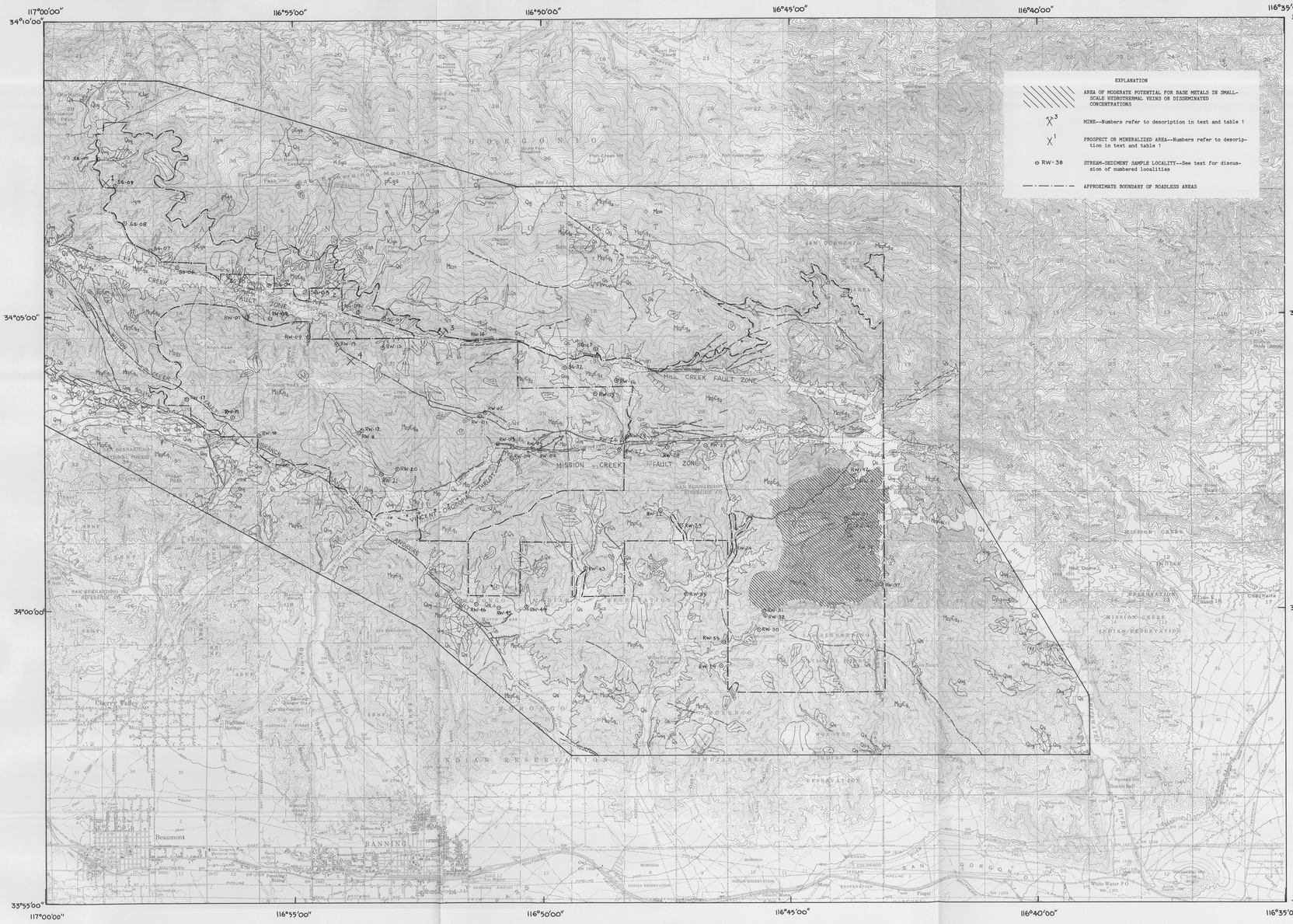
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1563-A




Base from U.S. Geological Survey, 1:62,500, San Gorgonio White, 1954; Mentone Valley, 1955; Banning, 1956; Palm Springs, 1957.

