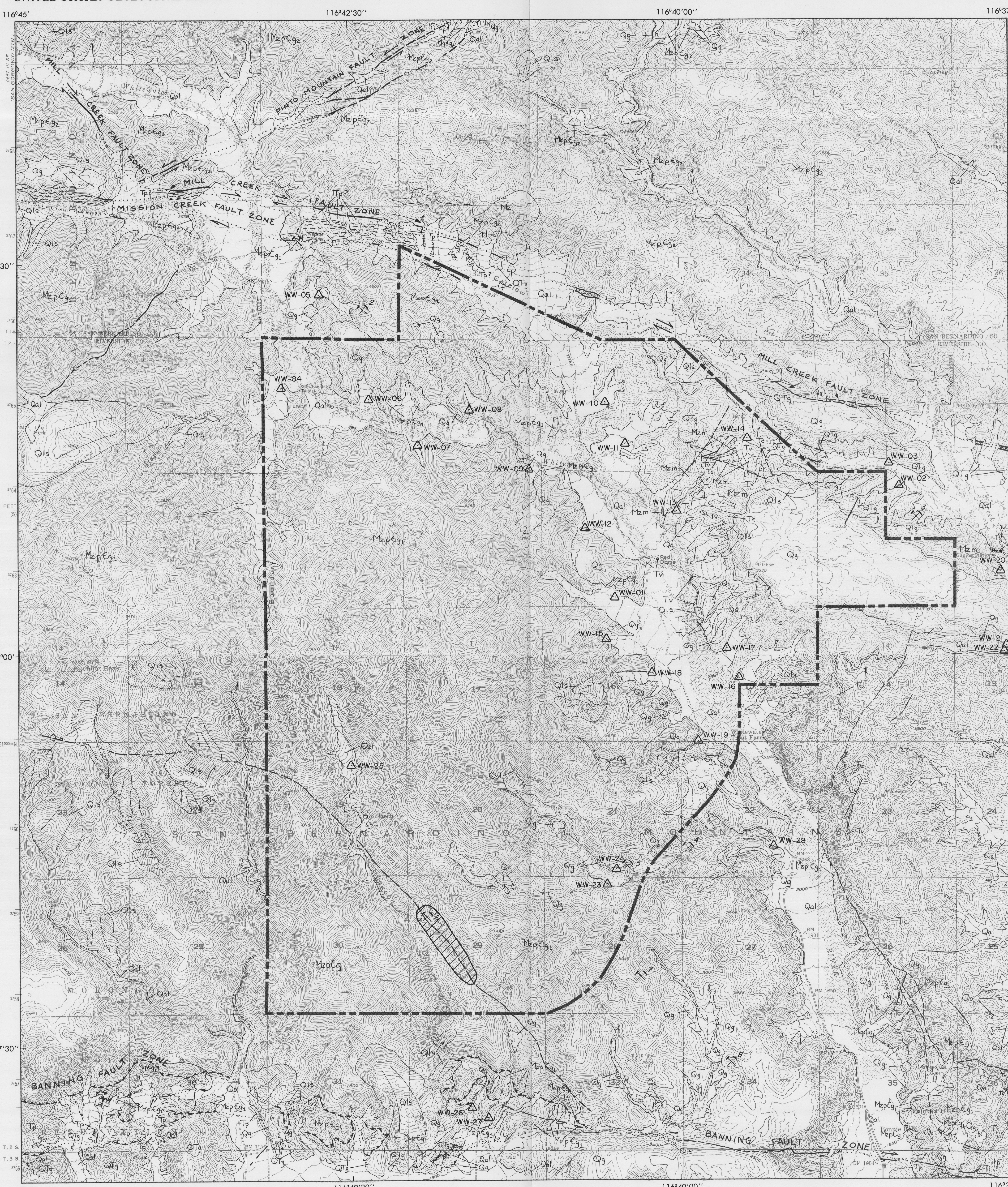
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED BY THE
U.S. GEOLOGICAL SURVEY AND THE U.S. BUREAU OF MINES
FOR THE
U.S. BUREAU OF LAND MANAGEMENT

MISCELLANEOUS FIELD STUDIES
MAP MF-1478-A



Base from U.S. Geological Survey Whitewater, 1955, photo-revised, 1972; Catclaw Flat, 1972

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION, 1982

Geology mapped by D. M. Morton, 1976-77; J. C. Matti and B. F. Cox, 1980-81; R. E. Powell, 1981

MINERAL RESOURCE POTENTIAL MAP OF THE WHITEWATER WILDERNESS STUDY AREA, RIVERSIDE AND SAN BERNARDINO COUNTIES, CALIFORNIA

By
Jonathan C. Matti, Brett F. Cox, Curtis M. Obi,
Robert E. Powell, Margaret E. Hinkle, and Andrew Griscom
U.S. Geological Survey
and
Edward L. McHugh
U.S. Bureau of Mines
1982

