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MINERAL RESOURCE POTENTIAL OF THE ROADLESS AREAS AND THE SANTA LUCIA WILDERNESS IN THE LOS PADRES NATIONAL FOREST, SOUTHWESTERN CALIFORNIA

SUMMARY REPORT

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Santa Lucia Wilderness and 22 roadless area that consist of the Sespe-Frazier, Garcia Mountain, Black Mountain, La Panza, Machesna Mountain, Los Machos Hills, Big Rocks, Stanley Mountain, Miranda Pine, Horseshoe Springs, Tepusquet Peak, La Brea, Spoor Canyon, Fox Mountain, Diablo, Matilija, Dry Lakes, Sawmill-Badlands, Cuyama, Antimony, Quatal and Little Pine Roadless Areas. All the roadless areas occur in the Los Padres National Forest, Kern, Los Angeles, San Luis Obispo, Santa Barbara, and Ventura Counties, California. The Santa Lucia Wilderness was established by Public Law 95-237 in 1978. The twenty-two roadless areas were classified as further-planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The study area in the Los Padres National Forest contains mines, prospects, and occurrences that contain identified resources of antimony, barite, bentonitic clay, building stone (sandstone and marble), copper, gold, gypsum, petroleum, phosphate rock, silver, uranium, and zinc, but geologic and geochemical investigations generally indicate little potential for the presence of these mineral commodities at other localities within the study area. The few areas with potential for additional mineral resources are associated with those containing known resources or are present in similar geologic settings. Anomalies identified from our geochemical study are related to localities previously known for mineralization; no new areas of mineral resource potential were delineated as a result of the geochemical study.

Several roadless areas contain resources or reserves (see table 1): the Sespe-Frazier Roadless Area (RA) contains bentonitic clay, lode gold, gypsum, petroleum, and phosphate rock; the Black Mountain RA contains uranium; the Horseshoe Spring RA contains building stone (sandstone); the La Brea RA contains barite, copper, and zinc; the Fox Mountain RA contains phosphate rock; the Cuyama RA contains gypsum; the Antimony RA contains antimony, building stone (marble), gold, and silver; and the Quatal RA contains bentonitic clay.

Phosphate-rock reserves in the Sespe-Frazier RA are minable under 1982 conditions. Bentonitic clay in the Sespe-Frazier RA and sandstone in the Horseshoe Spring RA are marginal reserves because reserves outside the study area meet current market demands. Marble and other sandstone deposits in the study area are subeconomic resources because of high transportation costs and occurrences outside the study area which supply current needs. The deposits of antimony, barite, copper, gold, gypsum, silver, uranium, and zinc contain either marginal reserves or subeconomic resources because of combinations of low commodity prices, generally low grade and tonnage, high mining and benefication costs, and poor access.

Petroleum will probably continue to be found in and around the Sespe oil fields and may be present below thrust faults in two parts of the study area in the Sespe-Frazier RA.

Low to moderate potential exists for the presence of undiscovered antimony resources in part of the Antimony RA. Low to moderate potential exists for the presence of undiscovered barite resources throughout the study area. Low to moderate potential exists for the presence of additional low-grade lode gold resources in parts of the Sespe-Frazier and Antimony RAs. Low to moderate potential exists for the presence of low-grade mercury resources in part of the Stanley Mountain RA. A low to moderate potential exists for the presence of undiscovered oil and gas in Miocene and younger rock throughout the study area, and a moderate potential exists for the presence of undiscovered oil and gas at two localities in the Sespe-Frazier RA. A low to moderate potential exists for the presence of low-grade uranium resources at depth in parts of the Black Mountain RA.

INTRODUCTION

This report summarizes the results of a mineral survey in the Santa Lucia Wilderness and 22 roadless areas, consisting of the Sespe-Frazier, Garcia Mountain, Black Mountain, La Panza, Machesna Mountain, Los Machos Hills, Big Rocks, Stanley Mountain, Miranda Pine, Horseshoe Springs, Tepusquet Peak, La Brea, Spoor Canyon, Fox Mountain, Diablo, Matilija, Dry Lakes, Sawmill-Badlands, Cuyama, Antimony, Quatal and Little Pine Roadless Areas. These roadless areas all occur in the Los Padres National Forest, Kern, Los Angeles, San Luis Obispo, Santa Barbara, and Ventura Counties, California (fig. 1). For purposes of this report the individual areas are referred to collectively as the study area. The roadless areas individually range from about 2 to 523 mi^2 (fig. 1) and the study area totals some 1336 mi^2.

The multidisciplinary study was conducted jointly by the U.S. Geological Survey and the U.S. Bureau of Mines in

1980 through 1983. The Bureau of Mines conducted investigations that included field mapping, sampling of mines, prospects, and mineralized areas, mining-claim searches, and literature reviews. The Geological Survey studied mineralized areas and searched for previously unknown mineral occurrences using geologic, geophysical, and geochemical techniques.

Location and accessibility

The study area is in the Los Padres National Forest in the southern part of the Coast Ranges and western part of the Transverse Ranges of California. It forms an elongate curved area between U.S. Highway 101 on the west and Interstate 5 on the east. California State Highways 33, 58, and 166 provide paved approaches to numerous paved and unpaved roads that generally allow access to within a quarter mile of the borders of the various roadless areas. Trails provide access into many parts of most roadless areas.

Topography and vegetation

The study area is mostly characterized by steep-walled canyons and sharp ridges. Mountain top altitudes vary from 2,868 ft at Lopez Mountain in the Santa Luca Wilderness to 8,831 ft at Mt. Pinos in the Sawmill-Badlands Roadless Area. Although some summit ridges support forests of coniferous trees and riparian woodlands line some valley bottoms, impenetrable chaparral covers much of the vegetated portion of the study area. Mixtures of manzanita, buckbush, chamise and poison oak characterize the chaparral plant community and make off-trail traverses quite challenging and slow.

Sources of data

This report is based upon data derived from various disciplines involved in the investigation of the study area, which are described in reports on the geology (Frizzell and Vedder, 1985), inorganic geochemistry (Smith and others, 1985; Adrian and others, 1984), organic geochemistry (Frizzell and Claypool, 1983; Frederickson, 1985), geophysics (Griscom, 1985a, b; Dickinson, 1982; Dickinson and others, 1982), and investigations of mines and prospects (Avery, 1981; Barnes, 1981; Benham, 1983; Benham and McCulloch, 1981; Capstick and Hyndman, 1982a, b; Denton, 1982; Gabby, 1981; Hale and others, 1983; Horn, 1983; Kuizon, 1981, 1982, 1983 a, b, c, d; Lambeth, 1982; Lipton, 1981; Longwill, 1982; McCulloch and Neuman, 1982; Sabine and Esparza, 1981; and White, 1982a, b), which are summarized by U.S. Bureau of Mines (1985). Preliminary conclusions based upon all of these data were presented in Frizzell and Hale (1983) and Frizzell and Kuizon (1983a, b).

Other mineral resource evaluations have been carried out for different parts of the Los Padres National Forest. These include a study of mineral resources in the San Rafael Primitive Area (Gower and others, 1966), the Ventana Primitive Area (Pearson and others, 1967), and additions to the Ventana Primitive Area (Seiders and others, 1983). Mineral occurrences for the Antimony RA are discussed in a county report by Troxel and Morton (1962). Weber and others (1973) describe mineral occurrences in the southern part of Ventura County.

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GEOLOGY AND STRUCTURE

Despite its large size, much of the study area is composed of similar rock types. Thick sequences of Mesozoic and Cenozoic sedimentary rocks underlie most of the study area (fig. 2). These sedimentary rocks overlie crystalline basement rocks composed mostly of pre-Tertiary metamorphic and igneous intrusive rocks. Many maps and articles showing or discussing the geology of the study area are cited by Frizzell and Vedder (1985).

Large areas underlain by pre-Tertiary metamorphic and intrusive rocks occur in both the extreme northeastern and northwestern parts of the study area. Included are undifferentiated metasedimentary rocks distributed as screens and pendants within the plutonic rocks. These metasedimentary rocks include layered to spotted mica schist, metasandstone, metaquartzite, amphibolite, marble and minor calc-silicate rock, and greenschist. Also included in the unit are undifferentiated Precambrian granitic gneisses, Mesozoic granitic and ophiolitic rocks, and minor Tertiary igneous rocks.

Most of the rest of the study area is underlain by highly folded, in part chaotic, pre-Neogene sedimentary rocks. They comprise a thick, heterogeneous, incomplete marine section of interbedded sandstone, siltstone, shale, conglomerate and minor marble, ranging in age from Late Jurassic to Oligocene, with local nonmarine interbeds.

Neogene (Miocene and Pliocene) marine sedimentary rocks include organic-rich siltstone and shale, interbedded sandstone, and lesser conglomerate. These rocks formed mostly from sediments deposited in relatively restricted marine basins where the organic remains of aquatic flora and fauna living in the water column constituted a relatively important source of sediment. Neogene nonmarine rocks occur mostly in the Cuyama Badlands, Lockwood Valley, and along the eastern boundary of the study area in the Ridge Basin. These reddish rocks include interbedded arkosic sandstone, claystone, conglomerate, and bentonitic clay representing alluvial-fan, stream, and lacustrine deposits.

Several major and numerous minor faults traverse the study area and exhibit offsets ranging from a few feet to 150 mi. Some of these faults have created physio-chemical environments that locally control the presence of minerals. For example, the low-grade mercury deposits at the Deer Trail mine near the Stanley Mountain RA are in rocks fractured in response to movements on nearby faults. Faults create barriers through which fluids, such as oil and gas, cannot move; in addition, if the overriding fault block is thick enough, temperatures can be elevated within the overridden block. Faults having some thrust component include the South Cuyama and the Pine Mountain faults, and the San Cayetano thrust.

In addition to being faulted, the sedimentary rocks in the study area are generally much folded. Anticlines traditionally are important traps for oil and gas. These structural features are delineated on maps more detailed than the one presented herein (see Vedder and others, 1973; Dibblee, 1973; and numerous references in Frizzell and Vedder, 1985).

