UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of stream-sediment and panned-concentrate samples from the Baboquivari Peak Wilderness Study Area, Pima County, Arizona

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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 Baboquivari Peak Wilderness Study Area, Pima County, Arizona.

INTRODUCTION

In April, 1986, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Baboquivari Peak Wilderness Study Area, Pima County, Arizona (Adrian and others, 1987). Because many of the panned-concentrate samples were found to contain anomalous concentrations of gold and silver, additional samples were collected in March, 1987, mostly upstream from where the samples were collected in 1986. This present report tabulates results of analyses of the 1987 samples. The significance of the anomalous concentrations of gold and silver is discussed in another report (Nowlan, 1988).

The Baboquivari Peak Wilderness Study Area (AZ-020-203B) comprises about 3 mi^2 (8 km^2) in the southeastern part of Pima County, Arizona, and lies about 50 mi (80 km) southwest of Tucson, Arizona (see fig. 1). Access to the study area is provided on the east by state and private roads from Arizona Route 286, and on the west by Tohono O'Odham (Papago) Indian Reservation roads from Arizona Route 86.

The topographic relief in the study area is about 3,400 ft (1,036 m), with a maximum elevation of 7,734 ft (2,357 m) at the summit of Baboquivari Peak, a dramatic granite monolith that rises 500-1,000 ft above surrounding ridges and peaks. The study area lies along the east side of the crest of the Baboquivari Mountains in an area of rugged canyons, spectacular walls, and jagged outcrops of bedrock. The vegetation is mostly that of the Upper Sonoran life zone. Arizona white oak and Mexican pinyon are the dominant types of vegetation. Streams are ephemeral but may have running water for several months at a time during winter and early spring. A number of springs and wells exist outside the wilderness study area within ½ mile of the boundary and at least one spring is within the wilderness study area in Sabino Canyon. Analyses of water from springs and domestic wells on and near the Tohono O'Odham Indian Reservation were tabulated by Ficklin and others (1980, 1982).

The Baboquivari Peak Wilderness Study Area is underlain by granitic, volcanic, and sedimentary rocks of Jurassic age. The Jurassic rocks are cut by numerous Tertiary rhyolite dikes that generally trend northwest and in some cases were intruded along pre-existing faults. A reconnaissance geologic map of the Baboquivari Peak 15-minute quadrangle has been released by the U.S. Geological Survey (Haxel and others, 1980).

The Baboquivari Peak Wilderness Study Area is within the Baboquivari mining district (Keith, 1974, p. 14-17) which covers the Baboquivari and Quinlan Mountains, an area that reaches about 33 mi (53 km) from the Mexican border north to Arizona Route 86 (McDonnell, 1986). Known mineral deposits within the district consist of scattered small occurrences of gold, silver,

