UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality maps of heavy-mineral-concentrate samples from the Morongo Valley (CDCA 218) and Mecca Hills (CDCA 343) Wilderness Study Areas, San Bernardino and Riverside Counties, California

By

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Open-File Report 85-244

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

1985

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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 Morongo Valley and Mecca Hills Wilderness Study Areas, California Desert Conservation Areas, San Bernardino and Riverside Counties, California.

INTRODUCTION

In April, 1984 the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Morongo Valley and Mecca Hills Wilderness Study Areas, San Bernardino and Riverside Counties, California.

The Morongo Valley Wilderness Study Area comprises about 9.5 mi^2 in the south central part of San Bernardino County, and lies about 40 mi east of San Bernardino (fig. 1). Access to the study area is provided by State Highway 62 which passes just east of the study area. Mecca Hills Wilderness Study Area comprises about 13.5 mi^2 and lies about 5 mi north of Mecca, California (fig. 1). Access to the study area is provided by a graded dirt road off State Highway 195 which passes to the east of the study area.

The Morongo Valley Wilderness Study Area is underlain by Precambrian gneisses and granitic rocks that may represent a portion of the North American craton (Ehlig, 1981). The older rocks are intruded by a variety of Mesozoic plutonic rocks that are mostly granodiorites and quartz monzonites. These plutonic rocks contain pendants and xenoliths of Paleozoic metasedimentary rocks. Quaternary alluvial deposits locally overlie the older units (Dibblee, 1967).

The Morongo Valley Wilderness Study Area is located in the eastern part of the San Bernardino Mountains, entirely within the Morongo Valley 15-minute quadrangle. The area encompasses roughly 6,000 acres of predominately rugged terrain. Local relief is great, rising from approximately 3,200 feet along the southern periphery of the WSA to 6312 feet at the summit of an unnamed peak near the northwestern margin of the WSA. The climate is arid to semiarid with a wide range in temperatures. The WSA is flanked by Little Morongo Creek on the east and Big Morongo Creek on the west. Smith Canyon cuts across the central part of the WSA.

The Mecca Hills Wilderness Study Area is underlain by Precambrian gneisses and anorthosite. This bedrock is overlain by Pliocene-Pleistocene non-marine alluvial fan and braided flood plain deposits. The area is located along the San Andreas Fault System.

Local relief ranges from near sea level along the western margins of the study area to elevations of almost 1300 feet east of Painted Canyon which bisects the study area. The climate is arid, with a wide range in temperatures.