GEOPHYSICAL STUDIES

Geophysical studies included the compilation and analysis of gravity, magnetic, and radiometric data (Griscom, 1985a, b; Dickinson, 1982; Dickinson, and others, 1982). The gravity data indicate relatively thin sections of Neogene rock in the southern half of the Santa Lucia Wilderness and south of the South Cuyama oil field in the northern Fox Mountain RA. It confirms thicker amounts of Neogene sedimentary rocks below the San Cayetano thrust in the southern part of the Sespe-Frazier RA and also may indicate a small amount of Neogene sedimentary rocks below the Pine Mountain fault at Pine Mountain. Magnetic data reflect the presence of granitic bedrock highs and indicate ultramafic rocks, but the data do not provide information on mineral deposits in the study area.

Although the radiometric data are equivocal, rather distinct radiometric anomalies occur over claims on Superior Ridge south of the study area and in the Hartman Ranch area in the upper Sespe drainage. Uranium mineralization has occurred in the lower part of the Sespe Formation in both these areas.

GEOCHEMISTRY

Inorganic geochemistry

A reconnaissance geochemical study was undertaken in 1981 and 1982 to assist in the evaluation of the mineral resource potential of the study area (Smith and others, 1985; Adrian and others, 1984). Several sample media were used in this study. The initial reconnaissance sampling consisted of stream sediments and panned concentrates from stream sediments. Selected rock samples were also taken from some mines and prospects to determine suites of elements related to mineralization and also from geologic units to determine geochemical background values. In addition, 16 water samples were taken from springs to determine if any mineralizing processes are operating in the ground waters of the region. During followup studies, an additional 47 rock samples were taken from areas that showed anomalous (above average for the study area) elemental concentrations in stream-sediment and/or panned-concentrate samples. In total, 451 stream-sediment, 451 panned-concentrate, 95 rock, and 16 water samples were taken for the geochemical study.

Stream sediments were chosen as the primary sample medium for the inorganic geochemical study because they represent a composite of rock and soil exposed in the drainage basin upstream from the sample site. Analysis of the heavy, nonmagnetic fraction of the panned concentrates from stream sediments proved to be useful in evaluating the common ore-forming sulfide and oxide minerals as well as other nonmagnetic minerals, such as barite, zircon, sphene, apatite, rutile, and native gold.

The largest anomalies were found in heavy-mineral concentrates from the Antimony RA. High values of antimony, arsenic, tungsten, tin, and boron appear to be related to previously recognized mineralization at Antimony Peak (antimony sulfide vein), Black Bob Canyon (the Black Bob gold deposit), and Brush Mountain (uranium prospects). Smaller, more scattered, and less consistent anomalies for tungsten, molybdenum, lanthanum, and bismuth from heavy-mineral concentrates from streams draining igneous and metamorphic terrain in the Sespe-Frazier RA are believed to be spatially related to numerous known gold occurrences there.

All anomalies identified from this geochemical study seem to be related to areas previously known for mineralization. No new areas of mineral resource potential were delineated as a result of the geochemical sampling program.

Organic geochemistry

One hundred and sixty samples of siltstone and shale were collected, primarily from natural and artificial surface exposures, and analyzed for oil-source capability and thermal maturity of the kerogen. Results of the reconnaissance study are detailed in Frizzell and Claypool (1983) and summarized below.

Most samples from pre-Neogene rocks contain less than one percent organic carbon. The data indicate that most of the organic matter present in these rocks has little capacity to generate oil and that terrestrial woody humic matter, possible source of natural gas, is the likely source of the organic carbon. Neogene marine rocks, on the other hand, contain organic matter in quantities and qualities conducive to the generation of oil, as well as gas.

These conclusions corroborate, in part, results of previous studies. Howell and Claypool (1977) studied Late Cretaceous rocks, and they concluded that those rocks have poor source and reservoir potential. Link and Smith (1982, p. 191-197) conclude that the mostly nonnmarine rocks in the Miocene and Pliocene Ridge Basin contain limited numbers of potential source beds with generally immature kerogens.

In addition to problems of locating suitable source rocks, rocks suitable for reservoir purposes are difficult to delineate. Data for 67 surface and subsurface samples of sandstone and siltstone, mostly pre-Neogene in age, in or near the study area indicate that the rocks have very low permeability and porosity and, thus, have poor reservoir potential (Frizzell and Claypool, 1983).

COMMODITY INVENTORY AND EVALUATION

Numerous commodities have been mined or prospected for within the study area. For the commodities for which we have data or a history of interest, this section briefly describes the mining or prospecting history, the geologic setting, any production, workings, sample analyses and identified resources (see table 1 for occurrences). The areas that have more than a low potential for the presence of undiscovered mineral resources are noted (see fig. 3). Numerous additional mines, prospects, and localities for the various commodities are listed in the individual reports by the U.S. Bureau of Mines (see references, table 1) as well as a companion map (U.S. Bureau of Mines, 1985).

The assignment of modifiers to the term "potential" in this and the following section involves integrating (a) the geologic setting of the commodity; (b) knowledge of the presence or absence of occurrences, mines and prospects for a given commodity in a given geologic setting; and (c) geochemical data. Given the uncertainties involved, the assignment of "no potential" to an area for a given commodity would be highly speculative; therefore this category is not used. "Low potential" indicates that a locality may contain dispersed mineral occurrences, which have few favorable geologic factors and which appear to have little possibility for the presence of undiscovered mineral deposits. "Moderate potential" indicates favorable geologic factors and localities that have a reasonable possibility for the presence of undiscovered mineral deposits.

Antimony

Antimony deposits at Antimony Peak in the Antimony RA (location 12, table 1) were rediscovered in 1853 and were patented in the late 1800's. These deposits had apparently been previously mined by Indians and Jesuits. About 600 tons of antimony ore was produced from this property between 1882 and 1941 (Jermain and Ricker, 1949, p. 2). At Antimony Peak, stibnite and antimony oxides occur in siliceous lenses irregularly distributed along a shear zone in quartz diorite-tonalite (Troxel and Morton, 1962, p. 56; Jermain and Richer, 1949). Strong antimony anomalies (and smaller anomalies in tungsten, tin, and boron) occur in streams draining the Antimony Peak area, and rocks from the area of the peak show anomalies in antimony, arsenic, tungsten, mercury, boron, and silver, in addition to small gold values (Smith and others, 1985). The patented Antimony Peak mine contains 470,000 tons of indicated and inferred marginal reserves and subeconomic resources averaging 1.0 to 2.7 percent antimony (Kuizon, 1982, p. 4). By comparison, commercial grade ore mined under different economic conditions elsewhere in the United States contains 5 to 10 percent antimony (Goldman, 1957, p. 35). Two areas, one near Antimony Peak and another just east of Antimony Peak, have low to moderate potential for the presence of additional low-grade antimony resources. None of our data indicate a potential for the presence of undiscovered antimony resources elsewhere in the study area.

Barite

Barite occurs at the patented White Elephant mine (location 6, table 1) in the La Brea RA where 4,000 tons of ore were produced in 1929 and 1930. The mineral occurs as veins in brecciated Cretaceous sandstone and siltstone. About 95,000 tons of 73 percent inferred subeconomic barite resources remain on the claims (Benhan and McCulloch, 1981, p. 7). Sustained production at commercial deposits outside the study area has been from barite deposits with more than 17,000 tons of 96 percent barite (Kundert, 1957, p. 73).

Panned-concentrate samples downstream from the mine had visible barite and showed high values for barium (greater than 1 percent barium). However, this is not conclusive evidence for the presence of undiscovered barite veins, because a majority of the panned concentrates from the entire study area had barium values greater than one percent. The high barium content in the samples of stream sediments derived from sedimentary rocks and a high content of sulfate in spring waters sampled may indicate the presence of barite veins elsewhere in the study area (Smith and others, 1984), although no other occurences of vein barite have been found. Therefore, while low to moderate potential exists for the presence of undiscovered barite resources in the study area, the widespread nature of the barium anomalies makes it impossible to delineate specific localities other than the known occurrence in the La Brea RA.

Bentonitic Clay

Parts of the nonmarine Neogene Lockwood Clay of Carman (1964) locally contain rather pure bentonitic clay. The clay probably represents the altered remnants of a volcanic ash layer that became interbedded in the nonmarine deposits (Carman, 1964, p. 44). A deposit in the eastern part of Lockwood Valley, from which 13 million tons were produced between 1954 and 1980 (White, 1982b, p. 8), has 7.2 million tons of bentonitic clay reserves, of which about 4.7 million tons (location 1, table 1) occur within the Sespe-Frazier RA (Hale and others, 1983, p. 17, table 2, No. 13). Although the Lockwood Clay crops out locally in the Sawmill-Badlands RA, no resources are estimated there (Longwill, 1982, p. 9, 16). Bentonitic clay resources occur, however, in the Quatal RA where about 1.6 million tons of subeconomic resources (location 15, table 1) have been identified (White, 1982b, p. 14). Because the bentonitic clay is stratabound (Carman, 1964; Dibblee, 1973; Vedder and others, 1973) and occurs in well prospected areas, the potential for the presence of undiscovered bentonitic clay resources is low.

Borates

Borates, associated with Miocene basalts and deformed lake and playa deposits, were mined within and near the eastern part of the Sawmill-Badlands RA between 1899 and 1912 (Carman, 1964). Ore at the Russell mine was hand sorted to average 29 to 42 percent B_2O_3 (boron oxide) with production from the district totalling about 35,000 tons (Longwill, 1982, p. 8-9). Production ceased around 1913 because of larger and richer deposits developed further east. The grade of ore required for refining or producing beneficiated products is probably not less than 20 percent B_2O_3 (Ver Planck, 1957, p. 92). No resources were identified in the Sawmill-Badland RA (Longwill, 1982), but a large boron anomaly marks the locality of the old mines (Smith and others, 1985). Because no other similar anomaly occurs elsewhere in the study area and because the geologic setting is unique to the known boron occurrences, there is no evidence for the presence of undiscovered boron resources elsewhere in the study area.