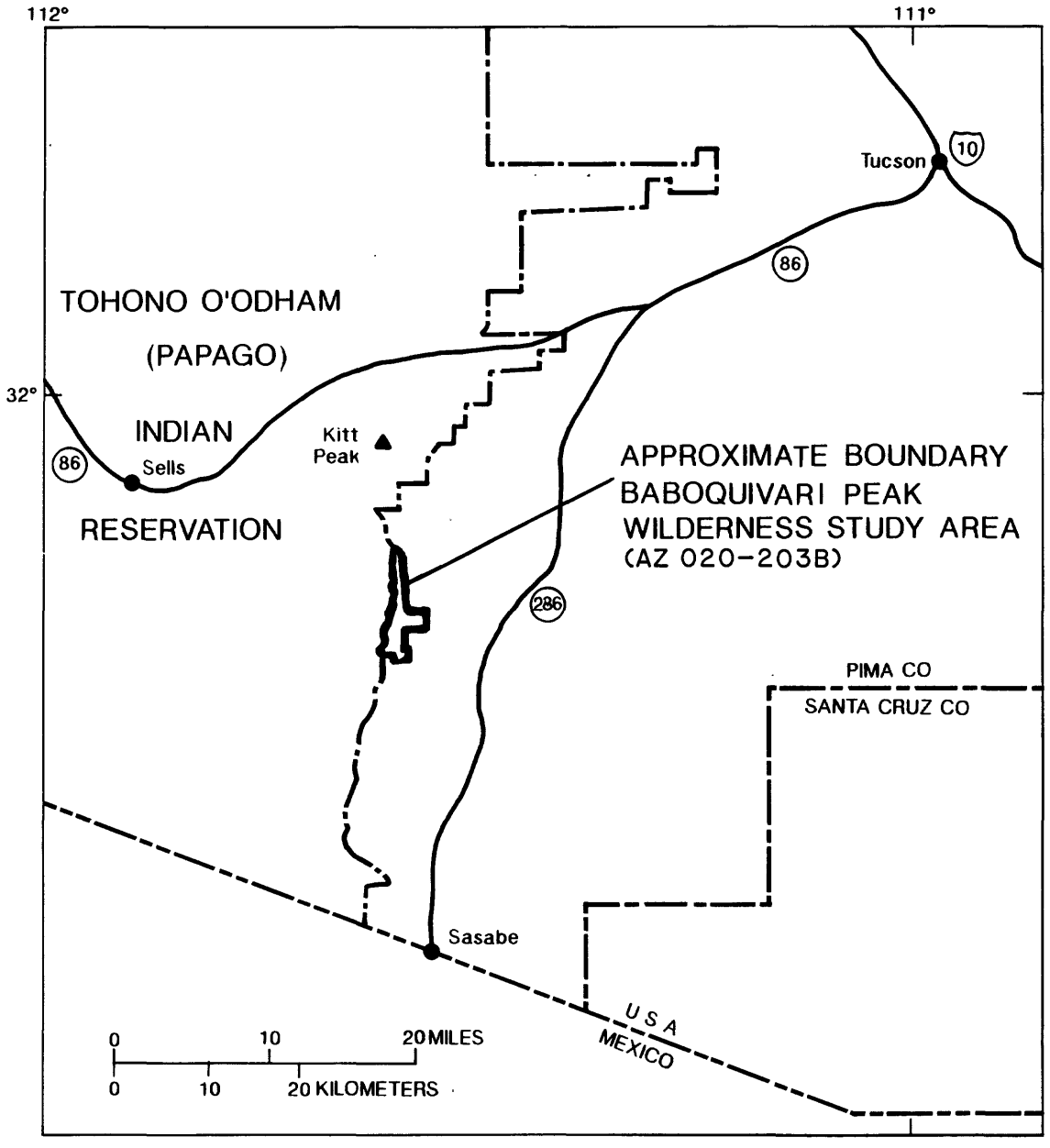

Figure 1. Index map, Baboquivari Peak Wilderness Study Area, Pima County, Arizona.

copper, lead, zinc, molybdenum, tungsten, manganese, fluorine, and beryllium. The deposits are closely associated with fault zones and swarms of intrusive dikes and sills (Keith, 1974). Keith (1969) indicates a copper occurrence in the Baboquivari Peak Wilderness Study Area. A gold-silver occurrence near the center of the wilderness study area was reported by Cruver and others (1982) and by Stipp and others (1967). These are the only reported mineral occurrences within the wilderness study area. Mining took place for many years at the Allison mine (Keith, 1974), 3 mi west, and in the Jupiter Canyon region (Seaman, 1983), 1-2 mi south of the wilderness study area. Production figures for these nearby mining areas are listed by Keith and others (1983).

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. Panned-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

Stream-sediment and panned-concentrate samples were collected at 14 sites in the Baboquivari Peak area (fig. 2).

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 as shown on USGS topographic maps (scale = 1:24,000).

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples were collected from the same active alluvium as the stream-sediment samples. 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.

Raw panned-concentrate samples

A heaping 16-inch pan (approximately 20 lb or 9 kg) of active alluvium was panned until most of the quartz, feldspar, organic material, and clay-sized material were removed.