EXPLANATION

AREA OF LOW TO MODERATE POTENTIAL FOR THE DISCOVERY OF LOW-GRADE GOLD AND SILVER DEPOSITS

PROSPECT OR MINERALIZED AREA--Numbers 1-8 refer to table 3

WW-26 STREAM-SEDIMENT SAMPLE LOCALITY--Numbers refer to tables 1 and 2

APPROXIMATE BOUNDARY OF WILDERNESS STUDY AREA

CORRELATION OF MAP UNITS

Qal, Qls — Holocene — QUATERNARY
Qg — Pleistocene
Unconformity
QTg
Unconformity
Tph — Pliocene — TERTIARY — CENOZOIC
Ti
Unconformity
Tc, Tv — Miocene
Unconformity
Mzm, Mzd — MESOZOIC
MzpCg1, MzpCg2 — MESOZOIC TO PRECAMBRIAN

DESCRIPTION OF MAP UNITS

Qal ALLUVIUM AND COLLUVIUM (QUATERNARY)

Qls LANDSLIDE DEPOSITS (QUATERNARY)

Qg YOUNGER GRAVEL DEPOSITS (QUATERNARY)--Unconsolidated to consolidated sand, pebbly sand, and gravel; gently dipping

QTg OLDER GRAVEL DEPOSITS (QUATERNARY AND TERTIARY)--Deformed gravel and pebbly sandstone steeply dipping

Tph PAINTED HILL FORMATION OF ALLEN (1954; 1957) (PLIOCENE)--Nonmarine sandstone, pebbly sandstone, and pebble-cobble conglomerate, with subordinate marine lenses near base

Ti IMPERIAL FORMATION (PLIOCENE)--Marine sandstone and siltstone

Tc COACHELLA FANGLOMERATE OF ALLEN (1954; 1957) (MIOCENE)--Well-indurated nonmarine cobble conglomerate and pebbly sandstone

Tv VOLCANIC ROCKS (MIOCENE)--Flows and intrusions of andesitic basalt, andesite, and rhyolite. Allen (1957) included these rocks within his Coachella Fanglomerate

Mzm PORPHYRITIC MONZOGRANITE (MESOZOIC)--Coarsely crystalline, seriate-textured biotite monzogranite containing phenocrysts and megacrysts of potassium feldspar

Mzd HORNBLENDE-BIOTITE DIORITE (MESOZOIC)

GRANITIC ROCKS AND GRANITIC GNEISS (MESOZOIC TO PRECAMBRIAN)--Divided into:

MzpCg1 GRANITIC ROCKS AND GRANITIC GNEISS SOUTH OF THE MILL CREEK-MISSION CREEK FAULT ZONE--Texturally foliated granitic rock and compositionally layered gneissic granitic rock and granitic gneiss ranging from biotite granodiorite to hornblende-biotite quartz diorite in composition; the unit mainly consists of deformed Mesozoic plutonic rocks, although prebatholithic rocks of Precambrian age may be present

MzpCg2 GRANITIC ROCKS AND GRANITIC GNEISS NORTH OF THE MILL CREEK-MISSION CREEK FAULT ZONE--Heterogeneous, texturally foliated to compositionally layered granitic rocks and granitic gneiss; mainly biotitic. The unit mainly consists of deformed Mesozoic plutonic rocks, but probably includes prebatholithic rocks of Paleozoic and Precambrian age

CONTACT

FAULT--Dashed where approximately located; dotted where concealed. Arrows indicate direction of relative movement

THRUST FAULT--Dashed where approximately located; dotted where concealed. Sawteeth on upper plate

CRUSHED AND SHEARED ROCK IN FAULT ZONE

LANDSLIDE DEPOSIT--Arrows show inferred direction of movement

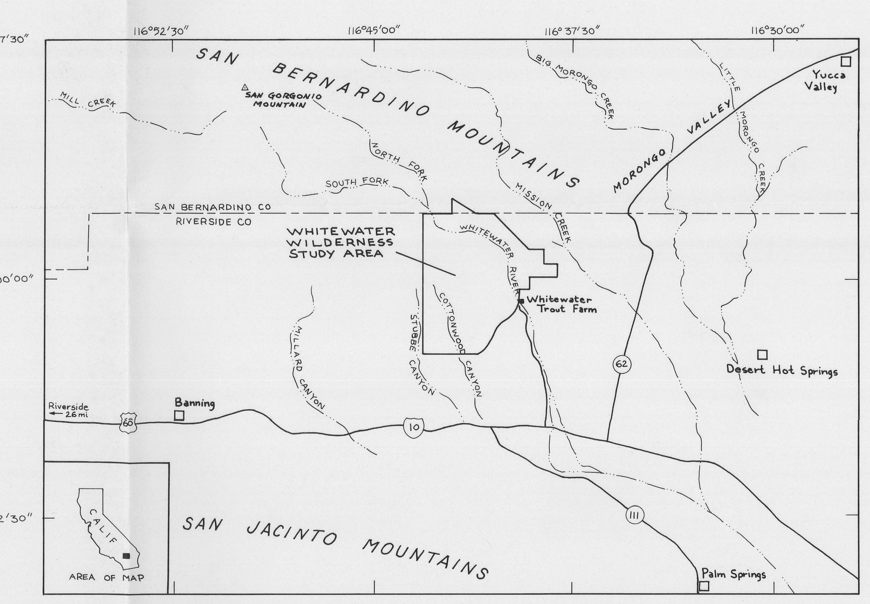


Figure 1.--Index map showing location of the Whitewater Wilderness Study Area, Riverside and San Bernardino Counties, Calif.

