DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1161-C

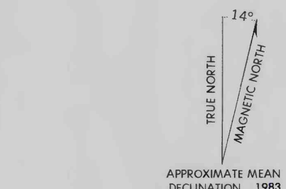
Base from U.S. Geological Survey
San Gorgonio Mountain, 1954;
Morongo Valley, 1955

Geology inside wilderness simplified from Morton and others (1980); geology outside wilderness from D.M. Morton, B.F. Cox, and J.C. Matti (unpub. mapping, 1978)

SCALE 1:62500

1 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM 1929



APPROXIMATE MEAN
DECLINATION, 1983

EXPLANATION

AREA OF LOW TO MODERATE POTENTIAL FOR PRECIOUS- AND BASE-METAL RESOURCES--Inferred from geologic and geochemical data

MINE OR PROSPECT

⊡ 1 Marble workings in Mill Creek Canyon

⊡ 2 Uranothorite workings near Alger Creek (open cut)

⊡ 3 Prospecting pit, East Fork of Barton Creek

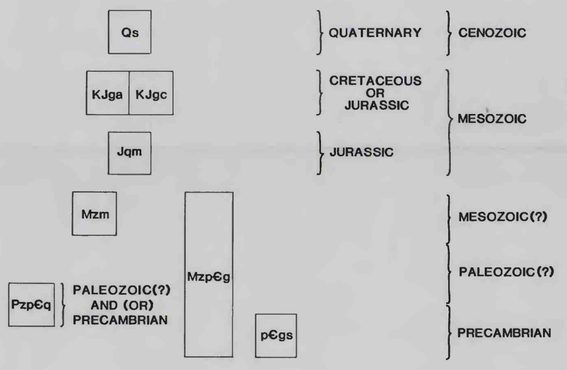
⊡ 4 Collapsed mine shaft northeast of San Gorgonio Mountain

GEOCHEMICAL SAMPLE SITE

△ WX-08 Bedrock sample site

⊙ SG-21 Stream-sediment sample site

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qs SURFICIAL DEPOSITS (QUATERNARY)--Unconsolidated to consolidated alluvium, colluvium, and glacial deposits consisting of sand, pebbly sand, and gravel

KJga GRANODIORITE OF ANDERSON PEAK (CRETACEOUS OR JURASSIC)--Texturally massive to foliated, medium-grained biotite granodiorite

KJgc GRANODIORITE OF CAMP ANGELUS (CRETACEOUS OR JURASSIC)--Texturally massive, medium-grained hornblende-biotite granodiorite

Jqm QUARTZ MONZODIORITE AND QUARTZ MONZONITE OF MANZANITA SPRINGS (JURASSIC)--Texturally massive to slightly foliated, coarse-grained, porphyritic hornblende-biotite quartz monzodiorite to quartz monzonite with large potassium feldspar phenocrysts. Unit previously termed the "granodiorite and quartz monzonite of Manzanita Springs" by Morton and others (1980)

Mzm MONZOGRANITE OF SAN GORGONIO MOUNTAIN (MESOZOIC)--Texturally massive to foliated, coarse-grained, muscovite-biotite monzogranite. Unit previously termed the "quartz monzonite of San Gorgonio Mountain" by Morton and others (1980)

MzpEg GRANITIC GNEISS (MESOZOIC?, PALEOZOIC?, AND PRECAMBRIAN)--Light-gray medium-grained diffusely layered quartzofeldspathic gneiss; contains abundant lenses of nonlayered granitoid rock and scattered inclusions of metaquartzite, marble, and skarn. Unit previously termed the "undivided heterogeneous gneissic granitoid rocks" unit by Morton and others (1980)

PzpEq METAQUARTZITE (PALEOZOIC? AND (OR) PRECAMBRIAN)--Light-gray fine- to medium-grained metaquartzite; recrystallized, highly deformed

