MINERAL RESOURCE POTENTIAL OF THE KINGS RIVER, RANCHERIA, AGNEW, AND OAT MOUNTAIN ROADLESS AREAS, FRESNO COUNTY, CALIFORNIA

SUMMARY REPORT

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STUDIES RELATED TO WILDERNESS

Under provisions of the Wilderness Act (Public Law 88-577, September 3,1964) and related acts, 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 Kings River (B5198), Rancheria (C5198), Agnew (5199), and Oat Mountain (5197) Roadless Areas, Sierra and Sequoia National Forests, Fresno County, Calif. The roadless areas were classified as further-planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service in January 1979.

SUMMARY

A combined geologic, geophysical, and geochemical investigation and a survey of the existing mines, prospects, and mineralized areas were conducted to determine the mineral resource potential of the Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas in Fresno County, central Sierra Nevada, California (fig. 1). The survey indicates that the potential for tungsten mineral resource is moderate in parts of the Kings River and Rancheria Roadless Areas, low in part of the Agnew Roadless Area, and low in part of the Oat Mountain Roadless Area (fig. 2). The survey also indicates that the potential for lode gold mineral resource is low in part of the Kings River Roadless Area.

Known tungsten occurrences and deposits are most prevalent in the central part of the Kings River Roadless Area and in the southern part of the Rancheria Roadless Area. The Wet Spot prospect (loc. 9, fig. 2; table 1) within the Kings River Roadless Area and the Lodge Pole prospect (loc. 25) in the Rancheria Roadless Area contain low tonnages of low-grade tungsten resources. The Garnet Dike mine (loc. 11, fig. 2; table 1), adjacent to the central part of the Kings River Roadless Area, was a producer of tungsten during the 1940's and 1950's and has substantial tungsten resources. Several small tungsten occurrences are at prospects in the Kings River, Rancheria, and Agnew Roadless Areas. Lode gold occurrences are known in the southwestern part of the Kings River Roadless Area, where part of one patented claim extends into the roadless area; several other lode gold prospects occur adjacent to the Kings River, Oat Mountain, and Rancheria Roadless Areas. Gold and silver values are sporadic and generally low throughout the study area, and these prospects have only a low potential for lode gold. Alluvial-gravel deposits in the western part of the Kings River Roadless Area generally contain small amounts of placer gold. There is no current mining activity in the study area.

Nonmetallic commodities in the study area consist of sand and gravel, marble, quartzite, and granite. Although much of this material is suitable for construction uses, its remoteness from markets would result in high, uncompetitive development and transportation costs. Abundant marble in the Agnew Roadless Area contains generally too high a content of magnesium oxide to be suitable as a raw material for cement manufacture. The geologic environment in the study area is unfavorable for oil, gas, geothermal energy, or coal resources.

INTRODUCTION

LOCATION AND ACCESS

The Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas lie between the crest of the Sierra Nevada and the east edge of the San Joaquin Valley, about 28 to 56 mi east of Fresno, Calif. (fig. 1). They encompass an area of approximately 92,500 acres in eastern Fresno County, Calif. The study area is dominated by the extremely rugged Kings River Canyon, one of the deeper canyons in the nation. The Kings River and its tributaries flow westward from the Sierra Nevada crest to the San Joaquin Valley and form one of the larger drainage systems in the Sierra Nevada. The roadless areas are mainly on the walls of the various branches of the Kings River Canyon. The individual roadless areas are located as follows (fig. 1): (1) Kings Canyon (B5198)—both sides of the Kings River Canyon in the central part of the study area; (2) Rancheria (C5198)—on the highlands north of the Kings River Canyon in the north-central part of the study area; (3) Agnew (5199)—on the south slope of the Kings River Canyon in the eastern part of the study area; and (4) Oat Mountain (5197)—on the south side of the Kings River Canyon in the western part of the study area.

Elevations in the study area range from 800 ft in the bottom of the Kings River Canyon at the western edge of the Oat Mountain Roadless Area to 10,051 ft at the top of Spanish Mountain at the boundary between the Kings River and Rancheria Roadless Areas. The east boundary of the Kings River Roadless Area includes the deepest part of the Kings River Canyon, 7,811 ft deep. State Highway 180, the Kings Canyon Highway, and a Fresno County road to the Pine

Flat Reservoir provide access to the Oat Mountain, Kings River, and Agnew Roadless Areas. State Highway 168 and a Fresno County road to the Wishon Reservoir provide access to the Rancheria Roadless Area. Secondary roads and trails reach the study area boundaries in a few places, but access into individual areas is limited to a few trails. Many parts of the study area are extremely steep and brushy and can be visited only with great difficulty on foot or by helicopter. The nearest population center is Sanger, Calif., about 20 mi west of the study area.