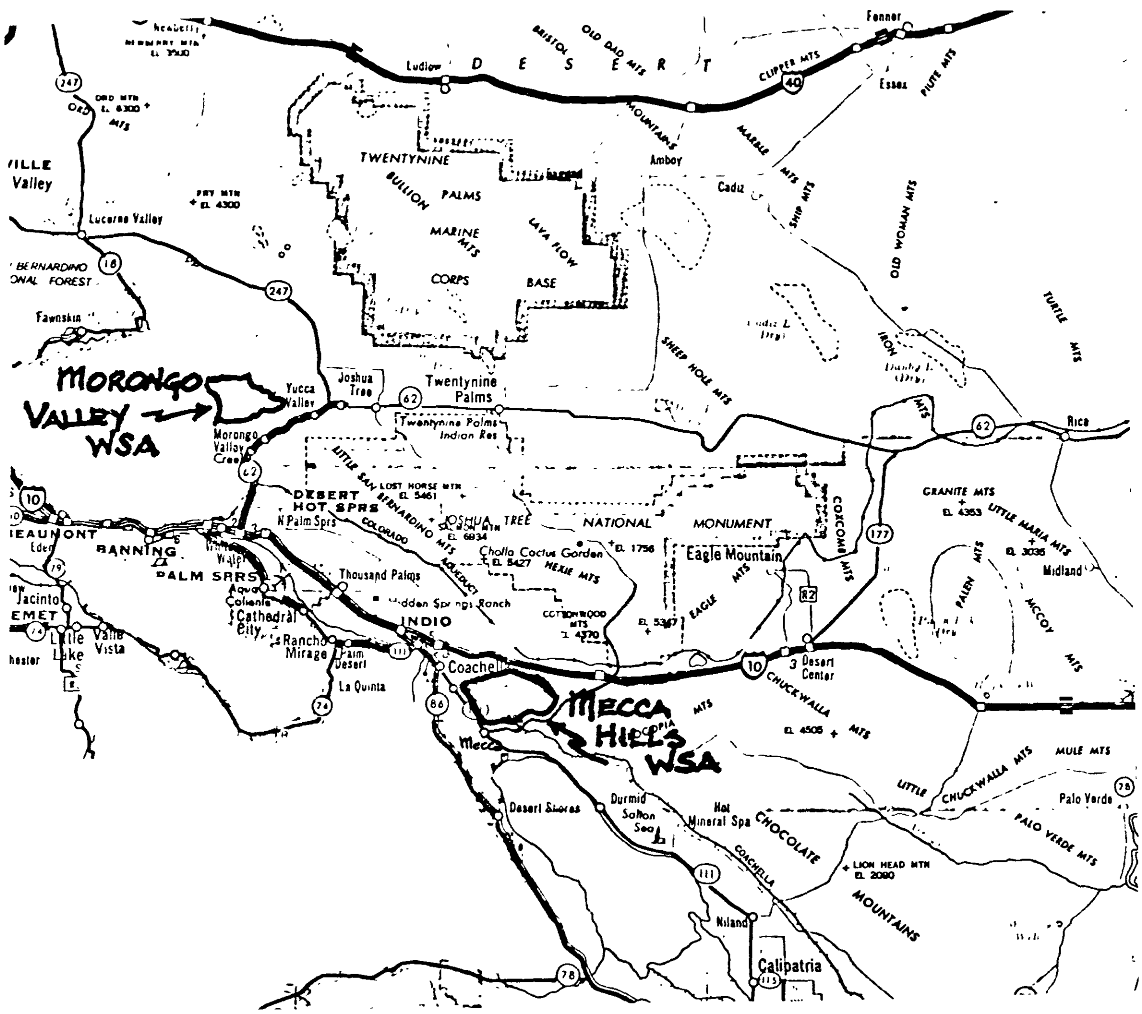

Figure 1. Location map of the Morongo Valley and Mecca Hills Wilderness Study Areas, San Bernardino and Riverside Counties, California.

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.

Sample Collection

Samples were collected at 12 sites in the Morongo Valley WSA (fig. 2) and 17 sites in the Mecca Hills WSA (fig. 3). At all of those sites a heavy-mineral-concentrate sample was collected. Sampling density was about 1 sample site per 1.3 mi^2 for the heavy-mineral concentrates. The area of the drainage basins sampled ranged from .5 mi^2 to 3 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 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