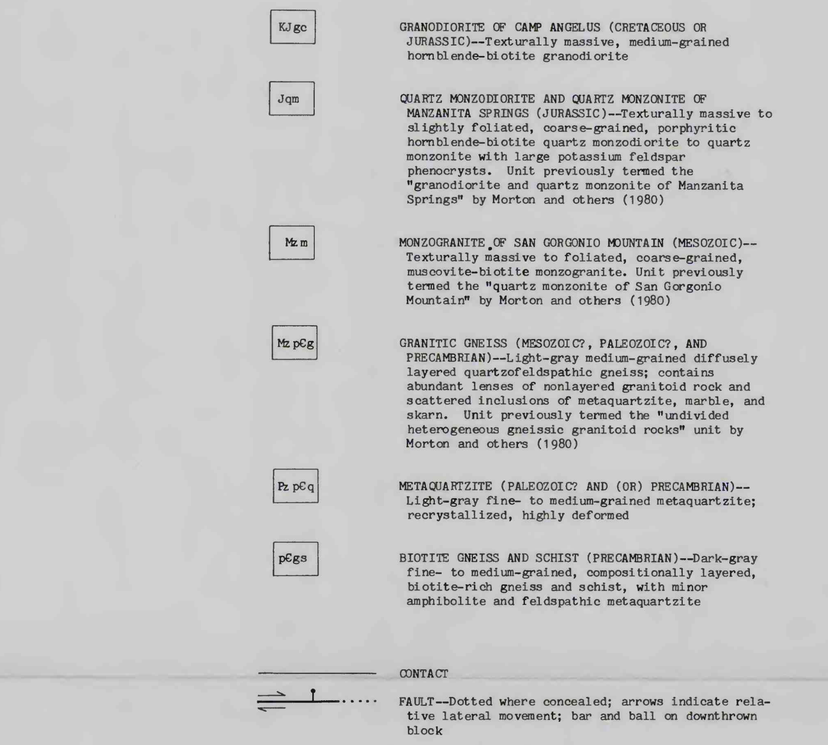
pEgs BIOTITE GNEISS AND SCHIST (PRECAMBRIAN)--Dark-gray fine- to medium-grained, compositionally layered, biotite-rich gneiss and schist, with minor amphibolite and feldspathic metaquartzite

CONTACT

FAULT--Dotted where concealed; arrows indicate relative lateral movement; bar and ball on downthrown block

APPROXIMATE BOUNDARY OF WILDERNESS

BOUNDARY OF MAPPED AREA



INDEX MAP

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands 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 San Gorgonio Wilderness in the San Bernardino National Forest, San Bernardino County, California. The San Gorgonio Wilderness was established as a wilderness by Public Law 88-577, September 3, 1964.

SUMMARY

The San Gorgonio Wilderness covers an area of about 35,250 acres in the southeastern San Bernardino Mountains approximately 75 mi east of Los Angeles, Calif. Geologic, geochemical, and geophysical evidence, together with a review of historical mining and prospecting activities, suggests that most of the San Gorgonio Wilderness has low potential for all types of mineral and energy resources—including precious and base metals, construction stone and aggregate, fossil fuels, radioactive minerals, and geothermal resources. One small area within the drainage basin of the East Fork of Whitewater River has low to moderate potential for precious- and base-metal resources.

GEOLOGY

The San Bernardino Mountains and San Gorgonio Wilderness are situated in the eastern part of the Transverse Ranges of southern California, a geologic province that trends east-west athwart the predominant northwest-southeast structural grain of California (Bailey and Jahns, 1954). Geologic features of the wilderness have been mapped most recently by Morton and others (1980); a simplified version of their map is shown on this map. The wilderness is underlain by two lithologically distinct terranes of gneissic rocks and by several varieties of granitoid rocks that have intruded the gneiss.