PREVIOUS AND PRESENT STUDIES

The southern part of the study area was first studied in reconnaissance by the 1864 Whitney survey of the Geological Survey of California. The field party included William Brewer, party chief, Charles Hoffman, topographer, and Clarence King (later the first Director of the U.S. Geological Survey) and James Gardner, geologists. The first geologic mapping in the study area was by Krauskopf (1953), who also made the first studies of mineral deposits in the study area. The Fresno sheet of the "Geologic Map of California" (Matthews and Burnett, 1965) includes the study area and shows several unmapped areas in rugged parts of the study area. Moore (1978) mapped the eastern part of the Agnew Roadless Area in the Marion Peak quadrangle. Summaries of mineral resource investigations in the study area were published by the U.S. Bureau of Mines (Longwill, 1982; Spear, 1932a, b). Several topical studies of metamorphic and granitic rocks along the margins of the Kings River and Agnew Roadless Areas have been done by Moore and Dodge (1962), Jones and Moore (1973), Girty (1977), and Chen and Moore (1982). Regional studies of the Cenozoic rocks in the study area have been made by Moore and Dodge (1980, 1981), and of the metasedimentary and metavolcanic rocks by Bateman and Clark (1974), Saleeby and others (1978), Nokleberg and Kistler (1980), and Nokleberg (1983). A geologic guide to the Kings Canyon Highway, which borders parts of the Kings River and Agnew Roadless Areas, was published by Moore and others (1979). Mineral resource assessments have been completed for the High Sierra Primitive Area, which lies directly north of the eastern part of the Agnew Roadless Area, by Moore and Marks (1972); and for the John Muir Wilderness Area, which lies directly east of the Rancheria Roadless Area by du Bray (1981), and du Bray and others (1982).

Geologic mapping and geochemical sampling for this study were done by the U.S. Geological Survey in 1981 and 1982. The entire study area was geologically mapped at a scale of 1:62,250, and the larger masses of metamorphic rocks were mapped at a scale of 1:24,000. Thin sections of 1,087 rock samples were examined, 388 rocks were analyzed by semiquantitative spectrographic methods, and 67 rocks were quantitatively analyzed for whole-rock composition. A total of 374 person-days were spent in the field.

Personnel of the U.S. Bureau of Mines searched the literature and county mining records, and conducted field investigations during 1979 and 1980. Information on the location, ownership, and status of mining claims and Federal leases was obtained from the records of Fresno County and the U.S. Bureau of Land Management. A total of 198 person-days was spent on fieldwork. A total of 165 chip and grab lode samples were taken from mines, prospects, dumps, and mineralized areas, and 9 sand and gravel samples were taken for heavy-mineral determinations. These samples were analyzed for gold and silver by the fire-assay method, and selected samples for tungsten by X-ray fluorescence; other selected samples were analyzed for copper, lead, zinc, chromium, nickel, and mercury. At least one sample from each mineralized structure or prospect was analyzed by semiquantitative methods for 42 elements to detect unsuspected minerals of possible value. All samples were checked for radioactivity and fluorescence.

GEOLOGIC SETTING

The roadless areas covered in this study are in the central part of the Sierra Nevada, a faulted and westward-tilted range extending more than half the length of eastern California. The east slope of the range is a precipitous fault scarp, whereas the west slope is moderately inclined but is deeply incised by major river systems, such as the Kings River, that create generally parallel east-west-trending deep canyons interspersed with areas of moderate relief. This part of the range is underlain by granitic and metamorphic rocks with sparse surficial deposits.

The Kings River Canyon exposes several Late Cretaceous granitic plutons of the Sierra Nevada batholith and less abundant relatively older metamorphic rocks. The plutons have intruded and contact metamorphosed highly deformed volcanic and sedimentary rocks principally of Triassic and (or) Jurassic age. The two largest bodies of metamorphic rocks are the Boyden Cave roof pendant in the Agnew Roadless Area and the Pine Ridge roof pendant in the Kings River Roadless Area. A few ridges and small peaks in the study area are capped by Tertiary volcanic rocks. Deep erosion of the Tertiary volcanic rocks and underlying bedrock reflects uplift of the Sierra Nevada during the late Tertiary and dissection by streams and glaciers. The upper part of the Kings River Canyon has a broad U-shaped cross section, hanging tributaries, and other features typical of glaciated river valleys. The lower part of the Kings River Canyon, containing the bulk of the roadless areas, has a narrow V-shaped cross section, steep-walled narrow canyons, tributary streams with steep gradients, and other features typical of youthful topography that is being actively uplifted and eroded.

MINING ACTIVITY

Tungsten and possible byproduct molybdenum and gold are the only mineral commodities for which production has been recorded in the study area. About 20,000 tons of tungsten ore was produced from the Garnet Dike mine (loc. 11, fig. 2; table 1) adjacent to the Kings River Roadless Area. About 337 lode claims have been staked within and adjacent to the roadless areas for tungsten, gold, copper, molybdenum, chromium, and uranium, as well as about 80 placer gold claims and 9 millsite claims. Except for part of one gold claim that was patented in the Kings River Roadless Area in the 1950's, no other patented mining claims, millsites, or oil and gas leases are located in the study area. None of these claims are currently active. No gold production has been recorded from the study area.

GEOLOGY

MESOZOIC

Metamorphic rocks

The metamorphic rocks in the study area primarily comprise two major terranes—the Kings terrane of metasedimentary rocks and the Goddard terrane of metavolcanic rocks (Nokleberg, 1983). Minor serpentinized ultramafic rocks occur in the western part of the study area as large inclusions in granitic rocks; the ultramafic rocks constitute the eastern part of the Kings River ophiolite (Saleeby and others, 1978).