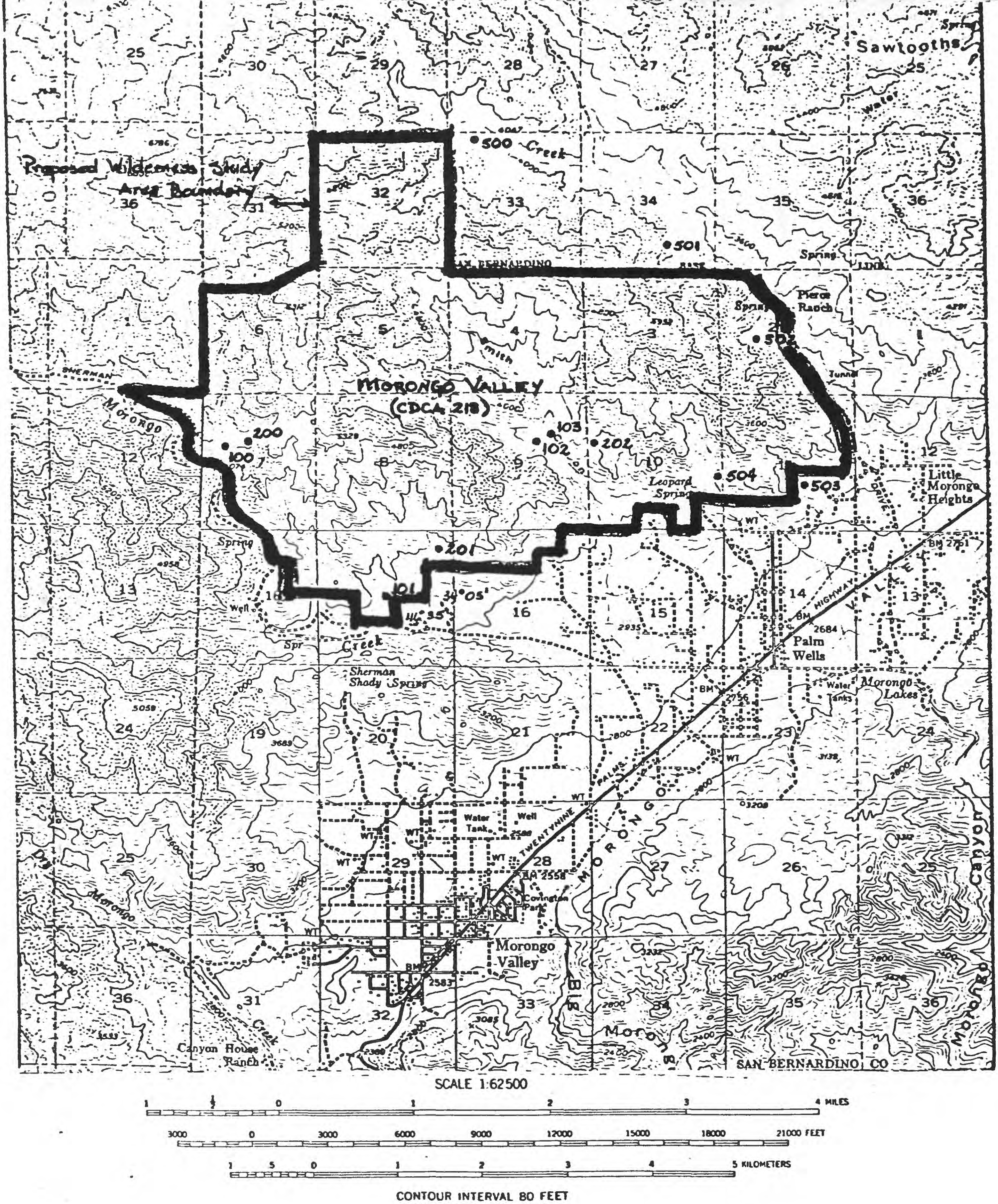

Figure 2. Map showing locations of geochemical samples collected from the Morongo Valley Wilderness Study Area, San Bernardino County, California.