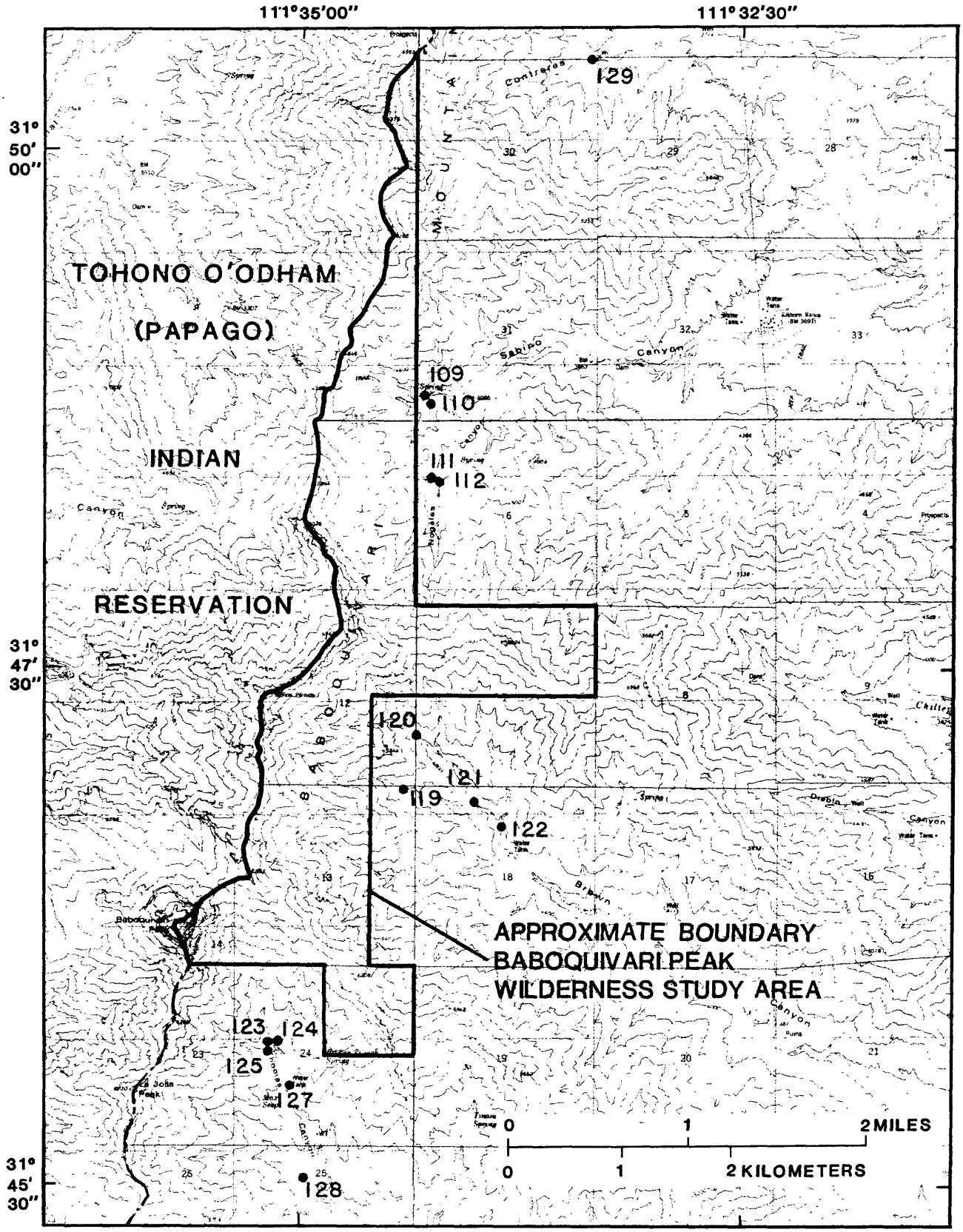

Figure 2. Localities of stream-sediment and panned-concentrate samples, Baboquivari Peak Wilderness Study Area, Pima County, Arizona. Base from U.S. Geological Survey, 1:24,000, Baboquivari Peak and Mildred Peak, 1979, quadrangles.

Sample Preparation

The stream-sediment samples were air dried, then sieved using 30-mesh (0.595-mm) stainless-steel sieves. The portion of the sediment passing through the sieve was pulverized to pass through a 100-mesh (0.15-mm) sieve and then saved for analysis.

After oven drying at about 90 °C, 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.

The raw panned-concentrate samples were dried at 90 °C and then were analyzed for gold without further preparation.

Sample Analysis

Spectrographic method

The stream-sediment and nonmagnetic heavy-mineral-concentrate samples were analyzed for 31 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. Element concentrations in the standards are geometrically spaced over any 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 (Fe, Mg, Ca, and Ti) are given in weight percent; all others are given in parts per million (micrograms/gram).

Chemical methods

Other methods of analyses were used on samples from this wilderness study area. Stream-sediment and raw panned-concentrate samples were analyzed for gold (Au) using atomic absorption spectroscopy (AA). For a more detailed summary of these other chemical methods see 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 3-5 list the results of analyses for the samples of stream sediment, nonmagnetic heavy-mineral concentrate, and raw panned concentrate, respectively. The numeric portions of the sample identifications correspond to the numbers shown on the site location maps (fig. 2). Columns in which the element headings show the letter "s" following the element symbol are emission spectrographic analyses, "aa" indicates atomic absorption analysis. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination. If an element determined 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 3-4, some of the elements listed in these tables (Fe, Mg, Ca, Ti, 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.