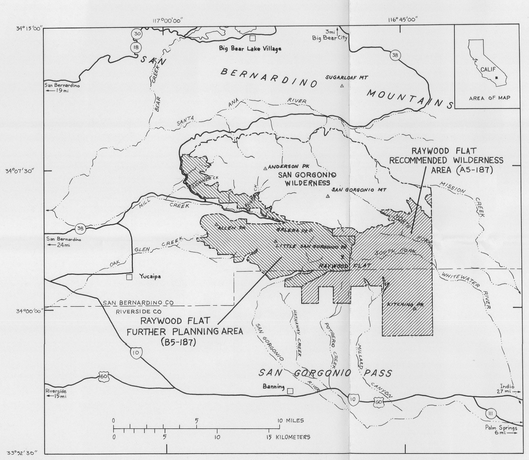
Geology mapped by D. M. Morton, 1976-1979; J. C. Matti and B. F. Cox, 1978-1981.

SCALE 1:62,500

CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION, 1983

Explanatory pamphlet accompanies map




INDEX MAP SHOWING LOCATION OF THE RAYWOOD FLAT ROADLESS AREAS (FURTHER PLANNING AREA B5-187 AND RECOMMENDED WILDERNESS AREA A5-187), SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIF.

CORRELATION OF MAP UNITS

| Map units | Period | Era |
|---|---|---|
| Qs, Qg, Qog | QUATERNARY | CENOZOIC |
| Tp, Tph | TERTIARY | CENOZOIC |
| KJgo, KJgc | CRETACEOUS OR JURASSIC | CENOZOIC |
| Jgm | JURASSIC | MESOZOIC |
| Mzm, Mzgy | | MESOZOIC |
| MzpCg, MzpCgg | | MESOZOIC TO PRECAMBRIAN |
| PzpCm | PALEOZOIC AND (OR) PRECAMBRIAN | PALEOZOIC AND PRECAMBRIAN |
| pCgs | PRECAMBRIAN | PRECAMBRIAN |
| ps | AGE UNCERTAIN | |

DESCRIPTION OF MAP UNITS

Qs SURFICIAL DEPOSITS (QUATERNARY)--Unconsolidated to consolidated alluvium and colluvium consisting of sand, pebbly sand, and gravel. Includes alluvium of active stream channels as well as alluvium of inactive deposits and older, slightly dissected deposits

Qg GLACIAL DEPOSITS (QUATERNARY)--Unconsolidated to slightly consolidated sand and pebble- to boulder-gravel deposits of alpine glaciers

Qog OLDER GRAVEL DEPOSITS (QUATERNARY)--Unconsolidated to consolidated sand, pebbly sand, and gravel that is well dissected and exhibits well-developed pedogenic soil cover

Tp POTATO SANDSTONE OF VAUGHAN (1922) (TERTIARY)--Nonmarine sandstone, pebbly sandstone, cobble conglomerate, and mudstone; includes the sandstone and conglomerate units mapped by Dibblee (1964, Tps and Tpc)

Tph PAINTED HILL FORMATION OF ALLEN (1958; 1957) (TERTIARY)--Nonmarine sandstone, pebbly sandstone, and pebble-cobble conglomerate

ps PELONA SCHIST (AGE UNCERTAIN)--Well foliated, chlorite-actinolite-albite-epidote greenstone associated with minor metachert, metasiltite, and carbonate. Age of protolith probably is Mesozoic, although some workers suggest that protolith may include rocks as young as Paleocene (Evans, 1982); metamorphism to greenschist facies may have occurred in Paleocene time

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

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

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

Mzgy GRANODIORITE OF YUCAIPA RIDGE (MESOZOIC)--Foliated, coarse-grained biotite granodiorite

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

$MzpCg_1$ GRANITIC ROCKS AND GRANITIC GNEISS SOUTH OF THE MISSION CREEK FAULT ZONE--Texturally foliated granitic rock, gneissic granite rock, and compositionally layered 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