Southwestern and northern areas of the wilderness are underlain by a belt of relatively homogeneous biotite-rich gneiss and schist. On the basis of a tentative lithologic correlation with the Precambrian Baldwin Gneiss of Guillou (1953), we believe that the biotite-rich gneiss terrane in the study area is Precambrian in age. The southeastern part of the wilderness is underlain by a terrane of heterogeneous crystalline rocks consisting mainly of granitic gneiss with wispy compositional layering. Bodies of leucocratic and mesocratic granitoid rocks are intermingled with the gneiss, and small masses of metaquartzite, marble, skarn, and biotite-rich gneiss are locally present as inclusions both in the granitic gneiss and in the granitoid rocks. The protolith of the granitic gneiss probably includes plutonic rocks that were intruded during both Precambrian and Mesozoic times. The small bodies of metasedimentary rock in the granitic gneiss have not been dated, but on the basis of regional geologic relations they may be late Precambrian and (or) Paleozoic in age.

Four lithologically distinct varieties of texturally massive to slightly foliated granitoid rocks form plutons of moderate size which have intruded the terranes of biotite-rich gneiss and granitic gneiss (plutonic rock terminology used herein follows Streckeisen, 1973). Leucocratic muscovite-biotite monzogranite underlies the highest peaks near the center of the wilderness. Units of biotite granodiorite, hornblende-biotite granodiorite, and porphyritic hornblende quartz monzodiorite crop out near the west end of the wilderness. Judging from regional geologic relations, the four intrusive units probably were emplaced during Jurassic and (or) Cretaceous times.

Within the San Gorgonio Wilderness, geologic environments potentially favorable for the occurrence of mineral deposits are small, scattered, and lack conclusive evidence that significant mineralization has actually occurred. The combination of rock types in the wilderness is different from that occurring in mining districts less than 15 mi away, where gold and tungsten occur primarily in large bodies of Paleozoic metasedimentary rock that are intruded by undeformed Mesozoic plutons. By comparison, only a few small bodies of metasedimentary rock and skarn occur in the San Gorgonio Wilderness. Most of these small bodies are scattered on the south and east flanks of San Gorgonio Mountain, where they are surrounded by highly deformed granitic gneiss rather than undeformed plutonic rock. We did not observe any significant evidence of mineralization associated with these small bodies of metasedimentary rock and skarn.

Other geologic environments potentially favorable for mineralization include quartz veins, pegmatitic segregations, and zones of limonite-stained rock, which are found within both terranes of gneissic rocks in the study area. We found no evidence of mineralization associated with the pegmatitic segregations and found only superficial mineralization of the quartz veins. We found no field evidence of significant mineralization in any of the areas of stained rock. However, a zone of limonite-stained granitic gneiss along the East Fork of Whitewater River may contain sites of metallic mineralization, as suggested by chemical analyses of bedrock and stream sediments in this area that show anomalous concentrations of precious and base metals.

GEOCHEMISTRY

A reconnaissance geochemical survey of the San Gorgonio Wilderness (Cox and Matti, 1983) was conducted for 33 major, minor, and trace elements in order to determine spatial variations in chemistry that might reflect local concentrations of ore minerals. We sampled stream sediments at 40 sites and bedrock at 13 sites throughout the wilderness and vicinity. The sample sites are shown on the map. Each stream-sediment sample was processed to yield three fractions for analysis: a minus-80-mesh fraction, a plus-80-mesh fraction, and a panned concentrate rich in heavy minerals.

Metallic elements

Geochemical anomalies detected in bedrock samples and in drainage samples suggest that incipient metallic mineralization has occurred in various parts of the San Gorgonio Wilderness. The anomalies include elevated values for molybdenum, tungsten, tin, copper, nickel, chromium, cobalt, lead, and zinc, but they are scattered and are generally of low magnitude compared to geochemical anomalies that have been reported in districts where significant mineral deposits have been proven. Therefore, most of the anomalies are probably not related to significant mineral deposits. The drainage basin of the East Fork of Whitewater River may have precious and base metals, because several geochemical anomalies—including the largest anomalies for cobalt, copper, gold, molybdenum, and tungsten—were detected in bedrock and stream-sediment samples from this area (sites SG-33; WX-04, -07, -11).