The spectrographic determinations for As, Au, Bi, Cd, Sb, Th, and W in stream-sediment samples, and for As, Cd, Sb, and Zn in heavy-mineral-concentrate samples were all below the lower limits of determinations shown in table 1; consequently, the columns for these elements have been deleted from tables 3 and 4, respectively.

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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 given for stream sediments]

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	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)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	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	2,000

TABLE 2.--Chemical methods used

[AA = atomic absorption spectroscopy]

Element determined	Sample type	Method	Determination limit (micrograms/ gram or ppm)	Analyst	Reference
Gold (Au)	stream sediment	AA	0.002	P. Hageman	Meier, 1980; O'Leary and Meier, 1986.
Gold (Au)	raw panned concentrate	AA	0.05*	J. Sharkey	Thompson and others, 1968; O'Leary and Meier, 1986.

*Based on a 10-g sample.

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE BABOQUIVARI PEAK WILDERNESS STUDY AREA, PIMA COUNTY, ARIZONA.

Sample	Latitude	Longitude	Fe-pct.	Mg-pct.	Ca-pct	Ti-pct.	Mn-ppm	Ag-ppm	B-ppm	Ba-ppm	Be-ppm	Co-ppm	Cr-ppm
			s	s	s	s	s	s	s	s	s	s	s
BQA109	31 48 48	111 34 18	3	1.5	.50	.2	500	N	100	500	1.0	10	100
BQA110	31 48 48	111 34 16	3	.7	.20	.2	500	N	30	500	1.5	10	70
BQA111	31 48 25	111 34 15	3	1.0	1.50	.3	700	N	30	500	1.0	15	100
BQA112	31 48 24	111 34 14	3	.7	.30	.2	500	.5	30	500	1.0	10	70
BQA119	31 46 55	111 34 25	3	1.0	2.00	.5	700	1.0	50	500	1.0	10	70
BQA120	31 47 11	111 34 20	3	1.0	.20	.3	700	.5	30	500	1.0	10	50
BQA121	31 46 51	111 34 0	3	1.0	.20	.2	700	N	30	500	1.0	20	50
BQA122	31 46 44	111 33 51	3	1.0	5.00	.2	500	N	50	500	1.0	10	30
BQA123	31 45 42	111 35 9	3	.7	.30	.3	700	N	30	300	2.0	7	50
BQA124	31 45 42	111 35 8	3	.7	.10	.2	700	N	50	300	3.0	10	70
BQA125	31 45 39	111 35 8	3	.7	.15	.7	700	N	30	300	1.0	10	50
BQA127	31 45 29	111 35 3	3	.7	.10	.2	1,000	N	20	300	1.5	10	50
BQA128	31 45 2	111 34 58	5	1.0	.15	1.0	500	N	30	500	1.0	10	100
BQA129	31 50 26	111 33 21	2	.3	.07	.2	300	N	15	500	1.0	7	<10

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE BABOQUIVARI PEAK WILDERNESS STUDY AREA, PIMA COUNTY, ARIZONA.--Continued

Sample	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Au-ppm aa
BQA109	30	50	N	<20	30	70	15	N	200	100	30	N	150	<.002
BQA110	15	30	N	<20	20	30	10	N	150	100	20	N	200	<.002
BQA111	50	70	N	<20	30	50	15	15	200	150	30	N	200	.900
BQA112	20	50	<5	<20	20	30	10	N	150	100	20	N	200	<.002
BQA119	50	70	N	<20	10	70	15	N	150	70	50	N	200	.008
BQA120	20	50	N	<20	10	70	10	N	150	100	20	<200	300	.009
BQA121	20	70	5	20	15	70	15	N	100	70	50	N	700	.550
BQA122	50	50	N	N	10	50	10	N	500	100	20	N	100	.003
BQA123	7	50	N	20	7	50	10	N	100	100	50	<200	1,000	<.002
BQA124	15	70	N	30	15	50	15	N	100	70	50	<200	300	.002
BQA125	10	70	N	30	15	50	20	N	<100	100	50	N	1,000	<.002
BQA127	20	70	N	20	15	50	15	N	<100	70	50	N	500	<.002
BQA128	10	70	<5	30	20	70	20	N	100	100	70	N	1,000	<.002
BQA129	10	30	<5	N	5	30	5	N	100	50	20	N	150	<.002

TABLE 4. RESULTS OF ANALYSES OF NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE BABOQUIVARI PEAK WILDERNESS STUDY AREA, PIMA COUNTY, ARIZONA.

