10	N	N	200	N	N	15
JB401	300	N	N	N	10	50	N	300	N	200	N
JB402	5,000	<2	N	N	10	200	N	100	N	500	N
JB403	5,000	<2	N	N	10	200	N	150	N	300	N
JB404	3,000	2	N	N	10	150	N	500	N	150	15
JB405	>10,000	<2	N	N	15	300	10	100	N	700	10
JB406	1,000	<2	N	N	15	50	N	700	N	200	N
JB407	700	<2	N	N	15	70	N	500	30	150	N
JB408	5,000	<2	N	N	10	150	20	200	N	500	N
JB409	3,000	<2	N	N	10	200	N	1,500	N	700	10
JB410	5,000	<2	N	N	10	200	N	100	N	1,000	N
JB411	3,000	<2	N	N	10	150	N	200	20	300	10
JB412	5,000	2	N	N	10	300	N	200	10	700	10
JB413	700	<2	N	N	10	70	N	300	30	200	N
JB414	700	2	N	N	10	100	N	300	N	300	N
JB415	700	<2	N	N	15	100	N	500	N	200	N
JB416	>10,000	<2	N	N	20	500	N	100	N	1,500	N
JB417	1,000	2	N	N	15	50	N	500	N	150	N

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, CALIFORNIA.--Continued

Sample	Pb-ppm s	Sb-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
JB300	50	N	300	N	500	>20,000	500	N	2,000	N
JB301	N	N	N	200	100	1,000	2,000	N	>2,000	<200
JB302	200	N	150	700	500	1,500	500	N	>2,000	N
JB303	30	N	100	1,000	700	200	300	N	>2,000	300
JB304	3,000	N	N	500	300	150	700	N	>2,000	N
JB305	700	N	200	1,000	700	5,000	500	N	>2,000	N
JB306	30	N	20	500	200	2,000	700	N	>2,000	<200
JB307	50	N	20	500	100	200	1,000	N	>2,000	N
JB308	7,000	N	N	500	300	<100	300	N	>2,000	N
JB309	1,000	N	100	N	200	100	700	N	>2,000	<200
JB310	500	N	70	500	500	1,500	300	N	>2,000	<200
JB311	N	N	100	N	300	N	500	N	>2,000	N
JB312	N	N	20	500	300	100	700	N	>2,000	700
JB313	70	N	100	500	700	200	500	N	>2,000	N
JB315	N	N	N	500	70	N	1,500	N	>2,000	<200
JB316	200	N	70	300	200	N	200	N	>2,000	N
JB317	200	N	100	N	200	N	300	N	>2,000	<200
JB318	50	N	N	700	100	N	200	N	>2,000	200
JB319	500	N	50	N	200	N	500	N	>2,000	N
JB320	N	N	<20	1,000	100	N	300	N	>2,000	N
JB321	N	N	70	N	200	N	500	N	>2,000	N
JB322	5,000	N	70	N	200	2,000	700	N	>2,000	N
JB323	20	N	N	500	200	N	1,000	N	>2,000	500
JB324	30	N	20	700	200	N	1,000	N	>2,000	500
JB325	30	N	100	700	300	N	500	N	>2,000	1,000
JB326	300	N	50	500	200	100	1,000	N	>2,000	N
JB327	700	N	200	700	200	N	200	N	>2,000	N
JB400	20	N	N	N	100	1,000	1,000	500	>2,000	N
JB401	70	N	100	N	200	N	700	N	>2,000	N
JB402	300	N	70	500	500	1,000	300	N	>2,000	<200
JB403	100	N	70	200	200	N	300	N	>2,000	N
JB404	N	N	N	700	500	100	200	N	>2,000	<200
JB405	N	N	50	>10,000	700	500	200	N	>2,000	N
JB406	20	N	50	500	300	N	500	N	>2,000	1,000
JB407	20	N	100	500	200	N	700	N	>2,000	N
JB408	500	N	150	700	500	N	300	N	>2,000	N
JB409	20	N	70	500	500	500	700	N	>2,000	300
JB410	N	N	50	N	700	2,000	200	N	>2,000	N
JB411	N	N	70	N	500	200	700	N	>2,000	500
JB412	N	N	100	200	700	200	300	N	>2,000	300
JB413	20	N	100	200	200	N	1,000	N	>2,000	N
JB414	20	N	150	200	200	N	500	N	>2,000	N
JB415	30	N	100	200	300	N	500	N	>2,000	N
JB416	N	N	100	700	700	5,000	300	N	>2,000	<200
JB417	N	N	150	200	200	N	300	N	>2,000	N

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, CALIFORNIA.--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
JB418	32 40 28	116 1 36	1.0	1.00	20	>2	1,000	N	N	N	20
JB419	32 39 18	116 0 53	.5	2.00	20	>2	1,000	N	N	N	30
JB420	32 37 38	116 1 56	.5	.10	15	>2	700	N	N	N	30
JB421	32 38 28	116 1 45	.3	.20	30	>2	1,500	N	N	N	20
JB422	32 38 21	116 1 2	.5	2.00	20	>2	700	N	N	N	20
JB423	32 38 6	116 0 59	.3	.50	20	>2	1,000	N	N	N	50
JB424	32 37 44	116 0 14	.5	.30	30	>2	1,000	N	N	N	30

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, CALIFORNIA.--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
JB418	3,000	<2	N	N	20	100	N	300	N	100	N
JB419	>10,000	2	N	N	10	150	N	100	10	150	10
JB420	1,000	<2	N	N	10	50	N	1,000	20	150	N
JB421	1,500	2	N	N	10	150	N	300	N	200	10
JB422	2,000	2	N	N	10	150	N	200	N	150	10
JB423	5,000	2	N	N	10	100	N	200	20	100	30
JB424	3,000	2	N	N	10	150	N	500	N	200	20

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE JACUMBA/IN-KO-PAH MTNS WILDERNESS STUDY AREA, CALIFORNIA.--Continued

Sample	Pb-ppm s	Sb-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
JB418	N	N	150	N	200	N	700	N	>2,000	N
JB419	100	N	100	700	300	N	1,000	N	>2,000	N
JB420	30	N	70	700	500	N	500	N	>2,000	1,000
JB421	N	N	30	700	300	200	1,000	N	>2,000	N
JB422	100	N	30	700	300	N	500	N	>2,000	500
JB423	N	N	20	700	150	N	1,000	N	>2,000	N
JB424	200	N	70	700	300	300	1,000	N	>2,000	300