$MzpCg_2$ GRANITIC ROCKS AND GRANITIC GNEISS NORTH OF THE MISSION CREEK FAULT ZONE--Heterogeneous, texturally foliated to compositionally layered granitic rocks and granitic gneiss; mainly biotitic; contains scattered inclusions of biotite-sillimanite-garnet schist, metaquartzite, and marble. The unit mainly consists of anatectic and migmatitic plutonic rocks and deformed plutonic rocks of Mesozoic age, although prebatholithic rocks of Precambrian age may occur along with the metasedimentary inclusions. Unit previously termed "undivided heterogeneous gneissic granitoid rocks" by Morton and others (1980)

PzpCm METASEDIMENTARY ROCKS (PALEOZOIC AND (OR) PRECAMBRIAN)--Marble and metaquartzite mapped by Dibblee (1964)

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

CONTACT

FAULT--Dashed where approximately located; dotted where concealed. Arrows indicate direction of relative movement. Bar and ball on downthrown block; hachures indicate scarp

THRUST FAULT--Dotted where concealed. Sawteeth on upper plate

CRUSHED AND SHEARED ROCK IN FAULT ZONE

LANDSLIDE DEPOSIT--Arrows show inferred direction of movement

# MINERAL RESOURCE POTENTIAL MAP OF THE RAYWOOD FLAT ROADLESS AREAS, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA

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1983

## 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 resource potential survey of the Raywood Flat Roadless Areas (A5-187, B5-187), San Bernardino National Forest, San Bernardino and Riverside Counties, California. During the Second Roadless Area Review and Evaluation (RARE II) by the U. S. Forest Service in January 1979, area A5-187 was classified as a recommended wilderness area and area B5-187 was classified as a further planning area.

## SUMMARY

Geologic, geochemical, and geophysical studies within the Raywood Flat Roadless Areas were conducted by the U.S. Geological Survey in 1979-1981; mines and prospects within the further planning area were investigated by the U.S. Bureau of Mines in 1982. These studies led to our identification of nonmetallic mineral resources at a marble mine in the further planning area, and to our recognition of a small area in the recommended wilderness that has moderate potential for base-metal resources. Except for these two areas of identified and suspected resources, elsewhere in the Raywood Flat Roadless Areas we did not observe indications of resource[1] potential.

The area having nonmetallic mineral resources is in the vicinity of the Mill Creek mine near the northeastern boundary of the further planning area (B5-187); there, we identified marginal reserves of marble suitable for the production of lime and construction stone. The reserves are marginal because of their remote location and poor accessibility. Geologic mapping did not reveal any additional marble occurrences within the study area.

The area having moderate potential for base-metal resources forms a small zone in the eastern part of the recommended wilderness (A5-187). Within this zone, evidence provided by stream-sediment geochemistry suggests that crystalline bedrocks in several drainages contain concentrations of metallic elements. Because the terrain is inaccessible and covered with dense brush, most of the bedrock in the specific drainages that contain the geochemical anomalies could not be examined. Thus, although we infer that mineral occurrences exist in the drainage basins, we have little data on which to base an estimate of their extent and quality. Locally, the crystalline rocks probably contain hydrothermal veins or disseminated occurrences where lead, copper, molybdenum, tin, cobalt, bismuth, and arsenic have been concentrated. However, the geochemical anomalies for these metals are small, and the stream drainages also are relatively small. Therefore, the inferred occurrences of metallic minerals probably are small scale, scattered, and low grade. There is only low probability that the inferred mineral occurrences are large scale.

## INTRODUCTION

The Raywood Flat Roadless Areas consist of a further planning area and a recommended wilderness area that are located in the southeastern San Bernardino Mountains, about 35 mi east of San Bernardino and about 10 mi north of Banning, Calif. (fig. 1). The further planning area (B5-187) constitutes about 29 $mi^2$ (18,610 acres); the recommended wilderness area (A5-187) constitutes about 35 $mi^2$ (22,320 acres).

## GEOLOGY

The Raywood Flat Roadless Areas are underlain mainly by crystalline bedrock that consists of granitoid plutonic rocks, gneissic plutonic rocks, and uncommon bodies of metasedimentary rock. The plutonic rocks and their gneissic equivalents include monzogranite, granodiorite, quartz diorite, and quartz monzodiorite (rock classification follows Streckeisen, 1973). Valley and upland areas locally contain Quaternary deposits of gravel and sand (Raywood Flat itself is an intermontane upland valley that is mantled with dissected deposits of older gravel), and large and small landslides are developed on some hillslopes. Three strands of the San Andreas fault system occur in the vicinity of the Raywood Flat Roadless Areas--the Mission Creek fault, the Mill Creek fault, and the south branch of the San Andreas fault. The south branch presently is the active strand of the San Andreas system. Although the Mill Creek and Mission Creek faults both appear to be strands that have been abandoned by the San Andreas system, many miles of right-lateral displacement on these two faults have carried rocks northwestward into the Raywood Flat area from their original location in the Salton trough area.