Radioactive and rare-earth elements

Elevated values for the rare-earth elements cerium and lanthanum are widespread in panned-concentrate samples from the eastern half of the wilderness, and are locally accompanied by high concentrations of the radioactive elements uranium and thorium. We tentatively attribute the anomalous abundances of these four elements to resistant heavy minerals such as monazite, allanite, zircon, and sphene. The anomalies probably are inconsequential because these minerals commonly are disseminated in minor amounts in rocks similar to the granitic gneiss and monzogranite of the San Gorgonio Wilderness but rarely form significant ore deposits in bedrock. However, such heavy minerals may be concentrated as placer deposits in stream gravels. It is therefore conceivable that small placer accumulations of rare-earth and radioactive minerals may be present along the North Fork of Whitewater River east of San Gorgonio Mountain, where one of the larger deposits of stream gravel and some of the more prominent geochemical anomalies are localized.

At four sample sites (SG-17, -18, -38, -39), prominent uranium anomalies in the minus-80-mesh fraction are accompanied by relatively low uranium concentrations in the panned-concentrate fraction. These four anomalies may represent hydromorphic enrichment (Rose, 1977, p. 330) of fine-grained sediments by adsorption or precipitation of uranium dissolved in stream water. However, the four anomalies are small compared to hydromorphic anomalies reported in regions of economic uranium mineralization, which commonly exceed 100 ppm in samples of fine-grained stream sediment. We do not attribute any special significance to these anomalies.

GEOPHYSICS

Low-altitude aerial radioactivity and aeromagnetic surveys of the San Gorgonio Wilderness were flown in 1978. Neither survey shows any indication of mineral deposits. The radioactivity survey (Pitkin and Duval, 1981) measured gamma radiation emitted from radioactive materials in order to estimate the apparent abundances of ^{40}K, ^{232}Th, and ^{238}U at the ground surface. Pitkin and Duval (1981) concluded that the apparent abundances of radioactive elements detected by the survey do not exceed those expected for nonmineralized granitic and metamorphic rocks of the types present in the San Gorgonio Wilderness.

The aeromagnetic survey revealed small magnetic anomalies that are clearly associated with topography. Magnetic measurements of rock samples and computer modeling of the topography show that the anomalies are caused by fine-grained magnetite that is disseminated throughout the granitic and gneissic rocks in amounts generally less than 1 percent. The study did not reveal any significant concentrations of iron-rich minerals.

A limited gravity survey was also conducted in the San Gorgonio Wilderness. The resulting data did not provide any evidence of significant mineralization.

MINING DISTRICTS AND MINERALIZATION

The locations of known mines and prospects in the vicinity of the San Gorgonio Wilderness are shown on the map. Little mineral production has come from the San Gorgonio Wilderness, and only a few prospects occur in the area. U.S. Forest Service records, which cover only the last 35 years, show that claims have been located on Mill Creek, Alger Creek, and on the East Fork of Barton Creek (sites 1, 2, and 3). A mine shaft located northeast of San Gorgonio Mountain (site 4) probably dates from earlier times. Commodities sought at these four sites apparently were limited to marble, uranium, and metallic minerals. We found no evidence of mining or prospecting activities involving fossil fuels, geothermal energy, or construction materials other than marble.

Marble workings in Mill Creek Canyon

Marble has been quarried at the Mill Creek mine on the north wall of Mill Creek Canyon about 2.7 mi southwest of San Gorgonio Mountain (site 1). The workings are located in the largest and easternmost of three lenticular marble bodies enclosed by granitic gneiss. The size of an open cut on the lower end of the marble lens suggests that about 13,600 tons have been removed. The three lenses are 27, 48, and 64 ft thick and 500, 1,100, and 1,800 ft long. The deposit is of little interest now because much larger, more accessible deposits of marble and limestone are available elsewhere in southern California.