The Kings terrane, first defined as the "Kings sequence" by Bateman and Clark (1974) and best exposed in the Boyden Cave and Pine Ridge roof pendants, consists principally of highly deformed and regionally metamorphosed quartzite, arkose, marl, mudstone, calcareous sandstone, and marble. Regional metamorphism has transformed these rocks into metaquartzite, biotite-quartz schist, meta-arkose, calcschist, biotite schist, and marble. The metasedimentary rocks of the Kings terrane are spectacularly exposed in the southern part of the Boyden Cave roof pendant in the Agnew Roadless Area. In this area, the major metasedimentary-rock types are marble, phyllite, biotite schist, calcschist, and quartzite. Very prominent ridges of marble crop out along the Windy Cliffs south of Boyden Cave and west of Boulder Creek, and metaquartzite and meta-arkose underly the prominent ridge south of Horseshoe Bend (see map sheet). Farther west, in the Pine Ridge roof pendant in the Kings

River and Oat Mountain Roadless Areas, the major metamorphic-rock types are biotite schist and lesser quartzite, marble, and calcschist. Smaller masses of metasedimentary rocks occur throughout the study area. Sparse fossils, mainly crinoids and ammonites, found near the mouth of Boulder Creek in the Agnew Roadless Area, indicate a Late Triassic and Early Jurassic age for the Kings terrane (Moore and Dodge, 1962; Jones and Moore, 1973; Saleeby and others, 1978). The margins of the larger roof pendants and most of the smaller masses of metamorphic rocks have been recrystallized to hornfels by the intrusion and associated heat of granitic plutons. The Kings terrane is interpreted as a submarine-fan system containing craton-derived sand and, farther to the south, silicic volcanic tuff and breccia (Saleeby and others, 1978). The base and top of the stratigraphic section of the Kings terrane are either faulted or intruded by granitic plutons; the minimum stratigraphic thickness is estimated at several thousand feet (Saleeby and others, 1978).

The Kings terrane is intensely deformed. Moderately appressed to isoclinal folds and axial-plane schistosity are common. Bedding has generally been transposed to a series of parallel tectonic lenses or foliation by penetrative deformation, and isoclinal folds and axial-plane schistosities are common. Structural analyses show that most of the Kings terrane is twice deformed (Girty, 1977; Nokleberg and Kistler, 1980). Multiple deformation is indicated by two generations of superposed minor and major structures, mainly folds with axial-plane schistosity and lineation, and by local shear and cataclasite zones (Girty, 1977; Nokleberg and Kistler, 1980). The older set, called "first-generation structures", strike east-northeast and dip moderately to steeply north. These first-generation structures are best exposed in the phyllite unit along the north side of the Kings Highway east of Boyden Cave. The younger set, called "second-generation structures", strike north-northwest and dip steeply to vertically. These second-generation structures are common in the metasedimentary rocks of the Kings terrane. Detailed structural analysis indicates that the second-generation structures are superposed on the first-generation structures (Girty, 1977; Nokleberg and Kistler, 1980). Local and regional comparisons of major and minor structures indicate that the first generation structures formed in a regional deformation during the Early or Middle Jurassic and that the second generation structures formed during the Late Jurassic Nevadan orogeny (Nokleberg and Kistler, 1980). Crosscutting of the metamorphic rocks and contained structures by relatively undeformed granitic plutons of Early Cretaceous age indicates that the regional deformation ceased by that time.

The Kings and Goddard terranes are separated by a major pregranitic fault named the "Kings River suture" (Nokleberg, 1983). The evidence for this fault consists of narrow slivers of fault-bounded and highly deformed metasedimentary and metavolanic rocks that strike obliquely into one another in the Agnew Roadless Area. Intense shears and cataclastic zones, part of the second generation structures, also occur in the eastern part of the pelitic and calcphyllite unit of the Boyden Cave roof pendant near the fault. The parallelism of the Kings River suture to the second-generation structures indicates that the suture probably formed along with these structures during the Late Jurassic Nevadan orogeny.

The metavolcanic rocks of the Goddard terrane occur only in a narrow zone in the Agnew Roadless Area. In this zone, the metavolcanic rocks consist of highly deformed fault-bounded lenses of metarhyolite and metadacite flows and tuff. Sparse occurrences of fossils and radiometric dating of samples from elsewhere in the Goddard terrane in the central Sierra Nevada indicate mainly a Jurassic age for the Goddard terrane (Nokleberg, 1983). The Goddard terrane is interpreted as a fault-bounded fragment of the upper part of an Andean-type arc that formed on the Jurassic margin of western North America (Nokleberg, 1983). Intense deformation of the metavolcanic rocks in the Agnew Roadless Area is indicated by a well-developed schistosity that strikes north-northwest and dips steeply to vertically, parallel to second-generation structures in the metasedimentary rocks. This relation suggests that the metavolcanic rocks of the Goddard terrane were deformed only in the second deformation that occurred during the Late Jurassic Nevadan orogeny.

Granitic rocks

Several major masses or plutons of quartz monzonite, granodiorite, and quartz diorite occur in the study area; numerous smaller bodies of gabbro and metagabbro occur mainly in the western part of the study area. There is a general progression from more silicic plutons in the eastern part to more mafic plutons in the western part of the study area. Contacts between plutons are shown on the accompanying map, although individual plutons are not separately named. Contacts between plutons, and between plutons and wallrocks, are generally clean and sharp and exhibit consistent age relations, as determined by such features as diking and stoping.