Building stone

Active mining is in progress at the Colson quarry, adjacent to the Horseshoe Springs RA (location 5, table 1), where about 2,000 tons of flagging and rubble are produced annually from thin-bedded, fine-grained sandstone and interbedded siltstones of the Miocene Monterey Formation. These rocks extend a mile northwest and southeast into the Horseshoe Springs RA and include in excess of 50,000,000 tons of raw material (Horn, 1983; p. 4). Although sandstone has been identified in other roadless areas (Sespe-Frazier RA, Hale and others, 1983; Dry Lakes RA, White, 1982a; Matilija RA, Lambeth, 1982), these have not been shown in table 1 because large amounts of potentially suitable rock are available thoughout the Transverse Ranges, both inside and outside the study area. Existing quarries have good supplies and are located closer to markets. However, other localities in the study area containing sandstone are described in a companion map (U.S. Bureau of Mines, 1985).

Marble and dolomitic marble are present in the Antimony RA. A total of about 85 million tons of this material is identified at the Lebec and White Rock properties (locations 13, table 1; Kuizon, 1981, table 1, Nos. 3, 17). Hart (1978, p. 94) describes the Sierra Blanca Limestone, a commercial-grade rock, which crops out in the study area west of Wheeler Hot Springs. Steeply dipping bands of marble and calc-silicate rock 6 mi east of Sespe Hot Springs (Frizzell and Vedder, 1985) are thin and inaccessible.

Copper and zinc

A copper and zinc occurrence is present near Wildhorse Mountain (location 7, table 1) in the La Brea RA. Gabbroic rocks, part of the dismembered Coast Range ophiolite (an association of dark-colored igneous and sedimentary rocks formed in oceanic areas), contain vugs and fractures filled with malachite, azurite and associated disseminated sulfide minerals. This mineralization may have occurred by remobilization and precipitation of syngenetic copper in the gabbro (Smith and others, 1985). Prospects in a high-grade zone contain 1,300 tons of gabbro with 1.87 percent copper and 3.13 percent zinc. An additional 5,850 tons of gabbro containing 0.18 percent copper and 1.34 percent zinc are present nearby (Benham and McCulloch, 1981, p. 4).

Although copper occurrences are reported in the Sespe-Frazier RA (Weber and others, 1973, p. 65), we found no geochemical indications of a potential for the occurrence of the metal there or elsewhere in the study area.

Geothermal resources

Thermal springs form a linear pattern in the southern part of the study area along the Santa Ynez fault system (Muffler, 1979, map 1). Temperatures of spring waters in and near the Diablo, Dry Lakes, and Matilija RAs range between 62° F and 118° F (White, 1982a; Lambeth, 1982; Godwin and Stephens, 1979), and portions of these RAs have been classified as lands valuable prospectively for geothermal resources. Although data are insufficient to estimate reservoir parameters, these springs probably only have potential for non-electric, or direct heat, purposes.

Sespe Hot Springs, in the Sespe-Frazier RA, forms the eastern termination of the linear pattern of springs and is classified as a "Known Geothermal Resource Area" (a KGRA; Muffler, 1979, map 1). Temperatures of waters from the four springs in this hot-water hydrothermal convection system range to 194° F (Brook and others, 1979, table 6, No. 61) and subsurface temperatures of source aquifers probably range between 230° F and 270° F (McCulloh and others, 1981, p. 359). Although these springs have potential for direct heat use, their remote location limits their usefulness for this purpose.

Lode gold

Lode gold was discovered in the late 1800's at the Castaic mine (location 2, table 1) and Frazier mine (outside study area) in or near the Sespe-Frazier RA and at the Black Bob mine (location 14, table 1) in the Antimony RA. Gold production of about 1300 oz was reported from the late 1800s until 1942 from mines in the Sespe-Frazier RA (Hale and others, 1983, p. 9). Small amounts of gold, silver, and lead were produced from the Black Bob mine in the early 1900's (Kuizon, 1982, p. 7).

Gold prospects and former mines are locally found in quartz veins along shear zones in Precambrian gneiss in the Sespe-Frazier RA. The gold in one mine, outside the study area west of Frazier Mountain and not examined in this study, apparently occurs as disseminated particles in gossan-rich shear zones and is associated with iron sulfides (Carman, 1964, p. 60). In the Sespe-Frazier RA, similar quartz veins along shear zones are mostly one to several feet thick and trend northwesterly (Hale and others, 1983).

Although at least a trace of gold occurs in 12 of the 17 gold prospects and mines examined in or near the Sespe-Frazier RA (Hale and others, 1983), we were able to establish identified resources for only one locality because many of the workings are caved and not well enough exposed to determine resources and reserves. Of the 266 samples collected from 17 gold prospects or former gold mines in or near that roadless area, about 22 percent (58 samples) con-ained a trace or more gold (Hale and others, 1983, tables 2, 3. Data discussed below resides in this reference.). Thirty of 115 samples from four prospects and mines on the west side of Frazier Mountain (Dom Bosco, Esperanza, Jewel, and White Mule) contained from a trace to 0.22 oz gold/ton (all but the one contained 0.08 oz gold/ton or less). Four of 12 samples from two prospects and mines (Gold Dust and Hidden Value) southeast of Frazier Mountain contained from 0.046 to 0.316 oz gold/ton. Eight of 28 samples from an unknown prospect in Lockwood Creek contained from 0.026 to 0.072 oz gold/ton. Of ten samples from the Brown prospect, nine yielded no significant values, and one contained 0.31 oz gold/ton; of 40 samples collected from the Gold Hill Group, 36 yielded no significent gold values, three contained trace to 0.012 oz gold/ton, and one contained 0.122 oz gold/ton. Eight of 24 samples from the Castaic mine (location 2, table 1) yielded gold values: six samples from a massive quartz vein assayed 0.02 to 1.2 oz/ton. This quartz vein contains about 8,000 tons of indicated and inferred subeconomic resources averaging 0.38 oz gold/ton (Hale and others, 1983, table 1, No. 26). Although the gold bearing veins in the Frazier mine may extend into the roadless area (Hale and others, 1983, table 2, No. 52), and although the Harris mine contains anomalous gold values (Smith and others, 1985), we are unable to establish identified resources with significant gold values for any other mine or prospect within the Sespe-Frazier RA except the Castaic mine. Potential is low to moderate for the presence of additional undiscovered lode gold resources in this roadless area.

Gold at the Black Bob and Cedar mines (location 14, table 1) in the Antimony RA is found in quartz veins along shear zones, but these shears are in Mesozoic biotite granodiorite, not in Precambrian rocks as they are in the Sespe-Frazier RA. Heavy-mineral concentrates taken downstream from the mines show strong arsenic and tin anomalies (elements often associated with gold), but rock sampling indicates only the known gold locality in that drainage (Smith and others, 1985). These mines contain 1,600 tons of marginal reserves averaging 0.13 oz/ton gold and 11,000 tons of subeconomic resources averaging 0.034 oz/ton (Kuizon, 1982, p. 4, 13).

Anomalies in antimony, arsenic, tungsten, mercury, boron, silver, and gold from Antimony Peak (location 12, table 1) indicate the previously known antimony deposits and suggest possible gold mineralization (Smith and others, 1985). Jermain and Ricker (1949, p. 5) reported gold and silver values of $0.60 per ton. Seven chip samples contained gold ranging from trace to 0.29 oz/ton (Lucia Kuizon, unpub. report, 1982). Low to moderate potential exists for the presence of undiscovered gold resources in the vicinity of Antimony Peak.

From a total of 74 chip samples collected from the Deer Trail mine just outside the Stanley Mountain RA, two samples contained gold values of 0.014 and 0.026 oz/ton (Kuizon, 1983d, p. 6). Four chip samples from the Clyde's Saylor prospect in the Machesna Mountain RA contain gold ranging from 0.01 to 0.06 oz/ton (Kuizon, 1983b, p. 9).

Low potential exists for the presence of undiscovered lode gold resources elsewhere in the study area.

Placer gold

Placer gold mining by Spanish settlers and Indians began in the region in the early 1800's in the La Panza mining district, partly within the La Panza, Machesna Mountain, and Black Mountain RAs. Total gold production in this district is estimated at $200,000 (Clark, 1970, p. 179). In the early 1840's placer gold was mined from Piru Creek in the Sespe-Frazier RA.

Many of the generally small and discontinuous Quaternary(?) and modern terrace and stream gravel deposits were sampled for placer gold (see various references, table 1; U.S. Bureau of Mines, 1985). Calculated grade for individual samples ranges from none detected to 0.015 oz gold/cu yd with grades on significant volumes of gravel averaging less than 0.002 oz gold/cu yd. Localities within the study area with appreciable volumes of gravel include: the Lucky Girl placer on the boundary of the La Panza RA with about 15,000 cubic yards of terrace and stream gravel (about 3,000 cubic yards are in the La Panza RA) averaging 0.0002 oz gold/cu yd (Barnes, 1981); the Jehovah Jireh property in the Machesna Mountain RA with about 27,000 cubic yards of bench gravels that average 0.002 oz gold/cu yd (Kuizon, 1983b, p. 8); and the CIC placer on Piru Creek in the Sespe Frazier RA that contains about 82,000 cubic yards with less than 0.0005 oz gold/cu yd (Hale and others, 1983). The general low grade and discontinuous occurrence of placer gold within the study area probably precludes recovery of the gold by commercial ventures, but does not necessarily preclude recovery by hobbyists. Low potential exists for the presence of undiscovered placer gold resources in the study area.

Gypsum

Gypsum was discovered in the Cuyama RA in 1892. Subsequently, other gypsum deposits were discovered in and near the Cuyama, Sawmill-Badlands, Sespe-Frazier, and Quatal RAs. Two deposits (Frenchman's Point and Burgess Canyon) in the Sawmill-Badlands RA contain thin, impure gypsum-bearing zones, but no resources were identified (Longwill, 1982). Several claims for gypsum were filed in or near the Fox Mountain RA as early as 1901 (McCulloch and Neumann, 1982), but no resources were identified. The Monolith Quarry, just west of the Quatal RA, produced about 1.7 million tons of gypsum and gypsite between 1939 and 1980 (White, 1982b, p. 7). A small amount of gypsum of the alabaster variety was mined for local use in the 1950's through 1970's from the Cuyama and Sawmill-Badlands RAs.