Although geologic environments that commonly are favorable for the development of mineral deposits occur in the Raywood Flat Roadless Areas, we did not observe evidence for significant occurrences of precious and base metals or energy minerals. Favorable sites for mineralization in the study area might be expected in the following generalized geologic settings: (1) metasedimentary rocks that could contain contact-zone metasomatic replacement deposits; (2) injection pegmatites and pegmatitic metamorphic segregations that could contain deposits of metallic or radioactive elements; (3) foliated and gneissic granitoid rocks that could contain disseminated deposits of metals, radioactive elements, or rare-earth elements; (4) quartz veins or other vein-type deposits that result from hydrothermal mineralizing systems; (5) layered greenstone units of Pelona Schist that could contain massive-sulfide deposits; and (6) Quaternary sand and gravel deposits that could contain placer accumulations of precious metals, radioactive minerals, or rare-earth elements. Our examination of rocks within the Raywood Flat Roadless Areas suggests that, although small-scale mineral occurrences may exist locally, these generalized geologic environments probably have not been the sites of large-scale mineralization.

## GEOCHEMISTRY

A reconnaissance geochemical survey of stream sediments in the Raywood Flat Roadless Areas was conducted for 32 major, minor, and trace elements to identify any spatial variations in stream-sediment chemistry that might reflect local concentrations of ore minerals. The results of the geochemical survey are discussed by Matti and Cox (1983).

The patterns of chemical composition determined by the stream-sediment geochemical survey of the Raywood Flat Roadless Area do not indicate significant large-scale mineralization within the study area. Few elemental values are anomalous with respect to the average geochemical background for the study area; most of the analyses fall within ranges that are reasonable for nonmineralized crystalline rocks and derivative stream sediment. Geochemical evidence thus is compatible with geologic evidence: both reconnaissance tools suggest that large-scale occurrences of metallic or nonmetallic minerals probably do not exist in the Raywood Flat Roadless Areas.

Anomalous and elevated values for uranium, thorium, lanthanum, niobium, yttrium, and zirconium, occur in stream-sediment samples throughout the Raywood Flat Roadless Areas, although most commonly in the further planning area (B5-187) north of the Mission Creek and Mill Creek fault zones. Elevated or anomalous values for beryllium and rare-earth elements and transition metals probably reflect higher-than-average background levels for these elements rather than local concentrations of ore minerals. These elements probably occur in common rock-forming non-ore minerals like sphene, zircon, apatite, allanite, and epidote that we have observed in thin sections of the crystalline rock units.

In scattered panned-concentrates, metallic elements were detected in amounts that exceed background values; these elevated values indicate that local mineral concentrations may exist in the study area. The origin of these anomalies is unknown. However, their geologic sources probably are limited in size and distribution because the anomalies are not large and because they generally do not show systematic geographic patterns or clustering. The anomalies probably are not related to significant mineral occurrences; instead, they probably represent localized small-scale occurrences in quartz veins, in injection pegmatites and pegmatitic segregations in the layered gneiss, or in various kinds of igneous dikes.