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 resource potential. 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 Whitewater Wilderness Study Area, California Desert Conservation Area, Riverside and San Bernardino Counties, California.

SUMMARY

On the basis of geological, geochemical, and geophysical investigations and a review of prospecting and mining activities, we conclude that most of the Whitewater Wilderness Study Area has low to insignificant potential for economic development of all types of mineral resources and energy resources. This mineral-resource assessment is based on the following considerations: (1) geologic mapping indicates that geologic environments favorable for the occurrence of economic mineral deposits have not produced extensive zones of mineralization within the study area; (2) generally low concentrations of specific elements as determined by chemical analyses of stream-sediment and panned-concentrate samples from 28 localities indicate that elemental abundances generally fall within expected background ranges; (3) aeromagnetic patterns suggest that anomalous magnetic highs that occur within the study area most likely are associated with volcanic rocks and do not point to the existence of economic concentrations of magnetic minerals; and (4) historic prospecting activities have been limited and unsuccessful by comparison with mining operations that have been conducted in different geologic terranes elsewhere in the San Bernardino Mountains. Therefore, we believe that most of the Whitewater Wilderness Study Area has a low to insignificant potential for development of metallic and radioactive minerals, industrial building stone and aggregate, fossil fuels, and geothermal resources. One small area in the southern part of the wilderness study area shows evidence of gold and silver mineralization, and this locality has a low to moderate potential for the discovery of low-grade gold and silver resources.

INTRODUCTION

The Whitewater Wilderness Study Area is located about 45 miles east of Riverside and about 15 miles northwest of Palm Springs, Calif. (fig. 1). The study area comprises approximately 18 square miles (11,500 acres) that adjoin the San Bernardino National Forest in the southeastern San Bernardino Mountains. The area consists of rugged mountainous terrain as well as foothills of the California high desert, and is traversed by the Whitewater River, a major perennial stream that flows south and east into the Salton Sea. Access to the study area from the south is via dirt roads that lead from U.S. Interstate 10 and a paved road that follows Whitewater River canyon. Access from the east is via a dirt road that leaves State Highway 62 and follows Mission Creek.

GEOLOGY

The Whitewater Wilderness Study Area lies between several strands of the San Andreas fault system: on the south the Banning fault zone, and on the north the Mill Creek and Mission Creek fault zones, two strands of the San Andreas system that parallel each other closely but that have had separate fault-movement histories. The study area is underlain mainly by crystalline bedrock that consists of a lithologically monotonous assemblage of granitoid rocks, gneissic granitoid rocks, and compositionally layered granitic gneiss. In the eastern part of the study area the crystalline bedrock is overlain depositionally by Miocene, Pliocene, and Quaternary sedimentary and volcanic rocks. Unconsolidated to consolidated Pleistocene and Holocene sedimentary units occur throughout the study area, and include a variety of sand and gravel deposits.

Geologic evidence suggests that the Whitewater Wilderness Study Area generally has a low potential for the discovery of mineral resources. During our geologic field studies we observed localized zones of mineralized rock, but geologic environments favorable for the occurrence of economic mineral deposits have not produced extensive zones of mineralization. The suite of deformed granitic and gneissic rocks is a nondescript terrane of crystalline lithologies that lacks metasedimentary pendants and contains no evidence of extensive alteration and veining. Locally, shear zones within the crystalline rocks show minor traces of gold, silver, and iron and copper oxides and sulfides, as in the Bonanza prospect in Cottonwood Canyon. However, the mineralized shear zones are limited in areal extent and they are not abundant in the crystalline terrane. Miocene sedimentary and volcanic rocks have not provided geologic environments favorable for the occurrence of economic mineral deposits. Pebbles and cobbles of detrital magnetite occur as clasts in some sedimentary layers; although these clasts locally are abundant, their concentrations are not great enough to warrant placer or mining operations. We did not observe significantly mineralized or altered zones associated with the Miocene volcanic rocks. Except for their possible use as gravel resources, Pliocene and Quaternary sedimentary rock units also do not provide geologic environments favorable for the occurrence of economic mineral deposits.

GEOCHEMISTRY

A reconnaissance geochemical survey of stream sediments in the Whitewater Wilderness Study Area was conducted for 32 major, minor, and trace elements in order to determine spatial variations in stream-sediment chemistry that might reflect local concentrations of ore minerals. The locations of 28 geochemical sample localities are shown on the mineral resource potential map, and the tabulated analytical results for stream sediments and panned concentrates are shown in tables 1 and 2.