Gypsum occurs as discontinuous beds or lenses interbedded in Neogene sandstone and siltstone sequences interpreted to have been deposited in hypersaline lagoonal to very shallow marine environments (Thor, 1978, p. 52-54) and saline lakes. Three prospects in the Cuyama RA (locations 9, 10, 11, table 1) are estimated to collectively contain about 370,000 tons of subeconomic gypsum resources that average between 83 to 90 percent $CaSO_4$ (calcium sulfate) (Kuizon, 1981, p. 9). Gypsum-bearing beds occur both inside and outside the Sespe-Frazier RA near Pine Mountain (location 3, table 1). About 8 million tons of subeconomic gypsum resources, averaging 76 percent $CaSO_4$, occur within the latter roadless area (Hale and others, 1983, p. 16).

Because the gypsum is stratabound and occurs in well prospected areas, the potential for the presence of undiscovered gypsum resources is low.

Mercury

Mercury was discovered north of the Santa Lucia Wilderness (at the Rinconada mine) in 1872 and adjacent to the Stanley Mountain RA (at the Deer Trail mine) in 1914. Total production from the Rinconada and Deer Trail mines was about 3,000 and 200 flasks of mercury (a flask contains 76 pounds of mercury), respectively (U.S. Bureau of Mines, 1965, p. 165).

Mercury deposits in California are generally associated with major fault zones and, in many places, with young volcanic systems. Hot fluids containing mercury apparently move through the crushed rock and fill openings or replace host rocks as local changes in pressure, temperature, and chemistry permit.

The Rinconada mine produced mercury from silica-carbonate rock, an altered form of serpentinite, that formed prior to the mercury mineralization (Eckel and others, 1941, p. 531). This mine was one of the largest producers in San

Luis Obispo County and yielded ore containing about 5 to 10 lbs of mercury per ton (Eckel and others, 1941, p. 536). Rocks similar to those at the mine do not occur in the Santa Lucia Wilderness (Sabine and Esparza, 1981). Mercury occurs as cinnabar which fills fractures in brecciated calcite at the Deer Trail mine. The mine contains about 32,000 tons of vein calcite and sandstone averaging 1.71 lbs mercury/ton (Kuizon, 1983d, p. 10). Low to moderate potential exists for the presence of low-grade mercury resources in and adjacent to this mine. Low potential exists for the presence of undiscovered mercury resources in other parts of the study area.

Petroleum

Oil and gas exploration began in the region in the 1860's, and the first wells were drilled in the Sespe Creek area in 1887 (Kew, 1924, p. 121). The Sespe oil field, part of which is in the Sespe-Frazier RA, has produced 24 million barrels of oil and 22 billion cubic feet of gas since it's discovery, and it currently produces 96 percent of the production within the boundaries of the Los Padres National Forest (700,000 barrels of oil and 900 million cubic feet of gas in 1981, Hollis Record, written commun., 1982).

Wildcat drilling and oil and gas production in and near the study area have not been very successful. Of the approximately 222 classifiable holes completed outside known oil and gas fields through 1981, about 214 were dry holes, and less than 80,000 barrels of oil were pumped from the eight producing wells, all of which are now abandoned or idle (Frizzell and Claypool, 1983). These statistics are not surprising when the organic geochemistry of the rocks in the study area is reviewed. These data indicate that most pre-Miocene rocks sampled contain less than 1 percent total organic matter (Frizzell and Claypool, 1983), most of which has little capacity to generate oil (although it may generate natural gas).

Samples from Miocene and younger marine rocks, however, indicate that they have about 2 percent organic matter of a type that does produce oil and gas. Most localities underlain by Miocene and younger marine rocks, though, are either composed of relatively thin sequences of these rocks or contain sections that have been breached by erosion, thus allowing the escape of any entrapped oil and gas. (Hydrocarbon-bearing fluids generally travel upward through minute holes in rocks. They can be trapped against various types of impermeable zones or layers, but if the porous rocks crop out at the earth's surface, any fluids that may have been using the rock as a conduit will be lost.)

For instance, the southern two-thirds of the Santa Lucia Wilderness is underlain by Miocene marine rocks that appear to be about 5,000 ft thick in which canyons as deep as 1600 ft have been cut. Similarly, the Miocene rocks exposed at the surface in the Tepusquet Peak, La Brea, and Little Pine RAs are apparently relatively thin (about 2,000 to 4,000 ft) and generally have been deeply dissected by erosion.

Although the Miocene rocks at the surface in the Fox Mountain RA are relatively thin and have been deeply dissected, similar rocks have been projected to occur below the low angle South Cuyama fault northwest of the roadless area. However, if this fault is present in the roadless area, gravity data do not support the presence of appreciable thicknesses of Neogene rocks below it (Griscom, 1985b).

An elongate, east-west negative-gravity anomaly confirms the presence of Miocene rocks below the San Cayetano thrust in the southernmost part of the Sespe-Frazier RA. South of the line labled A-A' (fig. 3), the fault may be less than 12,000 ft below sea level (Griscom, 1985b). Another, smaller, negative-gravity anomaly may indicate that Miocene and younger rocks are present below the Pine Mountain fault, and a small part of this anomaly is present in the roadless area near Pine Mountain (Griscom, 1985b).

In summary, drilling experience and organic geochemical data indicate a low potential for the presence of undiscovered oil and gas in pre-Miocene rocks outside known fields. A low to moderate potential for the presence of undiscovered oil and gas in marine Miocene and Pliocene sedimentary rocks is indicated by favorable organic geochemical data but variable physical settings. The most favorable settings, which have moderate potential for the presence of oil and gas, exist below the San Cayetano, and, perhaps, the Pine Mountain faults. Late Eocene marine, Oligocene nonmarine, and Neogene marine rocks near existing oil and gas fields in and near the southern part of the Sespe-Frazier RA still probably contain additional oil and gas.

Phosphate rock

Phosphate-rock occurrences were first reported in Ventura County in 1925 and Santa Barbara County in 1931. In the 1960's, two phosphate deposits, one at Pine Mountain (location 3, table 1) adjacent to and in the Sespe-Frazier RA and the second at the Cuyama deposit (location 8, table 1) adjacent to the Fox Mountain RA, were extensively explored. The Cuyama phosphate mine produced 18,000 tons of phosphate rock between 1965 and 1970 (McCulloch and Newmann, 1982, p. 6).

Phosphate pellets were probably precipitated in a Neogene offshore muddy shelf environment that had both a low sedimentation rate and optimal chemical environment (Thor, 1978, p. 47-48). The Fox Mountain RA may contain more than 300 million tons of phosphatic pellet-bearing rocks (Fedewa and Hovland, 1981, p. 72), but most of these rocks are covered by thick overburden. The area (location 8, table 1) does, however, contain more than 21 million tons of subeconomic phosphate-rock resources with 4.84 percent P_2O_5 (phosphorous pentoxide), which are not as deeply buried (McCulloch and Neumann, 1982, p. 4).

Phosphate-bearing beds occur both inside and outside the Sespe-Frazier RA near Pine Mountain (location 3, table 1). About 51 million tons of phosphate- rock reserves, averaging 10 percent P_2O_5, occur within the study area (Hale and others, 1983). This phosphate rock deposit is minable under 1982 conditions, assuming a hypothetical one million ton per year open-pit mining operation utilizing advanced technology in the processing operation. By comparison, 18 percent P_2O_5 represented the minimum grade of phosphate-bearing rock for earlier resource estimates with different economic conditions in the Permian phosphate fields in Wyoming where more than 25 billion tons of reserves occur (Sheldon, 1963, p. 148, table 20). Because the phosphate is stratabound and occurs in well prospected areas, the potential for the presence of undiscovered phosphate-rock resources in the study area is low.

Rock products

A variety of unconsolidated materials, including relatively well sorted alluvial gravel, sand, and silt, underlie major river and sidestream valley bottoms throughout the study area. Although these materials can be used for construction purposes, they are not specifically identified herein. Because there are abundant deposits of these materials outside the study area, deposits in the study area cannot compare favorably with those closer to major markets.

Silver

Although silver does not occur as the primary metal of interest at any prospect in the study area, it does occur associated with gold-bearing veins in both the Sespe-Frazier and Antimony RAs. Selected samples from prospects in or near the Sespe-Frazier RA contain silver values ranging from 0.4 to 0.6 oz silver/ton, but since many workings are caved and not well enough exposed, no tonnages are assigned (Hale and others, 1983). The 1,600 tons of marginal reserves at the Black Bob and Cedar mines in the Antimony RA (location 14, table 1) average 0.5 oz/ton silver and the 11,000 tons of subeconomic resources average 0.27 oz/ton silver (Kuizon, 1982).

From a total of 74 chip samples collected, two samples from the Deer Trail mine adjacent to the Stanley Mountain RA contained silver values of 2.4 and 3.3 oz/ton silver (Kuizon, 1983d, p. 6). Two chip samples from Clyde's Saylor prospect in Machesna Mountain RA contained silver ranging from 0.1 to 0.3 oz/ton (Kuizon, 1983b, p. 9). Low potential exists for the presence of undiscovered silver resources in the study area.

Uranium

Uranium minerals were first reported in the Antimony, Sawmill-Badlands, Machesna Mountain, and Black Mountain RAs in the 1950's. In the Black Mountain RA, biotite schist, which has been intruded by granitic rocks, locally shows scintillometer readings four to five times regional background. The uranium associated with these schists locally averages 90 ppm uranium while the silicified granitic rocks average 6 ppm uranium (Smith and others, 1985). The Black Widow prospect (location 4, table 1) has produced about 400 lbs of U_3O_8 (uranium oxide); it and two nearby prospects contain about 153,000 tons of subeconomic uranium resources averaging 0.02 - 0.047 percent U_3O_8 and 2,900 tons indicated and inferred uranium resources averaging 0.18 percent U_3O_8 (Gabby, 1981, table 1). Low to moderate potential exists for the presence of undiscovered low-grade uranium resources at depth at these sites.