Three plutons dominate the study area. (1) A pluton of porphyritic quartz monzonite, dated at 86 m.y. (Chen and Moore, 1982), occurs in the eastern part of the Kings River Roadless Area and is best exposed in the vicinity of Brush Canyon. This pluton is characterized by abundant phenocrysts of potassium feldspar and is light colored (8-12 percent mafic minerals). Similar porphyritic quartz monzonite plutons also occur in the central part of the Kings River Roadless Area in the Converse Basin area (see map sheet). (2) A pluton of fine-grained quartz monzonite occurs in the western part of the Kings River Roadless Area, just east of the Garnet Dike mine (loc. 11, fig. 2; table 1), and is intruded by and thus, is older than the porphyritic quartz monzonite of Brush Canyon. This pluton of fine-grained quartz monzonite is also light colored (about 5 percent mafic minerals), equigranular, and locally garnet bearing. Abundant fine-grained alaskite and pegmatite dikes locally cut the pluton. This pluton, which occurs near many of the tungsten-bearing tactite mineral deposits and occurrences, may have been the principal source of the hydrothermal fluids that were responsible for alteration of the marble to tactite. (3) A pluton of quartz diorite, dated at 112 m.y. (Chen and Moore, 1982), occurs in the southern part of the Oat Mountain Roadless Area and in the southwestern part of the Kings River Roadless Area. This pluton is best exposed in the White Deer Flat area south of Oat Mountain. Locally this pluton of quartz diorite forms a complex pattern of dikes that intrude biotite schist and other metasedimentary rocks. The pluton is intruded by the fine-grained quartz monzonite described above. Two other, smaller plutons of granodiorite occur in the Agnew Roadless Area. One is the schistose granodiorite of Tombstone Creek (Moore and Marks, 1972), dated at 99 m.y. by Chen and Moore (1982), that intruded along part of the Kings River suture within the Boyden Cave roof pendant; the other is the at 109 m.y. by Chen and Moore (1982), in the eastern part of the Agnew Roadless Area.

CENOZOIC

Tertiary basalt

Numerous remnants of late Tertiary olivine basalt lava flows are scattered over the upland parts of the study area. These flows, which belong to the San Joaquin and Kings volcanic fields, represent numerous small eruptions from scattered vents during the period 4.5-3 m.y. ago (Moore and Dodge, 1980, 1981). The basalt is generally rich in alkalies, particularly potassium, and some is so potassic that it contains the mineral leucite. The largest area of Tertiary basalt crops out north of the north rim of the Kings River Canyon within the Rancheria Roadless Area. These lavas were formerly much more extensive, but glacial action has eroded much of the basalt. On the south side of the Kings River Canyon, relatively large remnants of basalt flows are preserved northwest of Hume Lake, partly in the Kings River Roadless Area. Within the entire volcanic field, the dikes or pipes that fed these volcanic extrusions have rarely been found. However, an interesting basalt dike, about 5.7 ft thick and more than 0.6 mi long, was discovered during this study in the Kings River Roadless Area, west of Deer Ridge (see map sheet).

Quaternary deposits

Unconsolidated sand and gravel occur in the Kings River channel and at scattered localities along tributary stream channels. Gold and tungsten minerals, eroded from lode deposits upstream, have been deposited in small amounts with Quaternary sand and gravel. Abundant colluvium, defined as either talus, thick soil, or minor landslide or solifluction material, and extremely thick brush over thick soil occur in the central and western parts of the study area. Unconsolidated glacial deposits, principally of Wisconsin age, occur in the Rancheria Roadless Area and in the eastern part of the Agnew Roadless Area. These glacial deposits consist mainly of till composing terminal and lateral moraines. Quaternary deposits are not subdivided on the geologic map.

AEROMAGNETIC STUDIES

Aeromagnetic data, which reflect local variations in the intensity of the Earth's magnetic field, were taken continuously during flights nominally 1,000 ft above the terrain. Owing to the steep topography of the study area and the performance limitations of fixed-wing aircraft, actual survey heights may have been as low as 600 ft over ridges and as high as 2,000 ft over valleys.

Variations in the magnetic field are generally caused by variations in the magnetic-mineral content of the rock units; magnetite is the common magnetic mineral in the region. Magnetic minerals, where locally concentrated or absent, may cause a magnetic anomaly that can be a guide to mineral occurrences or deposits. Boundaries between magnetic and relatively less magnetic rock units are generally located approximately at the steepest gradient on the flanks of the magnetic anomaly because at these magnetic latitudes, the inclination of the Earth's magnetic field is relatively steep.

Analysis of the magnetic data (U.S. Geological Survey, 1982) indicates that although many of the magnetic anomalies do not correlate with topography, the area east of long $118^{\circ}47'$ W. is underlain by magnetic granodiorite with substantial topographic relief, and here the magnetic anomalies do correlate well with topography. Although certain of the plutonic rocks in this area are significantly magnetic and display characteristic magnetic anomalies, no significant correlation between the magnetic map and either the known mineral occurrences (tungsten or gold) or the geochemical anomalies is apparent. Accordingly, the magnetic map generally does not provide any additional evidence for possible mineral deposits. The magnetic data do suggest, however, that a magnetic tactite deposit (loc. 30, fig. 2; table 1), near Lockwood Creek, may extend for about 0.5 mi southeastward of the prospect in the Agnew Roadless Area.