The patterns of chemical composition determined from the stream-sediment geochemical survey do not indicate economic mineralization within the Whitewater Wilderness Study Area. Most of the analyses fall within ranges that are reasonable for nonmineralized crystalline rocks and derivative stream sediments, and few values exceed this geochemical background. We believe that any potential metallic sources for the anomalous values designated in tables 1 and 2 probably are limited in size and distribution because the anomalies do not show any systematic patterns or clustering. The anomalies probably are insignificant and probably represent a localized geologic source such as small quartz veins or quartz-feldspar segregations in the layered gneiss. The anomalous values probably have no economic significance. The stream sediments were derived from a mainly granitic terrane that has been crushed, sheared, recrystallized, locally laced with quartz-feldspar metamorphic segregations, and locally altered to produce zones of saussuritized, chloritized, and epidotized rock. Locally-elevated metallic values can be expected in rocks having granitic parentage and having this style of metamorphism and deformation, and we believe the anomalous values for elements in the Whitewater Wilderness Study Area represent expectable geochemical variability. Because of the isolated nature of the metallic-element anomalies and the lack of evidence for large-scale mineral deposits, mineralization in the study area most likely has resulted only in small, scattered mineralized zones. Therefore, the results of the geochemical survey are compatible with the geologic evidence: the geochemistry suggests a low mineral resource potential for the Whitewater Wilderness Study Area.

GEOPHYSICS

An aerial magnetic survey of the Whitewater Wilderness Study Area was flown in 1981, and the data have been analyzed by Andrew Griscom (unpub. data, 1981). The aeromagnetic patterns suggest that anomalous magnetic highs occurring within the study area are associated with volcanic rocks and do not point to the existence of economic concentrations of magnetic minerals.

MINING DISTRICTS AND MINERALIZATION

Metallic mineral resources

Within most of the Whitewater Wilderness Study Area, deposits of potentially mineable metallic minerals have not been discovered and mineral production has not been reported, although nearby deposits of stone, limestone, and sand and gravel have been worked. Shear zones within the granitic and gneissic crystalline rocks locally are mineralized, and gold, silver, and copper occur sporadically in such zones. A low-grade gold and silver occurrence in a limonitic zone of shearing and faulting was identified at the Bonanza prospect in Cottonwood Canyon, and we believe this vicinity has a low to moderate potential for the discovery of low-grade gold and silver resources. The location and character of known prospects in the vicinity of the Whitewater Wilderness Study Area are described in table 3.

Energy and industrial resources

Torbernite and other secondary uranium minerals at the DBL Claims (locality 4) were reported by Barrett (1955). The occurrence was not verified in 1981, and scintillometer traverses detected no anomalous radioactivity in the area.

The Whitewater Wilderness Study Area lies within an area considered prospectively valuable for geothermal resources (U.S. Geological Survey, 1978). However, no geothermal springs or evidence of hydrothermal alteration are known in the study area.

Several exploratory oil wells were drilled within 6 mi of the study area from 1918 to 1957 (Proctor, 1968, p.39). However, the wells were nonproductive.

Sand and gravel deposits occur within the Whitewater Wilderness Study Area, but the development of these resources for construction stone is unlikely because similar deposits outside the study area are more extensive and are closer to present markets.

REFERENCES

Allen, C. R., 1954, Geology of the north side of San Gorgonio Pass, Riverside County, in Jahns, R. H., ed., Geology of southern California: California Division of Mines and Geology Bulletin 170, map sheet 20, scale 1:62,500.

Allen, C. R., 1957, San Andreas fault zone in San Gorgonio Pass, southern California: Geological Society of America Bulletin, v. 68, p. 315-350.

Barrett, D. C., 1955, DBL-L to JDBL-D nos. 1 to 4 [California]: U.S. Atomic Energy Commission, Preliminary reconnaissance report (U. S. Department of Energy, file SC-SL-106), unpublished report, 1 p.

Centanni, F. A., Ross, A. M., and DeSesa, M. A., 1956, Fluorimetric determination of uranium: Analytical Chemistry, v. 28, p. 1651-1657.

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semi-quantitative 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 semi-quantitative spectrographic analysis: U. S. Geological Survey Circular 738, 25 p.

Proctor, R. J., 1968, Geology of the Desert Hot Springs--Upper Coachella Valley area, California: California Division of Mines and Geology Special Report 94, 45 p.

U.S. Geological Survey, 1978, Land valuable for geothermal resources, southern California: Menlo Park, California, Conservation Division, Western Region, unpublished map, scale 1:500,000.