The Clyde's Saylor prospect in the Machesna Mountain RA is in a geologic setting similar to that in the Black Mountain RA, but no resources were identified. Three chip samples from the prospects contained 0.009, 0.013, and 0.029 percent U_3O_8 (Kuizon, 1983b, p. 9).

Metasedimentary rocks occur as scattered roof pendants in the Brush Mountain area in the Antimony RA. Metasandstone and quartzite at the CL and Brush claims contain anomalous uranium and gold (13 samples contain 0.001 to 0.046 percent U_3O_8; six contain trace to 0.069 oz gold/ton) and scintillometer readings 8 to 10 times regional background (Smith and others, 1985; Kuizon, 1982; Troxel and Morton, 1962, p. 341, no. 673). The data are insufficient, however, to estimate resources. Low potential exists for the presence of undiscovered uranium resources in basement rocks in the study area.

In addition to occurring in igneous and metamorphic rocks, uranium has also been sought in Tertiary sedimentary rocks. The contact between the marine Coldwater Sandstone and the overlying nonmarine Sespe Formation, in particular, has been prospected for uranium because of an occurrence (Bowes and Myerson, 1957) west of Ojai, outside the study area, of uranium-bearing minerals in lenses and concretions commonly associated with carbonaceous material (Dickinson, 1982). Similar occurrences have been noted near Hartman ranch where carbonaceous samples contain as much as 0.8 percent U_3O_8 (Dickinson, 1982). The Sespe-Coldwater contact at and near this locality is more abrupt than near Ojai, and the mineralization model proposed by Dickinson (1982) probably does not apply. Other localities in or near the study area that contain minor uranium minerals are noted in Dickinson (1982) and Dickinson and others (1982). There is a low potential for the presence of undiscovered uranium resources in Tertiary sedimentary rocks in the study area.

SUMMARY ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Although we have identified antimony, barite, bentonitic clay, building stone, gold, gypsum, phosphate rock, and uranium resources and noted localities with potential for mineral resources, the geologic and geochemical data only indicate a low potential for the presence of undiscovered resources. Some parts of some roadless areas, however, have a low to moderate potential for the presence of specific undiscovered mineral commodities. Not noted for individual roadless areas, but present throughout the study area are: (1) low to moderate potential for the presence of undiscovered petroleum resources in areas underlain by Miocene and younger sedimentary rocks, and (2) low to moderate potential for the presence of undiscovered barite resources.

Sespe-Frazier Roadless Area No. 5002

No mining is taking place in the Sespe-Frazier RA, although over 400 mining claims have been located there since 1885. Current mining claims include 152 unpatented placers and lodes, one patented lode, and five millsites (Hale and others, 1983, p. 9). Gold production, totaling about 1300 oz, terminated in the roadless area in 1941. Gypsum has been prospected since 1964, and a phosphate prospecting permit extends into the roadless area near Pine Mountain (Hale and others, 1983). Petroleum has been produced at the Sespe Canyon Field since before the turn of the century.

Although the gold bearing veins in the Frazier mine may extend into the roadless area and although twelve former mines or prospects contain greater than trace amounts of gold (Hale and others, 1983, tables 2 and 3), gold resources could only be identified at one locality mainly because many workings were caved and not well enough exposed to determine resources. Eight thousand tons of indicated and inferred subeconomic gold resources averaging 0.38 oz gold per ton occur at the Castaic mine (location 2, table 1) (Hale and others, 1983, table 1, No. 26). Identified subeconomic lode gold resources at the Castaic mine do not contain enough gold-bearing quartz, though, to justify the cost of mining and building a concentrating mill. If a mill which accepted custom ore were present nearby, potential for development of the Castaic deposit would be enhanced. Potential is low to moderate for the presence of undiscovered gold resources near mines and prospects in the northern part of the Sespe-Frazier RA.

Several localities are underlain by stream and terrace gravel and sand that have been investigated as possible sources of placer gold, where deposits range from 1000 cubic yards averaging 0.004 oz gold/cu yd to 540,000 cubic yards averaging 0.0003 oz gold/cu yd (Hale and others, 1983, table 2, No. 16, 20, 21, 22 and 33). These placer gold occurrences are subeconomic because of low gold values and generally low volume and are not shown on fig. 3. Some of the occurrences, however, may be attractive for recreational panning and small portable dredging operations. Potential is low for the presence of undiscovered placer gold resources in the Sespe-Frazier RA.

Bentonitic clay has been produced from the Lockwood Clay of Neogene age just north of the roadless area since 1954. This unit extends into the northwest part the study area (location 1, table 1). A reserve of 7.2 million tons has been calculated for this prospect, of which 4.7 million tons occurs inside the roadless area (Hale and others, 1983, p. 17, table 1, No. 13). Bentonitic clay at this prospect is subeconomic because the mine adjacent to the roadless area has enough reserves to keep the clay plant supplied for 150 to 200 years at the 1981 rate of lightweight aggregate production (Hale and others, 1983, p. 17). Potential is low for the presence of undiscovered bentonitic clay resource in the Sespe-Frazier RA.

About 117 million tons of phosphate-rock reserves, averaging 10 percent P_2O_5 (phosphorous oxide), and 13 million tons of subeconomic gypsum resources, averaging 76 percent $CaSO_4$ (calcium sulfate), have been identified near Pine Mountain (location 3, table 1), and an estimated 51 million tons of this phosphate rock and 8 million tons of the gypsum are in the roadless area (Hale and others, 1983, table 2, No. 28). The phosphate-rock deposit is minable under 1982 economic conditions (Hale and others, 1983, p. 18). Low potential exists in the area for the presence of undiscovered phosphate and gypsum resources.

The Sespe-Frazier RA includes parts of the eastern oil fields of the Ventura basin. These fields may ultimately yield in excess of 2 billion barrels of oil (Taylor, 1976, table 2) about 82 percent of which comes from late Miocene or younger rocks. Despite relatively low quantity and quality of organic matter in pre-Miocene rocks, such rocks yield about 5 percent of the oil in the Ventura fields. Most of that (4 percent) is from the Oligocene nonmarine Sespe Formation, although Bailey (1947) makes a strong argument that the source for the Sespe oil is Eocene age rock.

Oil will probably continue to be found in suitable reservoir rocks in the vicinity of the Sespe fields. Potential targets include Miocene and Pliocene rocks below the San Cayetano thrust within the roadless area (most recently discussed by Yeats, 1983, fig. 11). South of the line A-A' (fig. 3), drilling depths necessary to penetrate the fault are probably less than 12,000 ft below sea level (Griscom, 1985b, after Nagle and Parker, 1971).

Gravity data suggest that Miocene age rocks may also be concealed below the Pine Mountain fault (Griscom, 1984b). If this is the case, these rocks may be potential drilling targets, although a 9,500-ft well drilled 1 to 2 mi southwest of the gravity anomaly did not penetrate the fault or drill through Eocene rocks. Moderate potential exists for the presence of undiscovered petroleum below the San Cayetano and Pine Mountain faults, low to moderate potential exists for the presence of undiscovered petroleum in Miocene and younger sedimentary rocks, and the potential is low for the presence of undiscovered oil in other parts of the roadless area.

Sespe Hot Springs is a hot-water hydrothermal convection system and has reservoir temperatures between 230^{o}-270^{o} F (McCulloh and others, 1981, p. 359). Although these springs have potential for direct heat use, their remote location limits their usefulness for those purposes.

Mica and molybdenum occurrences have been noted in the Sespe-Frazier RA (Tucker and Sampson, 1932, p.269 and p. 257), but exposures were not sufficient to determine their resource potential (Hale and others, 1983).

There is low potential for the presence of undiscovered resources for other mineral commodities in the Sespe-Frazier RA.

Garcia Mountain Roadless Area No. 5107

Although 28 mining claims have been located in the roadless area in the past, no mines were developed (Lipton, 1981, p. 6-7). Placer sampling indicated gold occurrences in trace quantities within the study area, but no significant volume of alluvium exists.

There is low potential for the presence of undiscovered mineral resources in the Garcia Mountain RA.

Black Mountain Roadless Area No. 5108

There are currently about 69 lode claims for uranium located in the roadless area. About 400 lbs of U_3O_8 (uranium oxide) was probably produced at the Black Widow prospect (Gabby, 1981, p. 8-9). The Black Widow and Black Widow Extension (both at location 4, table 1) contain about 2,900 tons of inferred subeconomic resources averaging 0.18 percent U_3O_8, and 78,000 tons of inferred subeconomic uranium resources averaging 0.02 percent U_3O_8 (Gabby, 1981, table 1). An unnamed prospect to the east of the Black Widow (also represented by location 4, table 1) has 75,000 tons of inferred subeconomic resources averaging 0.047 percent U_3O_8 (after Gabby, 1981, p. 9-11). Low to moderate potential exists for the presence of low-grade uranium resources at depth at these localities, but low potential exists for the presence of other undiscovered mineral resources in the Black Mountain RA.

La Panza Roadless Area No. 5109

Twenty-nine mining claims, including 13 gold placer claims, have been located within the roadless area. Evidence of prospecting was found only at the Lucky Girl prospect (mostly outside the roadless area) where an estimated 15,000 cubic yards of sand and gravel deposits (about 3,000 cubic yards are in roadless area) with a gold content of 0.0002 oz gold/cu yd were found (Barnes, 1981, p. 4, 8-9). There is low potential for the presence of undiscovered mineral resources in the La Panza RA.

Machesna Mountain Roadless Area No. 5110

Current mining activity within and near the roadless area includes uranium prospecting and small-scale gold placer operations. Approximately 200 placer and 300 lode claims have been located in the Machesna Mountain area since the late 1800's, and there are currently 21 gold placer and 20 uranium lodes located there (Kuizon, 1983b, p. 6-7).