GEOCHEMICAL STUDIES

GENERAL

A total of 388 rock samples, 127 minus-80-mesh stream-sediment samples, and bulk-sediment samples to produce 56 nonmagnetic heavy-mineral-concentrate samples were collected in and adjacent to the study area. Analyses of rock samples from altered areas and from areas of suspected mineralized zones indicate the geochemical abundances in these areas. Analyses of stream-sediment and nonmagnetic heavy-mineral-concentrate samples indicate the overall chemistry of the minerals present in eroded rock material from the entire drainage basin upstream from each sample site. The higher concentrations measured in the nonmagnetic heavy-mineral-concentrate samples permit determination of some elements, such as tungsten, that are not commonly detected in stream-sediment samples. Because of the processing procedures used, some elements determined in concentrate samples can be related to specific minerals; for example, barium commonly indicates only barite. All the samples were analyzed for 31 elements by six-step semiquantitative emission spectroscopy. Any rock samples in which either arsenic or silver was detected in the spectrographic analysis were also analyzed by atomic-absorption spectrometry for gold. All the stream-sediment samples were also analyzed for zinc by atomic-absorption spectrometry.

Statistically, the concentration range for each element determined is divisible into background and anomalous concentrations. The resulting anomalous concentrations may indicate either a specific rock type, areas with observed alteration, known mineral occurrences and deposits, or areas of undiscovered mineral occurrences and deposits. With proper interpretation, some anomalous values can be used as one of several criteria for determining the mineral-resource potential for specific types of mineral resources.

ROCK SAMPLES

Anomalous concentrations of as many as 15 elements (antimony, arsenic, barium, bismuth, chromium, copper, gold, lead, molybdenum, nickel, silver, tin, tungsten, vanadium, zinc) were identified in rock samples. Most of these concentrations and represent slightly above normal enrichment in rocks common in the study area. The moderately to highly anomalous concentratins of arsenic, copper, gold, lead, molybdenum, silver, tungsten, and zinc in different rock samples represent the following types of mineral occurrences. (1) Anomalous concentrations of copper, lead, molybdenum, silver, and zinc in schist, commonly iron stained or containing accessory pyrite, that occur throughout the study area represent widely scattered and minor occurrences of base-metal sulfide minerals; (2) Anomalous concentrations of tungsten in widely spaced samples of tactite and in granitic rocks adjacent to tactite in the south-central part of the Agnew Roadless Area indicate tungsten-bearing tactite occurrences; (3) Moderately anomalous concentrations of molybdenum and zinc in isolated and small tactite and gossan developed in marble about a mile east of Cabin Creek in the southern part of the Kings River Roadless Area (see map sheet) indicate a minor base-metal sulfide deposit; (4) Strongly anomalous concentrations of gold, lead, silver, and zinc at the Geraldine Lakes prospect (loc. 27, fig. 2; table 1) adjacent to the southeast corner of the Rancheria Roadless Area indicate local concentrations of base-metal sulfides hosted in tactite in marble.

STREAM-SEDIMENT AND HEAVY-MINERAL-CONCENTRATE SAMPLES

Anomalous concentrations of as many as 14 metallic elements (antimony, arsenic, barium, bismuth, chromium, copper, lanthanum, lead, molybdenum, nickel, silver, tin, thorium, and tungsten) were identified in samples of stream sediment or heavy-mineral concentrate. Anomalous values of bismuth, lanthanum, tin, and thorium probably represent only slightly above normal enrichment in the granitic and metamorphic rocks that underly most of the study area. Weakly anomalous concentrations of Cr or Ni, in samples collected in areas underlain by ultramafic and mafic plutonic rocks and basalt, probably represent only the expected normal enrichment in these rocks. Moderately to highly anomalous concentrations of antimony, arsenic, barium, copper, lead, molybdenum, silver, and tungsten may indicate the presence of hydrothermal-mineral deposits.

A study of the stream-sediment-sample analyses reveals no areas with clusters of significantly anomalous values of any element; however, several areas with clusters of anomalous elements are revealed in the heavy-mineral-concentrate data. In the western part of the Agnew Roadless Area, anomalous concentrations of tungsten, locally with anomalous molybdenum, in one area underlain by calcschist and granitic rocks, correlate with known or suspected tungsten-bearing tactite occurrences. Similar anomalies are present in the Kings River Roadless Area; areas with these anomalies are mainly on the north side of the Kings River Canyon, west of Deer Ridge, and near Fox Canyon (see map sheet), where several tungsten mines and deposits occur in tactite within marble near granitic rocks. Also in the same roadless area, anomalous concentrations of antimony, copper, lead, silver, and tin in samples collected from a small isolated area underlain by schist on the south side of the Kings River along Converse Creek may indicate the presence of localized stratiform sulfide or tactite occurrences. In the Oat Mountain Roadless Area, on the north side of Oat Mountain, anomalous concentrations of tungsten in samples from an area underlain by schist, marble, and sparse granitic rocks, may represent tungsten-bearing tactite occurrences. In the eastern part of this roadless area, one sample contained a highly anomalous concentration of barium; the area is underlain by schist, and so this sample may indicate a highly localized stratiform or vein barite occurrence. In the southern part of the Rancheria Roadless Area, anomalous concentrations of molybdenum, locally with anomalous tungsten, in an area underlain by granitic rocks and metasedimentary rocks that includes marble, may indicate tungsten-bearing tactite occurrences.