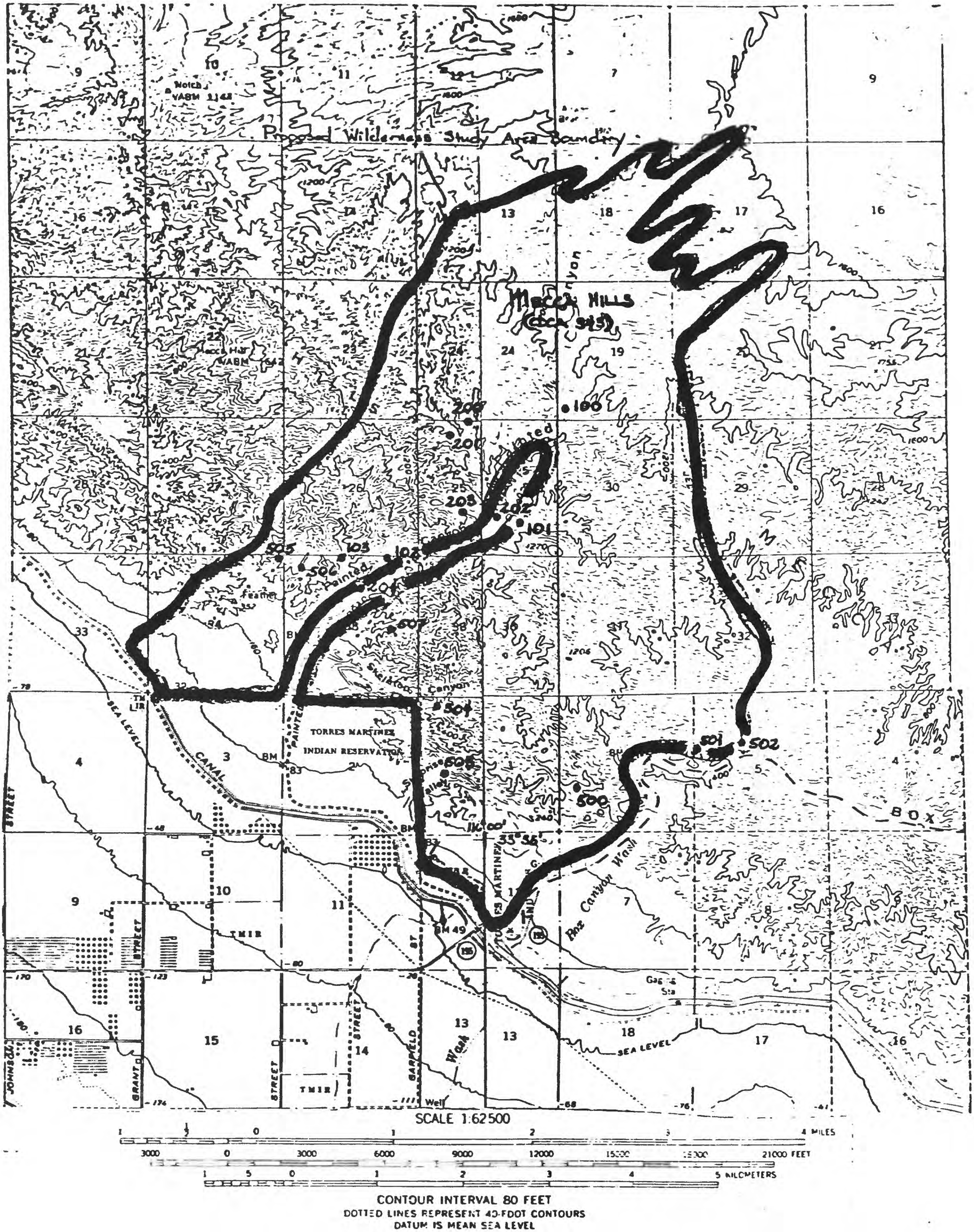

Figure 3. Map showing locations of geochemical samples collected from the Mecca Hills Wilderness Study Area, Riverside County, California.

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 Morongo Valley and Mecca Hills Wilderness Study Areas are listed in Tables 2 and 3, 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, 1976).

DESCRIPTION OF DATA TABLES

Tables 2 and 3 list the analyses for the samples of heavy-mineral concentrate. For the three 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 (figures 2 and 3). 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 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 2 and 3, 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.

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Ehlig, P. L., 1981, Origin and tectonic history of the basement terrane of the San Gabriel Mountains, Central Traverse Ranges, in Ernst, W. G., The geotectonic development of California: Englewood Cliffs, New Jersey, Prentice-Hall, Inc., p. 253-283.

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 5-mg sample

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	0.1	50
Magnesium (Mg)	.05	20
Calcium (Ca)	.1	50
Titanium (Ti)	.005	2
	Parts per million	
Manganese (Mn)	20	10,000
Silver (Ag)	0.1	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 Morongo Valley 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
MV100C	34 5 59	116 36 37	.7	.30	30	>2	1,500	N	N	N	20
MV101C	34 5 5	116 35 25	1.0	.70	50	>2	1,500	N	N	N	20
MV102C	34 6 1	116 34 10	.7	.20	20	>2	1,000	N	N	N	30
MV103C	34 6 5	116 34 1	.2	.10	50	2	2,000	N	N	N	20
MV200C	34 6 1	116 36 28	.5	.15	50	>2	2,000	N	N	N	20
MV202C	34 6 0	116 33 42	.7	.50	50	>2	1,500	N	N	N	20
MV500C	34 7 56	116 34 37	1.0	.70	50	>2	2,000	N	N	N	20
MV501C	34 7 10	116 32 50	.7	1.00	30	>2	1,000	N	N	N	20
MV502C	34 6 40	116 32 28	1.0	1.00	50	>2	2,000	20	N	N	20
MV503C	34 5 44	116 32 5	.5	.15	20	>2	1,500	N	N	N	150
MV504C	34 5 48	116 32 46	1.0	.20	20	>2	1,500	N	N	N	20

TABLE 2.--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
MV100C	>10,000	N	N	N	15	100	N	>2,000	N	50	20
MV101C	5,000	<2	N	N	10	100	<10	2,000	N	50	20
MV102C	2,000	2	N	N	N	50	N	>2,000	N	70	N
MV103C	500	<2	N	N	N	70	N	300	N	N	N
MV200C	>10,000	<2	N	N	N	70	N	300	N	<50	10
MV202C	700	<2	N	N	10	50	N	500	N	50	20
MV500C	700	2	300	N	10	70	N	1,000	N	150	N
MV501C	700	<2	500	N	N	50	N	100	N	50	N
MV502C	1,500	2	200	N	10	70	70	500	N	150	N
MV503C	700	<2	N	N	N	30	N	300	N	<50	10
MV504C	1,000	<2	N	N	N	30	N	200	N	<50	10

TABLE 2.--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
MV100C	50	N	N	300	200	200	700	N	>2,000	1,000
MV101C	20	N	N	700	150	N	1,000	N	>2,000	200
MV102C	200	N	N	700	150	200	1,000	N	>2,000	500
MV103C	200	N	N	200	100	N	1,000	N	>2,000	N
MV200C	50	N	N	200	150	<100	1,000	N	>2,000	N
MV202C	50	N	N	700	150	N	1,000	N	>2,000	N
MV500C	700	N	100	700	300	150	1,000	N	>2,000	<200
MV501C	500	N	N	500	150	150	700	N	>2,000	<200
MV502C	5,000	N	N	700	200	<100	700	N	>2,000	<200
MV503C	50	N	N	700	200	N	700	N	>2,000	<200
MV504C	50	N	N	700	150	N	700	N	>2,000	<200