Approximately 27,000 cubic yards of placer gold materials that may average 0.002 oz gold/cu yd have been estimated for the Jehovah Jireh prospect (Kuizon, 1983b, p. 8).

Uranium occurrences in and near the study area are sporadic and discontinuous, and low potential exists for the presence of uranium resources at depth (Kuizon, 1983b, p. 8). There is low potential for the presence of undiscovered mineral resources in the Machesna Mountain RA.

Los Machos Hills Roadless Area No. 5111

Six lode and four placer mining claims were located within or adjacent to the roadless area between 1864 and 1930. There are no active mining claims, patented claims, or mineral leases. About 4,500 cubic yards of stream and terrace deposits, containing a trace of gold, were found at an old placer prospect immediately outside the roadless area (Denton, 1982, p. 4, 6-7). There is low potential for the presence of undiscovered mineral resources in the Los Machos Hills RA.

Big Rocks Roadless Area No. 5112

There are no current mining claims within the roadless area. Three lode claims located in 1955, possibly for uranium, were not found in the field. There are eight oil and gas lease applications filed, but no drilling has resulted (Kuizon, 1983a, p. 6).

Phosphate and gypsum deposits have been found in the Santa Margarita Formation of Neogene age in and near other roadless areas in the study area, and although this formation crops out in the northwest and southeast parts of the roadless area, no phosphate or gypsum was found (Kuizon, 1982a, p 6). There is low potential for the presence of undiscovered mineral resources in the Big Rocks RA.

Stanley Mountain Roadless Area No. 5113

There have been at least 29 unpatented lode and placer claims and one millsite located in and near the roadless area (Kuizon, 1983d, p. 9). Seven oil placer claims were located near the northwest corner of the roadless area, one within its boundary. One gold(?) placer claim is located in the roadless area. One oil and gas lease application and part of another have been filed near the northeast corner of the study area (Kuizon, 1983d). Five lode claims and the millsite for the Deer Trail Mercury mine are adjacent to the west boundary. The Deer Trail mine contains about 32,000 tons of sandstone and vein calcite averaging 1.71 lbs mercury/ton (Kuizon, 1983d, p. 10). The Stanley Mountain RA has low to moderate potential for the presence of low-grade mercury resources near the mine, but has low potential for the presence of other undiscovered mineral resources.

Miranda Pine Roadless Area No. 5114

Seven mining claims, possibly for uranium, were located along the southern boundary of the roadless area in the late 1950's. Two oil and gas lease applications are filed in the eastern part of the roadless area. No evidence of mining activity was found in the study area (Kuizon, 1983c, p. 6). There is low potential for the presence of undiscovered mineral resources in the Miranda Pine RA.

Horseshoe Springs Roadless Area No. 5115

Mining is taking place at the Colson Stone quarry (location 5, table 2) adjacent to the southern part of the roadless area, where about 2,000 tons of dimension stone used as flagstone and rubblestone are being produced per year from the Monterey Formation. There are about 3.3 million tons of reserves at the quarry, and sandstone that extends for about 2 mi into the roadless area contains about 50 million tons of inferred marginal reserves (Horn 1983, p. 4). Low potential exists for the presence of undiscovered mineral resources in the Horseshoe Springs RA.

Tepusquet Peak Roadless Area No. 5116

No evidence of mining activity (Avery, 1981, p. 4-5) or a potential for the presence of undiscovered mineral resources, was found in the Tepusquet Peak RA.

La Brea Roadless Area No. 5117

Eighty-seven mining claims have been located in this roadless area. Six claims containing copper and zinc are present at Wildhorse Mountain (location 7, table 1) in a gabbroic member of the dismembered Coast Range ophiolite, but they are currently inactive. The prospect is estimated to contain more than 7,000 tons of ultramafic rock averaging 0.5 percent copper and 1.7 percent zinc (Benham and McCulloch, 1981, p. 4, 6-7). The potential for the presence of undiscovered copper and zinc resources is low.

Four thousand tons of barite were produced from veins in sandstone at the patented White Elephant mine (location 6, table 1) in 1929 and 1930. About 95,000 tons of inferred subeconomic resources averaging 73 percent barite ($BaSO_4$) are present there (Benham and McCulloch, 1981, p. 4, 7-8). Low potential exists for the presence of other undiscovered mineral resources in the La Brea RA.

Spoor Canyon Roadless Area No. 5118

There are no active mines in or near the study area, nor have any mining claims been located in the area. Twelve oil and gas lease applications occur within the roadless area boundaries (Benham, 1983, p. 4). Low potential exists for the presence of undiscovered mineral resources in the Spoor Canyon RA.

Fox Mountain Roadless Area No. 5120

The Cuyama Phosphate mine, just north of the roadless area, produced phosphate rock for soil conditioner between 1965 and 1970; reported production totaled about 18,200 tons (McCulloch and Neumann, 1982, p. 6). The phosphate-bearing rock occurs in the Santa Margarita Formation, which extends into the roadless area (location 8, table 1) where more than 21 million tons of inferred subeconomic phosphate rock resources with an average of 4.84 percent P_2O_5 (phosphorous oxide) (McCulloch and Neumann, 1982, p. 6, 8) are identified. Another 18 million tons of phosphate rock of similar grade occur outside the roadless area.

Numerous oil and gas wells have been drilled in the roadless area, but there is no known production (McCulloch and Neumann, 1983, p. 7). Miocene rocks that may contain petroleum have been projected below the South Cuyama fault by some geologists, although gravity data do not support their presence in great thickness (Griscom, 1985b). If present, these rocks could be a source and a reservoir for oil and gas.

Low potential exists for the presence of undiscovered mineral resources in the Fox Mountain RA.

Diablo Roadless Area No. 5127

Field investigations revealed no claims, prospects, or mineralized areas (Capstick and Hyndman, 1982a, p. 4) within the roadless area. The Agua Caliente hot springs within the roadless area has temperatures of 90° F and has been used for direct heat purposes (Godwin and Stephens, 1979). Low potential exists for the presence of undiscovered mineral resources in the Diablo RA.

Matilija Roadless Area No. 5129

About 33 mining claims have been located in the roadless area but no mines have been developed (Lambeth, 1982, p. 8, 10). Several warm springs within the roadless area near and along the Santa Ynez fault have temperatures between 65° F and 116° F. Data are not sufficient to estimate the sizes or temperatures of the reservoirs (Lambeth, 1982, p. 4, 11-12). The Sierra Blanca Limestone is exposed in Matilija Canyon and extends into the roadless area (Hart, 1978, p. 94).

Low potential exists for the presence of undiscovered mineral resources in the Matilija RA.

Dry Lakes Roadless Area No. 5131

There are no producing mines or active prospects within the Dry Lakes Roadless Area (White, 1982a). Wheeler Hot Springs, situated along the Santa Ynez fault zone, has a recorded surface temperatures ranging between 62° F to 118° F. Potential geothermal resources indicated by such temperatures could be used for direct-heat purposes (White, 1982a, p. 12, 13, 15).

Low potential exits for the presence of undiscovered mineral resources in the Dry Lakes RA.

Sawmill-Badlands Roadless Area No. 5134

About 388 claims have been staked within the roadless area, for oil, borate, gypsum, clays or uranium (Longwill, 1982, p. 11).

Borates were produced from three mines on the eastern slope of Mt. Pinos partly within the roadless area. Production ceased around 1913 because larger and richer deposits were developed in eastern California (Longwill, 1982, p. 5, 9, 16). The Lockwood Clay crops out in the roadless area but it has never been mined there (Longwill, 1982, p. 9, 16).

Two gypsum deposits (Frenchman's Point and Burges Canyon) in the western part of the roadless area have been mined for local use. Because the gypsum occurs in thin and discontinuous lenses in shale and sandstone, no resource estimates were made (Longwill, 1982, p. 10, 16).

Although anomalous uranium and gold occurrences were found in the roadless area, their local and sporadic nature suggests that potential is low for the presence of uranium or gold resources (Longwill, 1982, p. 10, 16).

The designation of the western part of the Sawmill-Badlands as having potential for undiscovered petroleum is misleading and overstates the potential for that area: the area has been unsuccessfully tested by 20 wildcat wells (Frizzell and Claypool, 1983) and is underlain by nonmarine Miocene and Pliocene sedimentary rocks that have less likelihood of producing oil and gas than do marine rocks of the same age (Link and Smith, 1982).

Low potential exists for the presence of undiscovered mineral resources in the Sawmill-Badland RA.

Cuyama Roadless Area No. 5135

Gypsum has been prospected in the Cuyama RA since the late 1800's, and a small amount has been produced for local use. Although numerous uranium claims have been located in the roadless area, there are no current mining claims (Kuizon, 1981, p. 7, 9).

The Santa Barbara Canyon gypsum deposit (location 11, table 1) contains about 30,000 tons of gypsiferous rock averaging 83 percent $CaSO_4$ (calcium sulfate). At the Wagon Road Canyon and Brush Fence Canyon gypsum deposits (locations 10 and 9, table 1), there are 276,000 tons, averaging 85 percent $CaSO_4$, and 61,000 tons, averaging 90 percent $CaSO_4$, respectively, of indicated subeconomic resources (Kuizon, 1981, p. 9-10).

Low potential exists for the presence of additional undiscovered mineral resources in the Cuyama RA.

Antimony Roadless Area No. 5136

Current mining claims within the roadless area include two lode gold claims, 17 limestone placer claims, and parts of 55 uranium claims. Small tonnages of antimony ore were produced periodically from the Antimony Peak patented property until the late 1940's. Marble had been produced from a few localities just south of the study area boundary during the 1950's and 1960's. Small quantities of gold, silver, and lead were produced in the early 1900's and 1930's (Kuizon, 1982, p. 7).