Stream-sediment samples from the east end of the recommended wilderness (A5-187) contain geochemical anomalies which indicate that mineralizing processes have taken place within the crystalline rocks of several adjacent stream drainages. Geographic clustering of these anomalies suggests that the area drained by the streams forms a distinct zone where metal-concentrating processes not only have occurred but have been sufficiently intense to be detected consistently by the reconnaissance geochemical method. Anomalous or higher-than-background values for several metals occur in panned concentrates from the following stream-sediment localities: RW-31 (1,500 ppm lead); RW-36 (700 ppm arsenic); RW-38 (10,000 ppm barium, 1,500 ppm lead, 500 ppm copper, 70 ppm molybdenum, 30 ppm bismuth, 100 ppm cobalt; anomalous lead and barite also occur in the bulk-sediment sample from this locality); RW-39 (150 ppm tin); RW-40 (500 ppm lead, 100 ppm tin); RW-41 (700 ppm lead, 100 ppm molybdenum, 20 ppm bismuth, 70 ppm cobalt); and RW-42 (700 ppm lead, 150 ppm molybdenum). Steep brush-covered topography prevented our examination of much of the bedrock in the drainages sampled by RW-31, -36, -38, -39, -40, -41, and -42. Consequently, we have no direct evidence for the type or scale of mineralization that may have occurred in this vicinity and can only infer that mineral occurrences exist here. Metallic mineralization here may reflect occurrences of minerals in disseminated concentrations. However, the lead-barium-bismuth-copper-molybdenum suite from sample RW-38, together with tin, molybdenum, lead, and arsenic in the other samples, is a suite of elements commonly found in veins and replacement bodies of hydrothermal origin. The barium anomaly in RW-38 probably is derived from barite, a common gangue mineral in lead-bearing hydrothermal veins. Thus, we suspect that this part of the recommended wilderness contains small-scale hydrothermal quartz-barite veins containing base metals.

## GEOPHYSICS

Two aerial magnetic surveys of the southern San Bernardino Mountains were flown in 1978 and 1979 as part of mineral resource investigations for the San Gorgonio Wilderness and Raywood Flat Roadless Areas (J. A. Pitkin, J. S. Duvall, and H. W. Oliver, unpub. data, 1978; U.S. Geological Survey 1979). The magnetic data have been analyzed by H. W. Oliver (in Cox and others, 1983; unpub. data, 1983). Rocks within the Raywood Flat study area are overlapped by both aerial surveys. The magnetic patterns and anomalies within the study area are not unexpected for the kinds of crystalline rocks exposed here, and there is no aeromagnetic evidence for mineralization within the Raywood Flat Roadless Areas.

Gravity measurements in the Raywood Flat Roadless Areas were made in 1981 to complete a larger gravity survey of the San Bernardino 1° by 2° quadrangle (Tang and Ponce, 1982; Biehler and others, 1983). The gravity data provide no evidence for mineralization within the study area.

## MINING DISTRICTS AND MINERALIZATION

Personnel from the U.S. Bureau of Mines Western Field Operations Center studied mineral resources of the Raywood Flat further planning area (B5-187) in 1982. County mining records were examined to determine claim locations. Library research was done to provide historical, geologic, and mineral resource data. Field studies included examining and sampling mines and prospects. A total of eight lode samples were taken from mineralized structures; five placer samples were taken from gravel deposits. The U.S. Bureau of Mines did not conduct a survey of mines and prospects for the recommended wilderness area (A5-187).

### History and production

The Mill Creek mining district covers Mill Creek Canyon and the northern half of the further planning area. The mineral commodities produced from this district consist of grouse marble (possibly used for manufacture of lime) from the Mill Creek mine (site 3), uranium-thorium ore from the St. Patrick mine (site 2), and construction stone from the Cable mine a few miles west of the study area. The Bear Valley mining district, 9 mi north of the study area, yielded placer gold and limestone.

Since 1891, about 9 placer claims and 160 lode claims have been filed within the Raywood Flat further planning area, and 60 placer claims and 170 lode claims have been located near the area. There are no active claims, patented claims, or mining leases in the further planning area.

### Mines and prospects

Mines and prospects examined in the Raywood Flat further planning area are described in table 1.

Marble workings in Mill Creek.--Marble has been quarried at the Mill Creek mine on the north wall of Mill Creek Canyon (site 3). The workings are located in the largest and easternmost of three lenticular marble bodies enclosed by granitic gneiss and intruded by monzogranite. The marble is white and crystalline, and locally hosts narrow, discontinuous garnet-epidote tactite pods which contain minor scheelite.