Table 3.--Prospects and mineralized areas in the Whitewater Wilderness Study Area

Map No.	Name	Workings	Resource data
1	Walthier Landing	None	A 7-ft-thick shear zone in gneiss strikes N. 70° E. and dips 75° N. The zone is exposed for 50 ft in outcrop. A sample contained 0.012 oz/ton gold and 0.2 oz/ton silver.
2	Island Mountain	None found; claims were staked in the area in 1897. County mining records report a 30-ft-deep shaft	Limonitic bands in gneiss contain malachite. Foliation and banding strike N. 30°-55° W. Of three samples from the area, one contained 0.02 percent copper; two averaged 0.08 percent copper.
3	Cocktail prospect	One shaft, 25 ft deep; one sloughed pit	Two vertical shear zones in gneiss strike N. 60°-80° E. They are 2-5 ft thick and are exposed for as much as 500 ft along strike. Pyrite and malachite are scattered through the zones. Of five samples, two contained 0.02 percent copper; none contained detectable gold or silver.
4	DBL claims	None found; two prospect pits reported (Barrett, 1955)	A 1- to 2-inch-thick fissure in gneiss containing torbernite and other secondary uranium minerals reported by Barrett (1955). No uranium minerals were found in 1981; no anomalous radioactivity was detected. Samples from a small chalcopyrite-bearing pod in gneiss contained 1.0 oz/ton silver and 1.85 percent copper.
5	Blacksheep claims	None, claims were staked in the area in 1896	Shear zones in gneiss contain quartz pyrite. Trend is generally northwest, dip about 50° N. Pyrite and chalcopyrite are in small pods. Of three samples, two contained 0.3 and 0.9 oz/ton silver, one contained 0.75 percent copper.
6	Bonanza prospect	A 129-ft adit was driven northeasterly. Claims were staked in the area in 1904	A limonitic zone in gneiss, parallel to foliation and banding, strikes N. 30°-40° W. and dips 30° NE. to vertical. Of five samples from the zone, one contained 1.6 oz/ton silver, and one contained 0.22 oz/ton gold. Remaining samples contained no metal concentrations of economic significance. Low to moderate potential for the discovery of low-grade gold and silver resources.
7	Desert Gold claims	One prospect pit	Limonitic shear zones in gneiss strike generally to the northwest and dip steeply to the northeast. The zones are as thick as 12 ft and contain finely disseminated pyrite. Of five samples, one contained 0.01 oz/ton gold and 0.3 oz/ton silver.
8	Desert Rainbow claims	Four open cuts, 25 to 50 ft long	Sheared zones in gneiss trend generally N. 65° W. and dip 15°-20° NE., parallel to foliation and banding. Small blebs of pyrite are in the zones. Of six samples, one contained 0.012 oz/ton gold.

STREAM-SEDIMENT GEOCHEMISTRY

METHODS

Sample collection

Stream-sediment samples were collected during the summer of 1981 at twenty-eight locations from small streams that drain the Whitewater Wilderness Study Area. The sample locations are shown on the mineral resource potential map. Two samples of stream sediment were collected at each site: (1) a bulk-sediment sample and (2) a panned concentrate rich in heavy minerals. Bulk sediment was selected as a sample medium because the geochemistry of sediment can reflect the bulk chemistry of bedrock terranes in the drainage basin. Panned concentrates were selected as a sample medium because many economically important elements either occur as high-density native metals that can be concentrated together with the heavy minerals, or occur preferentially within the heavy minerals themselves. For these elements, analysis of the panned concentrates is a more sensitive method of detecting geochemical anomalies within a drainage basin than analyses of the bulk-sediment sample alone.

The bulk-sediment sample was collected by combining a small number (3 to 6) of subsamples gathered from several locations within the stream channel. The composite sample then was passed through a 2-mm screen and material coarser than 2 mm was discarded. Composite samples were taken to compensate for local variations in sediment composition introduced by hydraulic sorting of minerals, and to minimize undesirable contamination caused by introduction of locally derived streambank material or slope wash at the channel margins. The finest sediment available was collected because minor and trace elements commonly are concentrated with the finer clay- and silt-rich fractions of alluvial sediment. A split of the bulk sample was panned down to yield the heavy-mineral concentrate. The bulk samples and panned concentrates were put into metal-free cloth and paper bags, and were air dried before being shipped to the laboratory.

In laboratory facilities of the U.S. Geological Survey the bulk-sediment samples were sieved into plus-80-mesh and minus-80-mesh fractions. Magnetite was removed from the panned concentrates with a hand magnet, and the concentrates then were immersed in bromoform (sp. gr. 2.89) to remove any residual low-density minerals (mainly micas, quartz, and feldspars). The concentrates then were separated into paramagnetic and nonmagnetic fractions with a Frantz[1] magnetic separator. As the final step before analysis the minus-80-mesh sediment and the nonmagnetic panned concentrates were pulverized to pass a 150-mesh screen.