[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	Au-ppm s	B-ppm s	Ba-ppm s	Be-ppm s	Bi-ppm s	Co-ppm s
BQH109	31 48 48	111 34 18	7.0	.10	2.0	2.00	300	N	N	70	5,000	3	N	100
BQH110	31 48 48	111 34 16	1.0	.15	.5	>2.00	150	N	N	50	300	3	N	N
BQH111	31 48 25	111 34 15	.7	.15	.7	>2.00	200	100	150	70	300	3	N	N
BQH112	31 48 24	111 34 14	.5	.10	2.0	2.00	500	N	N	30	<50	5	N	N
BQH119	31 46 55	111 34 25	.2	.07	.7	.20	50	N	N	30	1,500	3	N	N
BQH120	31 47 11	111 34 20	.5	.05	.7	.30	70	1,000	1,000	30	500	3	N	N
BQH121	31 46 51	111 34 0	.5	.10	.2	.15	200	1,000	700	50	500	2	N	N
BQH122	31 46 44	111 33 51	.7	.10	7.0	2.00	700	10	N	20	7,000	N	N	N
BQH123	31 45 42	111 35 9	.3	.10	.7	.30	100	N	N	30	200	3	N	N
BQH124	31 45 42	111 35 8	1.5	.20	.2	.70	300	500	500	50	500	5	N	N
BQH125	31 45 39	111 35 8	.2	.05	.5	.20	70	N	N	20	300	N	N	N
BQH127	31 45 29	111 35 3	.3	.05	.3	1.00	50	50	200	30	150	3	N	N
BQH128	31 45 2	111 34 58	.3	.07	.2	.20	70	N	N	50	1,000	<2	N	N
BQH129	31 50 26	111 33 21	.5	.05	1.0	>2.00	100	200	300	30	5,000	5	2,000	N

TABLE 4. RESULTS OF ANALYSES OF NONMAGNETIC HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE BABOQUIVARI PEAK WILDERNESS STUDY AREA, PIMA COUNTY, ARIZONA.--Continued

Sample	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zr-ppm s	Th-ppm s
BQH109	20	50	70	30	N	15	300	70	N	200	50	200	1,000	>2,000	N
BQH110	N	<10	70	N	50	20	N	100	N	200	100	N	1,500	>2,000	700
BQH111	N	<10	70	N	<50	15	N	70	N	500	100	N	1,000	>2,000	300
BQH112	N	<10	200	N	N	10	200	100	N	<200	50	N	1,500	>2,000	700
BQH119	N	N	70	N	N	20	300	70	N	200	30	N	1,500	>2,000	500
BQH120	N	N	<50	N	N	15	200	70	N	200	20	N	2,000	>2,000	200
BQH121	N	N	N	N	N	<10	300	N	N	<200	20	N	700	>2,000	<200
BQH122	<20	<10	1,000	N	N	<10	3,000	50	<20	500	100	500	700	>2,000	N
BQH123	N	N	200	N	N	15	20	50	N	<200	20	N	2,000	>2,000	700
BQH124	<20	<10	70	N	N	10	100	30	N	N	50	100	1,500	>2,000	200
BQH125	N	N	150	N	N	20	N	50	N	<200	20	N	1,500	>2,000	N
BQH127	N	N	N	N	<50	20	<20	70	N	<200	30	N	2,000	>2,000	500
BQH128	N	N	70	N	N	20	150	50	N	200	20	N	1,500	>2,000	700
BQH129	N	<10	200	N	50	10	300	100	<20	200	30	700	1,500	>2,000	700

Table 5.--Results of analyses of raw panned-concentrate samples

Sample	Latitude	Longitude	Au ppm-aa	Sample wt. (g)
BQG 109	31 48 48	111 34 18	.90	2.91
BQG 110	31 48 48	111 34 16	1.6	1.42
BQG 111	31 48 25	111 34 15	3.6	1.47
BQG 112	31 48 24	111 34 14	.70	2.96
BQG 119	31 46 55	111 34 25	2.0	1.24
BQG 120	31 47 11	111 34 20	1.7	1.67
BQG 121	31 46 51	111 34 0	.40	2.44
BQG 122	31 46 44	111 33 51	.30	5.49
BQG 123	31 45 42	111 35 9	.35	4.18
BQG 124	31 45 42	111 35 8	.45	4.84
BQG 125	31 45 39	111 35 8	.90	3.18
BQG 127	31 45 29	111 35 3	1.3	2.38
BQG 128	31 45 2	111 34 58	10.	4.25
BQG 129	31 50 26	111 33 21	1.3	2.59