St. Patrick mine.--Three uranium- and thorium-bearing pegmatite bodies that occur in granitic gneiss are exposed in bulldozed cuts at the St. Patrick mine (site 2). The pegmatite lenses probably formed as metamorphic segregations within the granitic gneiss. They consist of reddish-brown, coarse-grained microcline and quartz, with small amounts of uranothorite. The dikes measure a maximum of 3.5 ft thick and 48 ft long. The lenticular bodies are en echelon, and their northeast strike and southeast dip are conformable with foliation of the granitic gneiss. Similar pegmatitic dikes and lenses occur in the unit of biotite-rich Precambrian gneiss and also in the units of monzogranite and quartz monzodiorite. The Mountain Home prospect (site 1) is developed in pegmatite that cuts the porphyritic quartz monzodiorite unit. Only the pegmatites at the St. Patrick mine are known to contain radioactive minerals.

[1]The definition of resource follows established useage of the U.S. Bureau of Mines and U.S. Geological Survey (1980): "A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible". Defined in this broad fashion, a resource can contain extractable material (reserves) that can be developed now, and (or) additional material (marginal reserves, subeconomic resources) that feasibly may be developed in the future under more favorable market conditions and (or) with more advanced technological capability.

## ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Geologic, geochemical, and geophysical studies within the Raywood Flat Roadless Areas, together with an investigation of mines and prospects within the further planning area, resulted in our identification of nonmetallic mineral resources at a marble mine in the further planning area, and in our recognition of a small area in the recommended wilderness that has moderate potential for base-metal resources. Except for these two areas of identified and suspected resources, we did not observe indications of resource potential elsewhere in the Raywood Flat Roadless Areas. These mineral resource assessments are based on the following considerations:

(1) Geologic mapping within the study area revealed several geologic environments potentially favorable for metallic or nonmetallic mineralization. However, we did not observe evidence of significant mineral occurrences that might have formed in these environments.

(2) Generally low concentrations of metallic and radioactive elements, determined by chemical analyses from 56 stream-sediment and panned-concentrate samples, indicate that elemental abundances generally fall within background ranges expected for nonmineralized rocks. In the recommended wilderness (A5-187), the small area having geochemical anomalies for base metals is an exception to this generalization.

(3) Aeromagnetic patterns and gravity data do not indicate concentrations of magnetic minerals or minerals of high or low density.

(4) Prospecting activities have been limited and short lived, production has been limited to small amounts of marble and low-grade uranium ore from abandoned workings in the further planning area (B5-187), and no large deposits of metallic, nonmetallic, or radioactive minerals have been discovered. In view of extensive prospecting conducted in the San Bernardino Mountains for mineral deposits similar to those of the Holcomb Valley and Bear Valley districts about 20 mi north of the study area, the absence of significant historical workings in the vicinity of the Raywood Flat Roadless Areas reflects the generally low mineral resource potential of rocks in this area.

### Discussion of base-metal potential

Geochemical anomalies for base metals were detected in several small streams that drain an area in the eastern part of the recommended wilderness (A5-187). Anomalies for lead, molybdenum, copper, tin, bismuth, cobalt, barium, and arsenic occur in the panned-concentrate fractions of stream-sediment samples from several drainages that occur in this part of the study area. Because the terrain is inaccessible and covered with dense brush, all the bedrock in these drainages could not be examined; hence, the origin of the metallic anomalies is unknown. Thus, although we infer that mineral occurrences exist in the drainages, we have little data on which to base an estimate of their extent and quality. The mineral occurrences probably are in hydrothermal quartz-barite veins or in small-scale disseminated concentrations.

The geochemical evidence suggests that there is a high probability that mineral occurrences of some kind exist in the drainage basins. However, there is only low probability that the occurrences are large scale; more likely, they are small scale and scattered. This interpretation is based on three arguments:

(1) Geologic setting--Although we were not able to examine all the rocks in this area, those that we did examine are similar to other foliated and gneissic granitoid rocks in this part of the recommended wilderness that occur in the upper plate of the Vincent-Orocopia thrust. Here and elsewhere in the upper plate, we did not observe extensive quartz-vein networks or large areas of stained or altered rock that would provide surficial evidence for large-scale base-metal mineralization in hydrothermal veins or disseminated concentrations.

(2) Geochemical evidence--The stream drainages that yielded anomalous metallic values are fairly small, and the geochemical anomalies themselves are not large. Therefore, any mineral occurrences containing base metals also are likely to be small and scattered.