MINES, PROSPECTS, AND MINERALIZED AREAS

REGIONAL MINING ACTIVITY

Mining activity in the study area began as early as 1880 in the Davis Flat area (locs. 17-21, fig. 2; table 1) near the west boundary of the Kings River Roadless Area. Both vein and placer deposits were worked intermittently around the turn of the 20th century. Two gold claims, located in the Davis Flat area in the 1930's, were patented in the 1950's; however, no gold production from the study area has been recorded. The gold generally occurs in scattered gash quartz veins in granitic rocks; many of the veins narrow rapidly with depth and commonly carry about 1 percent of sulfide minerals, mostly pyrite. Quartz veins containing lode gold were probably the source of the placer gold in the western part of the Kings River Roadless Area.

Exploration and mining of tungsten deposits, the primary mineral commodity produced from this region, began in the 1930's and continued through the 1950's. No organized tungsten mining districts are in the vicinity; the mining activity took place at widely distributed deposits. Several deposits and occurrences along the Kings River (locs. 7-15, fig. 2; table 1), including the Garnet Dike mine (loc. 11), have been informally called the "Kings River tungsten district." The Garnet Dike mine, the main tungsten producer in this area, is adjacent to the Kings River Roadless Area in a partly surrounded by the roadless area. Development at this mine started in 1936, and production began in 1941 (C. H. Sheridan, oral commun., 1980); other tungsten mines in the district began limited production in 1941 or later. All these mines ceased operations by 1945 except the Garnet Dike, which operated intermittently until 1954. Production from the district totaled more than 22,000 short-ton units (stu) of tungsten trioxide (1 stu contains 20 lb of tungsten trioxide or 15.86 lb of tungsten); most of this production came from the Garnet Dike mine (Krauskopf, 1953; C. H. Sheridan, oral commun., 1980). Federal government purchase of strategic minerals at subsidized wartime prices was the main stimulus for most of the tungsten production.

The tungsten occurs in scheelite (calcium tungstate) in contact-metasomatic deposits called tactite or skarn that generally occur near carbonate beds near intrusive contacts of granitic rocks. Fractures within these carbonate beds commonly control the formation of tactite (Bateman, 1965); the resulting tactite generally is erratically distributed, small, irregular, and lenticular. Individual tactite bodies range in size from tiny pods and stringers to layers several hundred feet long by several feet wide, as at the Strawberry tungsten mine (Nokleberg, 1981). The tactite is generally composed of garnet, epidote, pyroxene, and varying amounts of quartz, calcite, amphibole, and wollastonite, and may contain scheelite, the main tungsten-bearing mineral in this region (Krauskopf, 1953; Bateman, 1965; Nokleberg, 1981; Newberry, 1982). Where present, the scheelite generally is sporadically distributed. Concentrations of scheelite range as high as a few percent tungsten trioxide. Sparse pyrite, chalcopyrite, and molybdenite also occur in tactite.

KINGS RIVER ROADLESS AREA

Fresno County records indicate that a total of 321 mining claims have been located within and adjacent to the Kings River Roadless Area. The oldest lode claim was located for gold in 1880; there are 233 lode, 80 placer, and 8 millsite claims. Two patented lode gold claims, staked in the 1930's in the Davis Flat area, are part of a group of five claims (locs. 17-21, fig. 2; table 1) near the west boundary of the roadless area; part of one patented claim extends into the roadless area. Records of the U.S. Bureau of Land Management indicate no Federal mineral or oil and gas leases within the roadless area.

The largest deposit in the Kings River Roadless Area is at the Wet Spot prospect (loc. 9, fig. 2; table 1), where an estimated 56,000 tons of inferred low-grade tungsten resources is in a small roof pendant adjacent to diorite. Soil cover is deep, and tactite outcrops are limited to the central part of the pendant. The tungsten is in scheelite, which occurs as tiny disseminations. The average tungsten concentration, weighted by sample length, in 19 samples from the deposit is 0.27 weight percent tungsten trioxide. Higher tungsten concentrations generally occur in the northern part of the tactite outcrop area. No production is reported for the prospect.

Nine other tungsten prospects within the Kings River Roadless Area (locs. 3-5, 8, 13-15, 19, 22, fig. 2; table 1) consist mainly of small stringers and masses of tactite exposed in small trenches and open cuts. The tungsten concentration is generally no more than 0.2 weight percent tungsten trioxide, and the estimated sizes of the tactite bodies are small. Six other tungsten mines and prospects (locs. 1, 2, 7, 10-12) are adjacent to the roadless area. The largest deposit is at the Garnet Dike mine (loc. 11) which produced about 20,000 stu of tungsten trioxide from about 20,000 tons of ore. As much as 100,000 tons of similar-grade (approximatly 1 weight percent tungsten trioxide) resources is estimated to remain (C. H. Sheridan, written commun., 1980). Three other tungsten mines—the Quigley, Quigley Kings River, and Lime Ridge (locs. 7, 10, and 12, respectively)—have together produced from 400 to 600 stu of tungsten trioxide.