The patented Antimony Peak property (location 12, table 1), situated in the center of the roadless area, contains about 240,000 tons of indicated and inferred marginal reserves, averaging 2.73 percent antimony, and about 230,000 tons of indicated and inferred subeconomic resources, averaging 1.02 percent antimony. The deposit is marginal because of high mining and beneficiation costs, low grade and prices, and poor access. Low to moderate potential exists for the presence of additional similar antimony resources, and perhaps gold, near and east of Antimony Peak (Kuizon, 1982, p. 4, 13; Smith and others, 1985).

About 1,600 tons of marginal gold and silver reserves averaging 0.13 oz gold per ton and 0.5 oz silver per ton occur at the Black Bob and Cedar properties (location 14, table 1). There are an additional 11,000 tons of inferred subeconomic resources averaging 0.034 oz gold per ton and 0.27 oz silver per ton (Kuizon, 1982, p. 4, 13). Low to moderate potential exists for additional gold and silver resources at the Black Bob and Cedar properties.

A total of about 85 million tons of indicated and inferred subeconomic marble and dolomitic marble resources occur within the study area at the White Rock and Lebec properties (locations 13, table 1; Kuizon, 1982, p. 5, 13). These resources may be used for local construction purposes.

Other localities containing iron, manganese, and uranium occurrences (Kuizon, 1982; Troxel and Morton, 1962) were not well enough exposed to determine if resources are present. Low potential exists for the presence of other undiscovered mineral resources within the Antimony RA.

Quatal Roadless Area No. 5268

Fifty-three unpatented mining claims have been located in the roadless area; of these, 52 were placer claims. There are currently eight claims located for gold and other minerals (White, 1982b, p. 8, 10).

Approximately 1.6 million tons of subeconomic bentonite resources that are suitable for bloating clay in the manufacture of lightweight aggregate and for foundry sand bonding occur within the roadless area (location 15, table 1) in the Lockwood Clay (White, 1982b). This deposit is subeconomic because of high production costs due to steeply dipping beds.

Low potential exists for the presence of undiscovered mineral resources in the Quatal RA.

Little Pine Roadless Area No. 5278

Five mining claims are located in the roadless area (Capstick and Hyndman, 1982b). No metallic or nonmetallic mineral resources have been identified within the Little Pine RA and low potential exists for the presence of undiscovered mineral resources.

Santa Lucia Wilderness NF 905

Although mines and mineral occurrences exist nearby, there is little evidence of mining or prospecting inside the wilderness.

Claims, sporadically located between 1900 and 1965, were mainly mercury placer claims located between 1900 and 1917. Mineralized and altered zones and host rocks at Rinconada Mine, a past producer of mercury adjacent to the wilderness, do not crop out inside the area (Sabine and Esparza, 1981). Low potential exists for the presence of undiscovered mineral resources in the Santa Lucia Wilderness.

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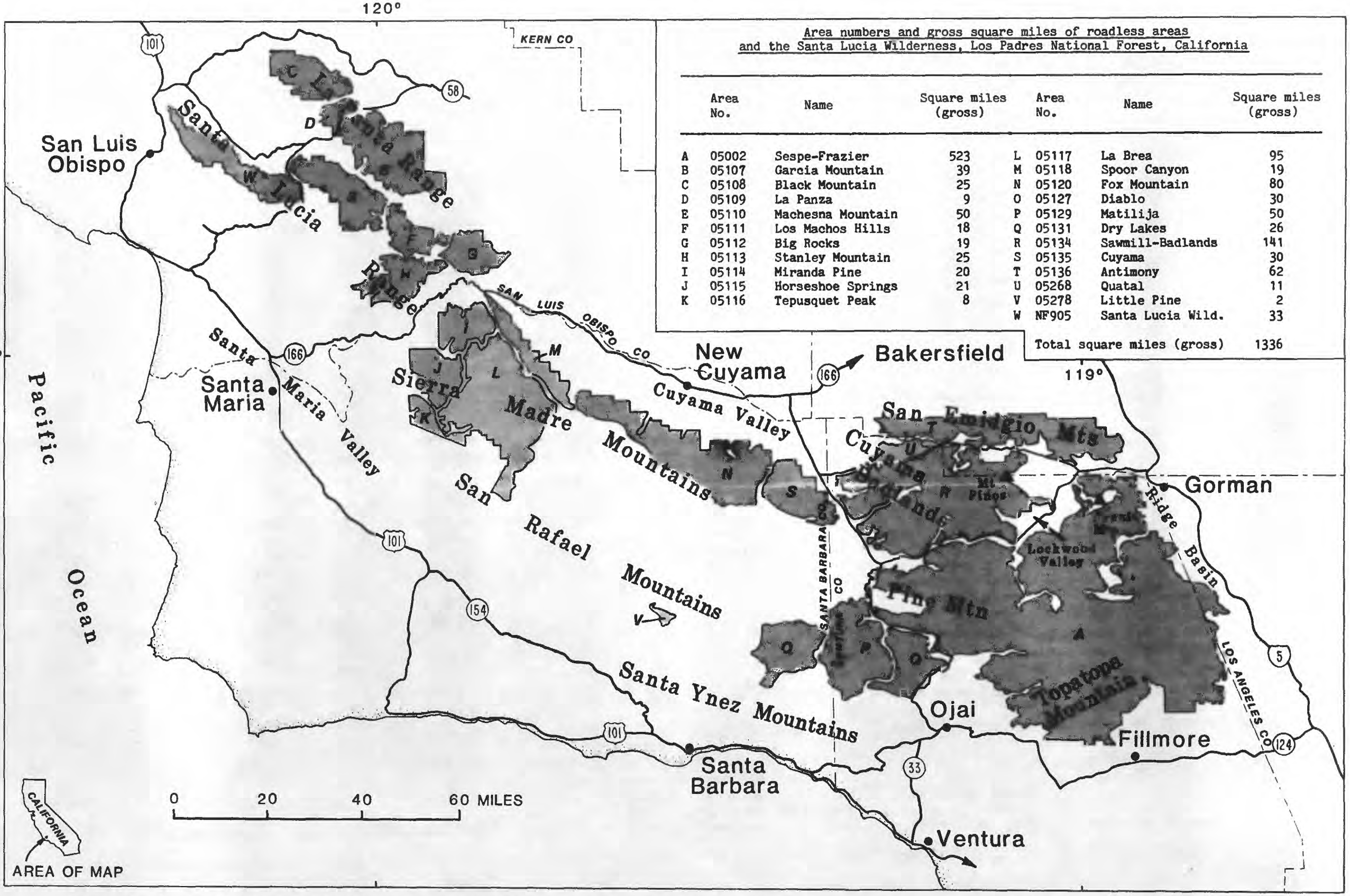
Table 1 Identified mineral resources in roadless areas and the Santa Lucia Wilderness in the Los Padres National Forest, California
[Numerous additional mines, prospects, and occurrences are noted in referenced reports and in U. S. Bureau of Mines (1985)]

Map location No.	Roadless area	Area No.	Mineral occurrence	Quantity (tons)	Grade	Classification	Reference
1	Sespe-Frazier	5002	Benotonitic clay[1]	4,700,000	Suitable for light-weight aggregate	Marginal reserves	Hale and others, 1983
2			Gold, lode[2]	8,000	0.38 oz/ton	Subeconomic resources	do.
3			Gypsum[2]	8,000,000	76% $CaSO_4$	do.	do.
			Petroleum	-	-	-	Frizzell and Claypool, 1983
3			Phosphate[3]	51,000,000	10% P_2O_5	Reserves	Hale and others, 1983
	Garcia Mountain	5107	None identified	-	-	-	Lipton, 1981
4	Black Mountain	5108	Uranium[2]	2,900	0.18% U_3O_8	Subeconomic resources	Gabby, 1981
				75,000	0.047% U_3O_8	do.	do.
				78,000	0.02% U_3O_8	do.	do.
	La Panza	5109	None identified	-	-	-	Barnes, 1981
	Machesna Mountain	5110	None identified	-	-	-	Kuizon, 1983b
	Los Machos Hills	5111	None identified	-	-	-	Denton, 1982
	Big Rocks	5112	None identified	-	-	-	Kuizon, 1983a
	Stanley Mountain	5113	None identified	-	-	-	Kuizon, 1983d
	Miranda Pines	5114	None identified	-	-	-	Kuizon, 1983c
5	Horseshoe Springs	5115	Building stone[1] (sandstone)	50,000,000	Suitable for building stone	Marginal reserves	Horn, 1983
	Tepusquet Peak	5116	None identified	-	-	-	Avery, 1981
6	La Brea	5117	Barite[2]	95,000	73% barite	Subeconomic resources	Benham and McCulloch, 1981
7			Copper[2], zinc[2]	1,300	1.87% Cu, 3.13% Zn	do.	do.
				5,850	0.18% Cu, 1.34% Zn	do.	do.
	Spoor Canyon	5118	None identified	-	-	-	Benham, 1983
8	Fox Mountain	5120	Phosphate rock[2]	21,400,000	4.84% P_2O_5	Subeconomic resources	McCulloch and Neumann, 1982
	Diablo	5127	None identified	-	-	-	Capstick and Hyndman, 1982
	Matilija	5129	None identified	-	-	-	Lambeth, 1982
	Dry Lakes	5131	None identified	-	-	-	White, 1982a
	Sawmill Badlands	5134	None identified	-	-	-	Longwill, 1982
9	Cuyama	5135	Gypsum[2]	61,000	90% gypsum	Subeconomic resources	Kuizon, 1981
10				276,000	85% gypsum	do.	do.
11				30,000	83% gypsum	do.	do.
12	Antimony	5136	Antimony[2]	240,000	2.73% antimony	Marginal reserves	Kuizon, 1982
				230,000	1.02% antimony	Subeconomic resources	do.
13			Building stone[1] (marble)	85,000,000	Suitable for building stone	do.	do.
14			Gold[2], silver[2]	1,600	0.13 oz/ton gold	Marginal reserves	do.
					0.5 oz/ton silver	do.	do.
				11,000	0.034 oz/ton gold	Subeconomic resources	do.
					0.27 oz/ton silver	do.	do.
15	Quatal	05268	Bentonite[2]	1,600,000	Suitable for light-weight aggregate	do.	White, 1982b
	Litte Pine	05278	None identified	-	-	-	Capstick and Hyndman, 1982b
	Santa Lucia Wilderness	NF 905	None identified	-	-	-	Sabine and Esparza, 1981

1 Marginal reserves because reserves outside the study area are closer to markets and meet current market demand.
2 Deposits of antimony, barite, copper, gold, gypsum, phosphate rock, silver, uranium, and zinc are probably marginal reserves or subeconomic resources because of combinations of commodity prices, generally low grade and tonnage, high mining and beneficiation costs, and inaccessibility.
3 Probably minable under 1982 conditions.