Chemical analysis

The minus-80-mesh stream-sediment fraction and the nonmagnetic panned concentrates were analyzed for thirty-two elements. All analyses were performed by the U.S. Geological Survey. Quantitative analyses for uranium were obtained by fluorimetric methods (modified from Centanni and others, 1956). The remaining thirty-one elements were analyzed by a semiquantitative emission spectrographic method. This direct-current-arc method has been described in detail by Grimes and Marranzino (1968), and involves two main steps. (1) The sample of powdered rock or sediment first is burned in an electric arc. Light emitted at specific wavelengths for each element is recorded on photographic film, and the density of the spectral lines increases with the concentration of the element in the sample. (2) The concentration of the element in the rock or sediment sample then is estimated by visually comparing the spectral-line densities of the sample to the line densities produced by a graduated series of artificial standards. The analytical results are reported in parts per million as six steps per order of magnitude, and numbers of this series multiplied by powers of ten. These six values or steps represent the approximate geometric midpoints of concentration ranges whose boundaries are as follows:

Reported value (ppm)	Interval (ppm)
1.5	1.2-1.8
2	1.8-2.6
3	2.6-3.8
5	3.8-5.6
7	5.6-8.3
10	8.3-12

The analytical precision of the emission spectrographic method has been evaluated by Motooka and Grimes (1976). Based on over 2700 replicate analyses performed on 22 different geologic samples, the analyses can be expected to fall within one reporting interval of the mean 83 percent of the time and within two reporting intervals of the mean 96 percent of the time. This precision is sufficient for most geochemical prospecting applications. However, precision tends to decline markedly when the concentration levels of the elements are near the upper or lower detection limit for a given element.

[1]Any use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

Table 1.--Spectrographic analyses of minus-80-mesh bulk-sediment fraction[1]

Field No.	Fe (%)	Mg (%)	Ca (%)	Ti (%)	Mn (ppm)	Ag	As	Au	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sb	Sc	Sn	Sr	Th	U[2]	V	W	Y	Zn	Zr
WW-01	7	1.5	2	0.7	2000	N	N	N	30	700	2	N	N	20	50	70	150	N	L	20	70	N	30	N	500	N	1.50	200	N	100	N	700
WW-02	15	0.7	1.5	1	1500	N	N	N	30	700	1	N	N	30	200	70	500	N	L	50	30	N	30	N	300	L	2.00	300	N	200	N	G
WW-03	10	1.5	1.5	0.7	1500	N	N	N	30	1000	2	N	N	30	200	70	500	N	L	50	30	N	30	N	300	N	1.50	300	N	100	N	1000
WW-04	7	1	1.5	0.5	1500	N	N	N	30	1000	2	N	N	20	20	70	200	N	L	20	70	N	30	N	300	N	2.50	200	N	100	N	500
WW-05	7	1	2	0.5	1500	N	N	N	30	1500	2	N	N	20	20	70	200	N	20	20	70	N	30	N	500	N	1.00	200	N	100	N	500
WW-06	10	1.5	2	0.7	1500	N	N	N	30	1000	2	N	N	20	100	50	200	N	20	30	50	N	30	N	500	N	1.00	200	N	100	N	700
WW-07	7	1	2	0.5	1500	N	N	N	20	1000	2	N	N	20	50	70	200	N	L	30	100	N	30	N	300	N	1.00	200	N	70	N	300
WW-08	10	1	2	0.5	1500	N	N	N	30	1500	2	N	N	20	50	70	200	N	L	20	50	N	30	N	500	N	0.80	200	N	100	N	700
WW-09	10	1	2	0.5	1500	N	N	N	30	1000	2	N	N	20	30	30	150	N	L	20	70	N	30	N	500	N	0.80	200	N	100	N	500
WW-10	20	1	1.5	0.7	2000	N	N	N	20	1000	1	N	N	50	300*	50	500	N	L	50	30	N	30	N	300	N	1.50	500	N	150	N	1000
WW-11	20	1	1.5	1	1500	N	N	N	30	700	1	N	N	50	300*	50	500	N	L	50	30	N	30	N	200	L	1.00	500	N	200	N	G
WW-12	10	1.5	2	1	2000	N	N	N	50	1000	2	N	N	30	100	70	200	N	20	30	70	N	30	N	500	N	0.55	200	N	100	N	700
WW-13	7	1	2	0.7	1000	N	N	N	300*	1000	2	N	N	20	100	50	150	N	20	30	30	N	30	N	500	N	2.00	200	N	200	N	1000
WW-14	7	1.5	1.5	1	1000	N	N	N	70	1000	2	N	N	20	100	50	200	N	L	30	50	N	30	N	500	N	1.50	200	N	100	N	1000
WW-15	10	1	1.5	1	1500	N	N	N	30	700	2	N	N	20	50	50	200	N	20	30	50	N	30	N	300	N	0.80	200	N	100	N	700
WW-16	20	0.7	1.5	0.7	1000	N	N	N	100	500	1	N	N	30	150	50	200	N	L	70	50	N	30	N	200	N	1.50	700*	N	100	N	300
WW-17	10	1.5	2	0.7	1500	N	N	N	100	1000	2	N	N	30	150	100	200	N	L	50	50	N	30	N	500	L	0.80	300	N	100	N	500
WW-18	7	1.5	2	1	1500	N	N	N	20	1000	2	N	N	20	100	50	200	N	L	20	50	N	30	N	500	N	0.20	150	N	100	N	500
WW-19	15	1	2	1	1500	N	N	N	20	700	2	N	N	20	100	50	200	N	L	20	50	N	30	N	300	N	0.55	300	N	100	N	500
WW-20	15	1	2	1	1500	N	N	N	20	1000	2	N	N	50	150	100	200	N	20	30	50	N	30	N	300	100*	2.00	300	N	200	N	1000
WW-21	15	1	1.5	0.7	1500	N	N	N	30	700	2	N	N	30	150	70	300	N	L	50	50	N	30	N	300	100*	2.00	300	N	200	N	1000
WW-22	15	1	2	1	1500	N	N	N	50	1000	2	N	N	30	150	70	200	N	L	50	50	N	30	N	500	N	2.00	300	N	100	N	500
WW-23	10	1	1.5	1	1500	N	N	N	20	700	2	N	N	20	100	50	200	N	L	20	50	N	30	N	300	N	2.00	300	N	100	N	500
WW-24	5	1	2	0.5	1500	N	N	N	70	700	2	N	N	15	30	100	150	N	L	10	70	N	20	N	300	N	2.50	150	N	70	N	300
WW-25	5	1	2	0.5	1500	N	N	N	50	700	2	N	N	20	30	100	100	N	L	20	70	N	20	N	300	N	1.00	150	N	70	N	300
WW-26	15	1	2	1	1500	N	N	N	50	700	2	N	N	30	100	70	200	N	L	30	50	N	30	N	500	N	0.80	200	N	100	N	1000
WW-27	7	1	2	0.7	1500	N	N	N	50	700	2	N	N	30	100	50	150	N	L	30	50	N	30	N	300	N	1.00	200	N	100	N	300
WW-28	10	1	2	0.7	1500	N	N	N	50	700	2	N	N	20	30	50	100	N	L	20	70	N	20	N	300	N	1.50	200	N	100	N	300