A few lode gold occurrences within the Kings River Roadless Area (locs. 16, 18, 20, 29, fig. 2; table 1) consist of widely disseminated gold in sparse quartz veins, generally in granitic rocks. The most significant gold prospect is the Southern Extension of the Nugget mine No. 2 prospect (loc. 18) which is on a patented claim in the western part of the roadless area. Seven grab samples of vein material contained as much as 0.061 troy oz gold per ton and as much as 0.8 troy oz silver per ton. The gold occurs in a 4-ft-thick quartz vein in granodiorite. Workings consist of small trenches, an adit, and an inclined raise.

Three other lode gold prospects—one of unknown name, the Olympia, and the Sierra Scientific (locs. 16, 20, and 29, respectively, fig. 2; table 1)—are within the Kings River Roadless Area. Gold concentrations are sporadic and are as high as 0.157 troy oz gold per ton; silver content is as much as 0.4 troy oz per ton. The gold generally occurs in quartz veins as much as 5 ft thick. Workings consist of small pits and trenches. Three gold prospects adjacent to the roadless area consist of quartz veins, as much as 1 ft thick, in granodiorite or quartz diorite. Gold concentrations are sporadic and are as high as 0.89 troy oz per ton; silver concentrations are as high as 0.4 troy oz per ton. Workings consist of open cuts, pits, trenches, and short adits; production is unknown.

Placer deposits were examined in nine areas, mainly along the Kings River and in the Sampson Flat area. Analyses of heavy-mineral concentrates from the deposits show few significant metallic concentrations; one sample from the Sampson Flat area contained 0.0016 troy oz gold per cubic yard valued at $0.64 per cubic yard at current gold prices ($400 per troy oz).

RANCHERIA ROADLESS AREA

Fresno County records indicate that a total of five mining claims, all lode, have been located at four places within the Rancheria Roadless Area (locs. 23-26, fig. 2; table 1). Records of the U.S. Bureau of Land Management indicate no Federal mineral or oil and gas leases within the roadless area.

The major mineral deposit in the Rancheria Roadless Area is the Lodge Pole prospect (loc. 25, fig. 2; table 1). This deposit contains about 12,000 tons of inferred low-grade tungsten resources averaging 0.34 weight percent tungsten trioxide in three discontinuous tactite lenses; maximum exposure of an individual lens is 200 ft long by 15 ft wide. Analyses of 30 samples from the deposit range from not detected to a maximum of 1.4 weight percent tungsten trioxide. A few samples contained silver, which is uncommon in the roadless area; silver concentrations are as much as 4.8 troy oz per ton. Three samples contained as much as 0.01 troy oz gold per ton. Other metallic concentrations are generally insignificant. The Lodge Pole prospect is estimated to contain more than 600,000 tons of tactite. Tungsten concentrations in the deposit are erratic, but additional possibly higher grade tungsten resources may occur at depth. One other small tungsten occurrence, the Ground Hog prospect (loc. 26), within the Rancheria Roadless Area contains only low tungsten concentrations; the highest tungsten content (0.27 weight percent tungsten trioxide), was in a pod less than 10 ft long. A major tungsten deposit, at the Obelisk prospect (loc. 28), occurs adjacent to the roadless area; about 8,000 tons of tactite averaging 1 weight percent tungsten trioxide is estimated (Moore and Marks, 1972). A small amount of tungsten ore was mined during the 1950's. At the Geraldine Lakes prospect (loc. 27), adjacent to the roadless area, tungsten concentrations in samples were generally less than 0.2 weight percent tungsten trioxide. One gold and one uranium prospect (locs. 23 and 24, respectively) also occur within the Rancheria Roadless Area; however, no significant concentrations of gold, uranium, or other metals were detected in any samples.

AGNEW ROADLESS AREA

Fresno County records indicate that about 33 claims have been located within the Agnew Roadless Area. Gold claims were located from 1900 to the 1930's and again in the 1970's; tungsten and uranium claims were located mainly in the early 1940's to mid-1950's. There are no patented mining claims, millsites, or oil and gas leases in the roadless area. Nine lode claims for tungsten and one millsite claim for tungsten were located at the Tehipite prospect (loc. 30, fig. 2; table 1) in 1936 and 1937. Although production records were not found, this mine probably produced ore between 1942 and 1944 (Logan and others, 1951, p. 497). One short caved adit, an ore bin, two cabin foundations, and haulage and drill roads are on the claims. No tactite outcrops were found; however, some tactite float was found near the ore bin. One of four samples of tactite from dump material and country rock contained 0.10 weight percent tungsten trioxide. In the late 1940's, four tungsten claims were located between Indian and Tenmile Creeks at the Scheelite Queen prospect (loc. 31). An unconfirmed report to the U.S. Bureau of Mines in 1948 stated that three samples of a tactite body contained greater than 1.0 weight percent tungsten trioxide and that the vein was traceable for several hundred yards. Ground and aerial reconnaissance during this study failed to find any extensive scheelite-bearing veins in the vicinity of the Scheelite Queen prospect.

Claims were located on the marble unit near and including Boyden Cave for building stone in 1907 and for gold in 1908. (Boyden Cave is a major tourist attraction that is operated privately under lease from the U.S. Forest Service.) The marble in which the cave is developed is white and slightly fractured and could be utilized locally for dimension or crushed stone, but other higher quality stone deposits are closer to major markets. Chemical analyses of the marble from several areas in the Boyden Cave roof pendant show from 24 to 53 weight percent calcium oxide and from 0.5 to 10 weight percent magnesium oxide; these data indicate excess magnesium oxide for consideration as a cement resource.