Area numbers and gross square miles of roadless areas and the Santa Lucia Wilderness, Los Padres National Forest, California

	Area No.	Name	Square miles (gross)		Area No.	Name	Square miles (gross)
A	05002	Sespe-Frazier	523	L	05117	La Brea	95
B	05107	Garcia Mountain	39	M	05118	Spoor Canyon	19
C	05108	Black Mountain	25	N	05120	Fox Mountain	80
D	05109	La Panza	9	O	05127	Diablo	30
E	05110	Machesna Mountain	50	P	05129	Matilija	50
F	05111	Los Machos Hills	18	Q	05131	Dry Lakes	26
G	05112	Big Rocks	19	R	05134	Sawmill-Badlands	141
H	05113	Stanley Mountain	25	S	05135	Cuyama	30
I	05114	Miranda Pine	20	T	05136	Antimony	62
J	05115	Horseshoe Springs	21	U	05268	Quatal	11
K	05116	Tepusquet Peak	8	V	05278	Little Pine	2
				W	NF905	Santa Lucia Wild.	33
						Total square miles (gross)	1336

Figure 1--Index map showing approximate locations of roadless areas and the Santa Lucia Wilderness, Los Padres National Forest, California.

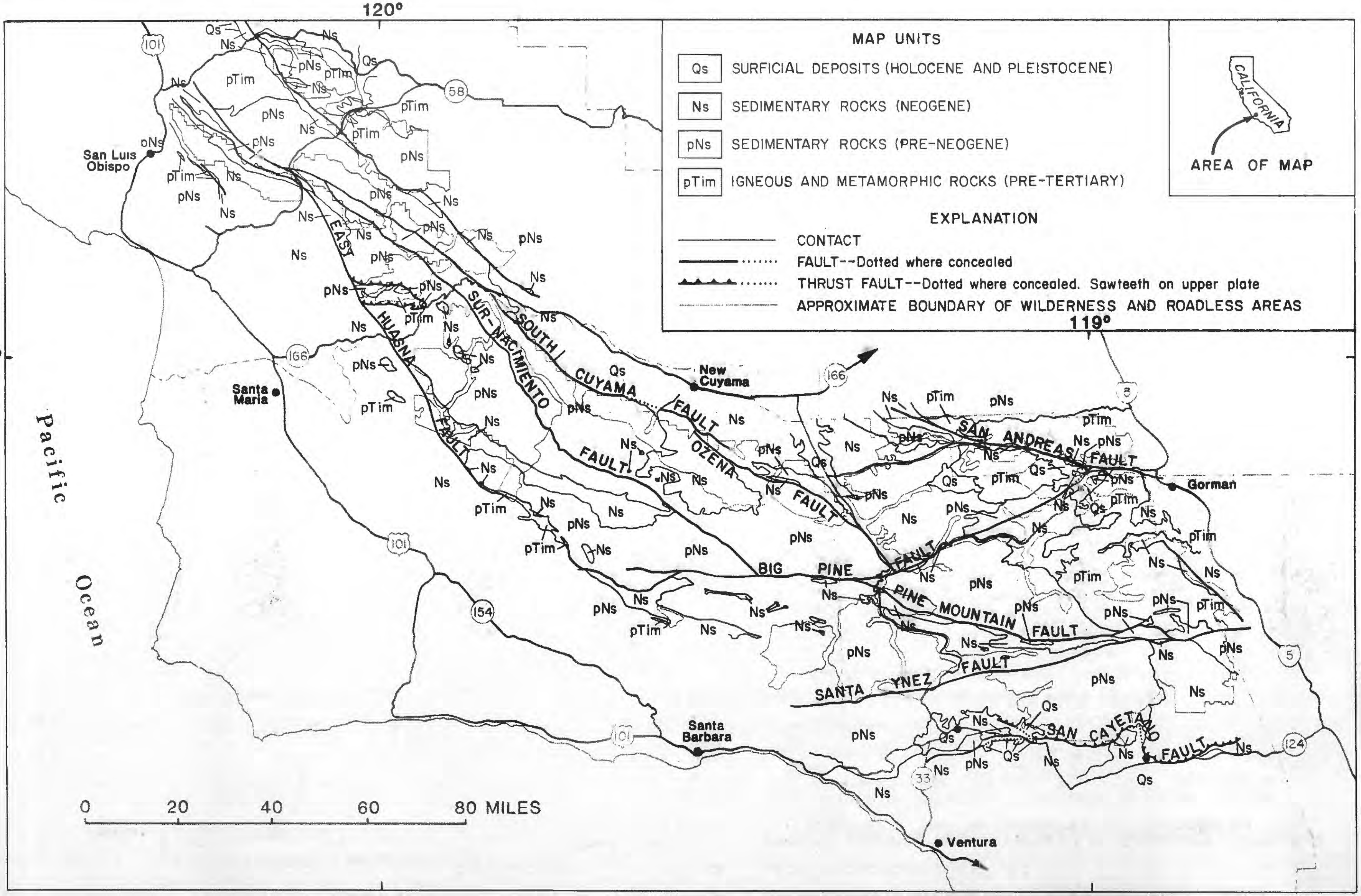


Figure 2--Simplified geologic map of roadless areas and the Santa Lucia Wilderness, Los Padres National Forest, California. Geology from Frizzell and Vedder (1985). See figure 1 for names and locations of roadless areas.

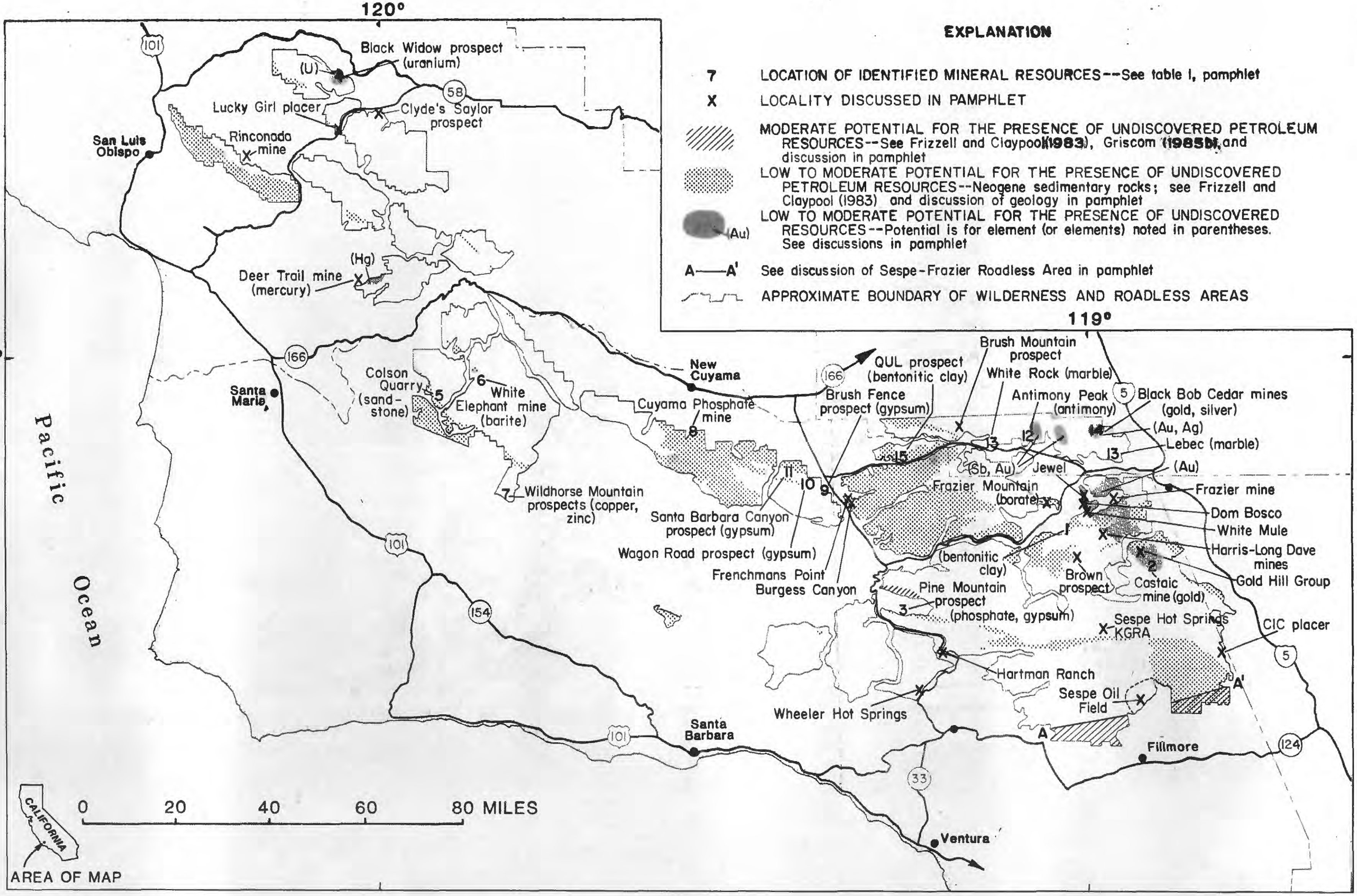


Figure 3--Mineral resource potential map of roadless areas and the Santa Lucia Wilderness, Los Padres National Forest, California. See figure 1 for names and locations of roadless areas, figure 2 for simplified geology, and table 1 for identified mineral resources.