(3) Base-metal occurrences elsewhere in the region--The probable scale of mineral occurrence in the area of geochemical anomalies can be estimated crudely by analogy with what is known about metallic mineral occurrences in similar geologic terranes elsewhere in southern California. Rocks similar to those in the recommended wilderness occur in the eastern San Gabriel Mountains, 45 mi west of the Raywood Flat Roadless Areas. A comparison between the two areas is valid not only because rocks in the upper plate of the Vincent-Orocopia thrust are similar in both areas, but because this geologic terrane probably once was continuous between the southeastern San Bernardino Mountains and the eastern San Gabriel Mountains and subsequently was dismembered and offset by strike-slip displacements on various fault systems in this part of southern California. In the eastern San Gabriel Mountains, large-scale mineral deposits containing lead, copper, molybdenum, and tin have not been discovered, although isolated small-scale occurrences of base metals have been identified and interpreted as accessory metals associated with tungsten and gold. Tungsten and gold occurrences in quartz and carbonate veins have been the targets of mineral exploration in the San Gabriel Mountains and have produced small amounts of ore, but base-metal occurrences have not produced any ore (Gay and Hoffman, 1954; Ridenour and others, 1982; Zilka and Schmauch, 1982). Gold and tungsten were not detected in the Raywood Flat stream-sediment samples that contain base metals. Using previous experience in the eastern San Gabriel Mountains as a guide, it is unlikely that large-scale mineral occurrences containing base metals exist in rocks underlying the Raywood Flat Recommended Wilderness.

Based on these three arguments, we conclude that bedrock in the area of geochemical anomalies has moderate potential for base metals in hydrothermal veins or in disseminated occurrences. The potential is moderate because two parameters are satisfied by our studies: (1) geologic and geochemical data provide suggestive evidence that mineral-concentrating processes have taken place; and (2) we recognize some conditions of an occurrence model for the type of metallic mineralization (hydrothermal quartz-barite veins), even though evidence for these conditions is fragmentary or ambiguous. Although we assign moderate resource potential to this area, any undiscovered mineral occurrences that might exist in this area probably are not important mineral deposits. Moreover, the size of the area having moderate resource potential probably is much smaller than the area actually containing mineral occurrences, as the boundaries are arbitrary and were drawn to enclose all drainage basins that contain stream-sediment geochemical anomalies.

### Discussion of nonmetallic resources and energy resources

The Mill Creek mine has about 5.5 million tons of demonstrated marginal reserves of marble suitable for lime, chemicals, cement, and construction material; however, nearly all the marble reserves are outside the further planning area (B5-187). Although marble has been produced from this deposit and possibly used for lime, we classify the reserves as marginal because of their remote location and inaccessibility. Similar or better deposits elsewhere are closer to major markets, are more accessible, and therefore incur lower transportation costs.

Stone and deposits of sand and gravel in the study area are suitable for construction uses, but similar or better deposits elsewhere in southern California are closer to major markets. Consequently, those in the study area are subject to higher transportation costs.

Pegmatite and uranium totalling less than 10 tons was shipped from the St. Patrick mine in 1954 (Rewett and Stone, 1957), at about the same time that other small uranium deposits, including the Thum Bum claim near Big Bear Lake (Troxel and others, 1957, p. 671), were being developed elsewhere in the eastern San Bernardino Mountains. Samples of the pegmatite that we analyzed contain 0.019 and 0.002 percent uranium oxide ($U_3O_8$), and 0.159 and 0.35 percent thorium. By comparison with most commercial uranium deposits being mined today that contain at least 0.1 percent $U_3O_8$, the uranothorite-bearing occurrences at the St. Patrick mine are small and low grade. The absence of significant radioactive-mineral resources at the St. Patrick mine is corroborated by an airborne radiometric survey (Pitkin and Duval, 1981), which did not detect abnormal levels of gamma radiation in this vicinity.

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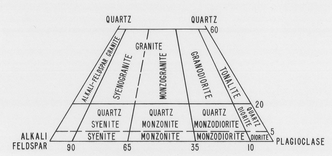


Classification of plutonic rock types (modified from Streckeisen, 1973)

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