Uranothorite occurrence near Alger Creek

Three lenticular masses of reddish-brown coarse-grained microcline-rich pegmatite containing disseminated uranothorite are exposed in an open cut near Alger Creek, just south of the San Gorgonio Wilderness (site 2). A quantity of ore totalling less than 10 tons was shipped from this area in 1954 (Hewett and Stone, 1957). The lenses are en echelon and are a maximum of 3.5 ft thick and 48 ft long. Samples analyzed by us contain from 0.01 to 0.08 percent U_3O_8 (average of 0.02 percent). By comparison, most commercial uranium deposits being mined today contain at least 0.1 percent U_3O_8. Due to their small size and low grade, the uranothorite-bearing pegmatite lenses near Alger Creek cannot be considered a significant source of uranium or thorium either now or in the near future. The low radioactive-mineral potential inferred for the Alger Creek area is corroborated by the airborne radiometric survey (Pitkin and Duval, 1981), which did not detect abnormal levels of gamma radiation in this vicinity.

Additional observations on mineral resources and mining activity

The two other known sites of prospecting activity similarly show no evidence of significant mineralization. A prospect pit at the claim on the East Fork of Barton Creek exposes a barren quartz vein in gneiss (site 3). The mine shaft north of San Gorgonio Mountain (site 4) is collapsed; no conspicuous mineralization is present at the surface in the granitic country rock. Samples of dump material contain only traces of gold, silver, and lead. Despite remarks by local residents, we found no evidence of silver mineralization at the head of Mill Creek, nor did we observe evidence of significant gold mineralization in analyses of vein quartz collected near Fish Creek. Potential construction materials are locally present in the wilderness. These include sand and gravel as well as granitic rocks that could be used as riprap. However, all these occurrences presently are of little interest because deposits of equal or better quality are available in areas of southern California that are more accessible and closer to markets.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Geologic, geochemical, and geophysical investigations conducted within the San Gorgonio Wilderness suggest that few significant targets for mineral resource exploration exist within the area. Historic mining activity in the wilderness and adjacent areas has been limited, small scale, and short lived compared to mining operations in nearby districts to the north and east. Therefore, we believe that most of the San Gorgonio Wilderness has low potential for metallic and radioactive minerals, construction materials, fossil fuels, and geothermal resources. Small-scale base- and precious-metal mineralization may be present along the East Fork of Whitewater River south of San Gorgonio Mountain, as suggested by the localization of iron-oxide stains, small bodies of skarn, and several prominent geochemical anomalies in that drainage basin. Accordingly, we infer low to moderate potential for base- and precious-metal resources in the watershed of the East Fork of Whitewater River.

In the event that future mineral resource studies are conducted in the San Gorgonio Wilderness, we recommend the following approaches: (1) detailed mapping and geochemical studies of skarn deposits on the south and east flanks of San Gorgonio Mountain in relation to potential occurrences of molybdenum and tungsten; (2) detailed mapping and geochemical studies of iron-stained gneiss along the East Fork of Whitewater River in relation to possible vein occurrences or disseminated occurrences of base or precious metals; and (3) further geochemical and mineralogic studies to evaluate the significance of widespread high concentrations of the rare-earth elements cerium and lanthanum determined by our geochemical survey of stream sediments.

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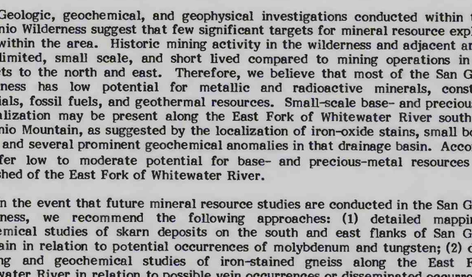

Classification of plutonic rock types
(from Streckeisen, 1973)

MINERAL RESOURCE POTENTIAL MAP OF THE SAN GORGONIO WILDERNESS, SAN BERNARDINO COUNTY, CALIFORNIA

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and

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U.S. Bureau of Mines

1983

Explanatory pamphlet accompanies map

Interior—Geological Survey, Reston, Va.—1983

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