[1]Qualified values: N = element not detected at nominal lower detection limit; L = element detected, but concentrations are less than the nominal lower detection limit; G = element detected at concentrations greater than the nominal upper detection limit.

[2]Uranium values were determined by fluorimetric analysis.

*Anomalous value: These values are identified because they represent empirical contrasts among the analytical data.

Table 2.--Spectrographic analyses of nonmagnetic fraction of panned concentrates[1]

Field No.	Fe (%)	Mg (%)	Ca (%)	Ti (%)	Mn (ppm)	Ag	As	Au	B	Ba	Be	Bi	Cd	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sb	Sc	Sn	Sr	Th	V	W	Y	Zn	Zr
WW-01c	1.5	0.3	10	G	1000	N	N	N	150	700	L	N	N	10	20	100	200	L	50	10	200	N	10	30	300	N	150	N	700	N	G
WW-02c	2	0.3	10	G	500	N	N	N	30	700	N	N	N	10	20	20	1000	N	L	10	70	N	20	L	300	700	100	N	700	N	G
WW-03c	1.5	0.5	7	G	500	N	N	N	70	700	N	N	N	10	50	20	500	N	L	20	50	N	10	N	300	200	100	N	500	N	G
WW-04c	2	0.2	15	G	1000	N	N	N	50	1500	N	N	N	50*	20	150	500	10	100	10	200	N	30	100	L	L	200	N	1500	N	G
WW-05c	2	0.3	10	G	1000	N	N	N	50	300	N	N	N	L	20	50	500	L	70	10	70	N	30	100	200	L	200	N	1000	N	G
WW-06c	2	0.5	20	G	1000	N	N	N	20	200	N	N	N	L	70	20	G	N	50	10	50	N	50	100	L	200	200	N	1500	N	G
WW-07c	2	0.5	15	G	1500	N	N	N	20	200	N	N	N	L	20	50	700	N	50	10	70	N	20	50	L	L	150	N	1000	N	G
WW-08c	2	0.3	10	G	1000	N	N	N	20	700	N	N	N	L	20	50	300	10	50	10	200	N	20	50	200	L	200	N	1000	N	G
WW-09c	3	0.7	20	G	2000	N	1500*	N	200	700	N	N	N	L	20	20	500	N	70	10	70	200*	50	20	300	L	200	N	1000	N	G
WW-10c	2	0.5	7	G	500	N	N	N	20	700	N	N	N	10	20	20	G	N	L	10	70	N	20	N	200	200	100	N	1000	N	G
WW-11c	1.5	0.3	5	G	200	N	N	N	20	1000	L	N	N	20	10	10	G	N	L	10	70	N	20	N	200	L	100	N	1000	N	G
WW-12c	5	0.7	10	G	3000*	N	L	N	300*	500	N	N	N	L	50	30	700	N	50	10	70	L	50	20	300	200	200	N	700	N	G
WW-13c	7	0.5	7	G	700	50*	N	N	500*	300	N	200*	N	300*	100	100	G	L	L	20	70	N	50	30	200	200	200	150*	1000	N	G
WW-14c	2	0.3	7	G	700	N	N	N	100	700	N	50	N	20	70	20	G	N	L	10	70	N	50	50	L	500	200	N	1500	N	G
WW-15c	2	0.5	10	G	1000	N	N	N	200	300	N	N	N	L	20	100	200	N	50	10	70	N	20	30	200	L	200	N	700	N	G
WW-16c	2	0.5	10	G	700	N	N	N	300*	500	N	N	N	15	100	200*	200	N	L	10	100	N	20	30	200	500	200	N	700	N	G
WW-17c	2	0.7	10	G	700	N	N	N	300*	300	N	N	N	10	150	200*	700	N	L	10	200	N	30	30	200	200	200	N	700	N	G
WW-18c	7	0.3	15	G	2000	N	500*	N	20	200	N	N	N	L	100	50	500	N	70	10	70	200*	50	30	200	L	200	N	700	N	G
WW-19c	2	0.5	10	G	500	N	N	N	20	300	N	70*	N	50*	200*	50	500	N	50	10	500	N	50	50	L	1500*	200	L	700	N	G