TABLE 3.--Spectrographic results from the analysis of heavy-mineral-concentrate samples from the Mecca Hills 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
MH100C	33 37 44	115 59 22	.2	.20	10	>2	500	N	N	N	30
MH101C	33 37 0	115 59 44	.5	.30	15	>2	1,000	N	N	N	20
MH102C	33 36 46	116 0 44	.5	.50	20	>2	1,000	N	N	N	20
MH103C	33 36 46	116 1 5	.5	.20	15	>2	1,000	N	N	N	20
MH200C	33 37 38	116 0 5	.5	.20	20	>2	1,000	N	N	N	20
MH201C	33 37 35	116 0 9	.5	.20	15	>2	700	N	N	N	50
MH202C	33 37 5	115 59 55	.3	.20	20	>2	1,000	N	N	N	20
MH203C	33 37 5	116 0 10	.7	.20	30	>2	700	N	N	N	20
MH204C	33 36 35	116 0 55	.5	.20	20	>2	1,000	N	N	N	20
MH500C	33 35 20	115 59 20	.3	.15	10	>2	700	N	N	N	50
MH501C	33 35 35	115 58 23	.5	.50	20	>2	1,000	N	N	N	20
MH502C	33 35 36	115 58 3	.3	.30	30	>2	1,000	N	N	N	30
MH503C	33 35 25	116 0 18	.5	.20	15	>2	1,000	N	N	N	20
MH504C	33 35 50	116 0 20	1.0	.70	15	>2	1,500	N	N	N	70
MH505C	33 36 46	116 1 32	.3	.20	15	>2	700	N	N	N	30
MH506C	33 36 42	116 1 23	.7	.50	20	>2	1,500	N	N	N	20
MH507C	33 36 20	116 0 40	.5	.30	15	>2	1,000	N	N	N	50

TABLE 3.--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
MH100C	>10,000	<2	N	N	N	100	20	N	N	<50	10
MH101C	>10,000	<2	N	N	10	70	N	200	20	<50	20
MH102C	1,500	<2	N	N	10	70	10	700	N	70	10
MH103C	2,000	<2	N	N	10	50	N	150	N	<50	10
MH200C	>10,000	2	N	N	N	70	15	300	N	50	N
MH201C	>10,000	N	N	N	10	50	N	300	N	N	10
MH202C	>10,000	2	N	N	10	200	N	150	N	50	N
MH203C	>10,000	2	N	N	N	50	N	150	N	N	N
MH204C	>10,000	2	N	N	N	100	N	300	N	<50	N
MH500C	5,000	<2	N	N	N	50	N	200	N	<50	10
MH501C	7,000	2	N	N	N	70	N	500	N	100	N
MH502C	>10,000	<2	N	N	N	100	N	300	N	<50	N
MH503C	10,000	<2	N	N	15	100	N	500	N	150	10
MH504C	3,000	<2	N	N	15	100	N	>2,000	N	100	10
MH505C	10,000	<2	N	N	10	70	N	200	N	100	10
MH506C	5,000	2	N	N	N	100	N	500	20	100	N
MH507C	10,000	<2	N	N	15	100	N	700	30	100	15

TABLE 3.--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
MH100C	70	N	N	1,000	150	N	500	N	>2,000	200
MH101C	50	N	N	1,000	200	N	500	N	>2,000	N
MH102C	>50,000	500	100	500	200	N	700	N	>2,000	200
MH103C	50	N	20	700	200	N	700	N	>2,000	300
MH200C	70	N	70	700	200	N	700	N	>2,000	<200
MH201C	70	N	N	500	150	N	700	N	>2,000	500
MH202C	100	N	N	1,000	200	N	500	N	>2,000	N
MH203C	200	N	N	>10,000	100	N	700	N	>2,000	N
MH204C	100	N	N	500	200	N	700	N	>2,000	200
MH500C	50	N	20	300	200	N	700	N	>2,000	300
MH501C	20	N	20	700	200	N	500	N	>2,000	N
MH502C	7,000	N	N	2,000	150	N	700	N	>2,000	<200
MH503C	70	N	100	700	300	N	700	N	>2,000	200
MH504C	100	N	50	500	300	N	700	N	>2,000	500
MH505C	50	N	50	700	200	N	500	N	>2,000	500
MH506C	50	N	150	500	300	N	1,000	N	>2,000	N
MH507C	100	N	100	500	300	N	700	N	>2,000	700