WW-20c	5	0.5	15	G	2000	N	5000*	N	20	500	N	N	N	L	50	50	500	N	50	10	500	200*	50	30	200	L	200	N	700	N	G
WW-21c	1	0.7	7	G	1500	N	N	N	50	300	N	N	N	10	100	50	G	N	50	10	70	N	30	70	L	1500*	200	L	2000*	N	G
WW-22c	7	0.5	7	G	1000	N	N	N	150	700	N	N	N	10	100	50	200	N	L	15	100	N	20	N	200	200	200	L	700	N	G
WW-23c	2	0.3	7	G	1000	N	N	N	100	500	L	N	N	10	20	50	500	L	50	10	70	N	20	20	200	300	200	N	700	N	G
WW-24c	2	0.2	20	G	1500	N	N	N	20	G*	N	50	N	10	20	50	700	N	50	10	20	N	50	50	L	500	200	N	1500	N	G
WW-25c	1.5	0.2	20	G	1000	N	N	N	20	200	N	L	N	10	50	20	700	N	50	10	20	N	20	30	L	700	200	N	1500	N	G
WW-26c	2	0.5	10	G	700	N	N	N	20	300	N	N	N	15	50	150	500	N	L	10	700*	N	30	30	L	500	200	N	700	N	G
WW-27c	1	0.2	20	G	1000	N	N	N	20	100	N	N	N	10	50	100	700	N	50	10	500	N	20	70	L	700	200	N	1500	N	G
WW-28c	1	0.2	10	G	1000	N	N	N	20	3000	N	N	N	10	20	20	200	N	L	10	150	N	20	20	200	500	150	N	700	N	G

[1]Qualified values: N = element not detected at nominal lower detection limit; L = element detected, but concentrations are less than the nominal lower detection limit; G = element detected at concentrations greater than the nominal upper detection limit.

*Anomalous value: These values are identified because they represent empirical contrasts among the analytical data.

SPECTROGRAPHIC DETECTION LIMITS
(Accompanies tables 1 and 2)

	Fe (%)	Mg (%)	Ca (%)	Ti (%)	Mn (ppm)	Ag	As	Au	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sb	Sc	Sn	Sr	Th	V	W	Y	Zn	Zr
Stream sediments																																
Lower	.05	.02	.05	.002	10	.5	200	10	10	20	1	10	20	200	5	10	5	20	5	20	5	10	100	5	10	100	100	10	50	10	200	10
Upper	20	10	20	1	5000	5000	10000	500	2000	5000	100	1000	500	2000	2000	5000	20000	1000	2000	2000	5000	20000	10000	100	1000	5000	2000	10000	10000	2000	10000	1000
Pan concentrates																																
Lower	.1	.05	.1	.005	20	1	500	20	20	50	2	20	50	500	10	20	10	50	10	50	10	20	200	10	20	200	200	20	100	20	500	20
Upper	50	20	50	2.0	10000	10000	20000	1000	5000	10000	200	2000	1000	5000	5000	10000	50000	2000	5000	5000	10000	50000	20000	2000	2000	10000	5000	20000	20000	5000	20000	2000
Bedrock samples																																
Lower	.05	.02	.05	.002	10	.5	200	10	10	20	1	10	20	200	5	10	5	20	5	20	5	10	100	5	10	100	100	10	50	10	200	10
Upper	20	10	20	1	5000	5000	10000	500	2000	5000	100	1000	500	2000	2000	5000	20000	1000	2000	2000	5000	20000	10000	100	1000	5000	2000	10000	10000	2000	10000	1000

Explanatory pamphlet accompanies map

Interior—Geological Survey, Reston, Va.—1982

For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225