A calcareous and pelitic phyllite unit east of the marble, striking N. 15° W. and dipping 80° E., is traceable intermittently along strike for about 750 ft. Two samples of phyllite from places where radioactivity was anomalous contained 0.013 and 0.014 weight percent uranium oxide; these samples represent only small low-grade uranium occurrences. Additional chip and grab samples collected from the phyllite unit elsewhere in the Agnew Roadless Area contained only minor amounts of precious and base metals.

OAT MOUNTAIN ROADLESS AREA

Fresno County records indicate that a total of 67 mining claims have been located within or adjacent to the Oat Mountain Roadless Area. Gold claims were located from the 1890's through the 1930's, tungsten claims in the 1940's, and uranium claims in the 1950's. Favorable geologic environments are: (1) quartz veins in granitic rocks for gold; (2) contact zones between metasedimentary and granitic rocks for tungsten; and (3) ultramafic rocks for chromium. There are no patented mining claims, millsites, or oil and gas leases in the roadless area.

Quartz veins were explored for gold at the Low Pocket prospect (loc. 32, fig. 2; table 1) and at an unnamed prospect 5 mi farther east (loc. 33). At the Low Pocket prospect, the quartz vein strikes N. 60° W. and is nearly horizontal in quartz monzonite. This vein, exposed intermittently for about 800 ft along strike in four trenches, seven pits, two shafts, and a roadcut, ranges from 3 to 80 ft and averages 3 ft in thickness. A total of 13 samples of vein quartz contained no more than traces of gold and silver. The vein exposed at the unnamed prospect is 3 ft thick and contains only trace amounts of precious and base metals.

Contacts between metasedimentary and granitic rocks, and ultramafic rocks lie on the east and west ends of the Oat Mountain Roadless Area, respectively. Tungsten occurrences along these contacts are outside the roadless area. However, 26 samples of rocks from along the contact zones in the roadless area contained only trace amounts of tungsten and minor amounts of base metals. Ultramafic rocks, primarily peridotite and serpentinite, crop out 1 mi south (loc. 34, fig. 2; table 1) of the Low Pocket prospect. Exposures of these rocks were found in bulldozer trenches and roadcuts. Four samples from the workings contained as much as 0.33 weight percent chromium and traces of nickel and silver.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mining history, results of recent mine and prospect examinations, and the geologic, geochemical, and geophysical data acquired during this study indicate that the potential for tungsten mineral resource is low to moderate in parts of the Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas (fig. 2). Also, the potential for lode gold mineral resource is low in part of the Kings River Roadless Area (fig. 2). Nonmetallic commodities in the study area consist of sand and gravel, marble, quartzite, and granite suitable for construction. The geologic environment in the study area is unfavorable for oil, gas, geothermal energy, or coal resources. Criteria for the classification of potential for specific mineral commodities are listed below by roadless area and mineral resource.

KINGS RIVER ROADLESS AREA

Potential for tungsten mineral resource is moderate in the central part of the Kings River Roadless Area (fig. 2), as indicated by the following criteria: (1) favorable geologic environment of marble, locally in schist, that is intruded by granitic rocks. (2) moderately abundant (10) tungsten prospects (locs. 3-5, 8, 9, 13-15, 19, 22, fig. 2; table 1); (3) about 56,000 tons of indicated and inferred low-grade tungsten resources averaging 0.9 weight percent tungsten trioxide in tactite at the Wet Spot prospect (loc. 9); (4) six tungsten prospects (locs. 1, 2, 7, 10-12) and the Garnet Dike mine (loc. 11) adjacent to the roadless area; and (5) generally moderate anomalies of tungsten and molybdenum in some heavy-mineral concentrates. This area of moderate potential for tungsten mineral resource is adjacent to the larger masses of marble where intruded by granitic rocks; it extends into the steep, inaccessible south side of the Kings River Canyon, where although abundant marble is intruded by granitic rocks, no tungsten occurrences are known. A small area with low potential for tungsten mineral resource occurs in the northwestern part of the roadless area around the Blue Star prospect (loc. 5).

Potential for lode gold mineral resource is low in parts of the west half of the Kings River Roadless Area (fig. 2), as indicated by the following criteria: (1) sparse prospects; (2) one patented claim (loc. 18, fig. 2; table 1) that extends into the roadless area; (3) unfavorable geologic environment of sparse and generally narrow quartz veins in granitic rocks; and (4) generally low concentrations of gold and silver in quartz veins at prospects.

RANCHERIA ROADLESS AREA

Potential for tungsten mineral resource is moderate in the southern part of the Rancheria Roadless Area (fig. 2), as indicated by the following criteria: (1) identified low-grade tungsten resources totaling about 12,000 tons of tactite, averaging 0.34 weight percent tungsten trioxide, at the Lodge Pole prospect (loc. 25, fig. 2; table 1); (2) an estimated 8,000 tons of tactite, averaging about 1 weight percent tungsten trioxide at the Obelisk prospect near the roadless area (loc. 28); (3) weakly anomalous concentrations of tungsten and some molybdenum in heavy-mineral concentrates; and (4) locally favorable geologic environment of marble intruded by granitic rocks. Highly anomalous concentrations of gold occur in massive sulfide in tactite at the Geraldine Lakes prospect (loc. 27) which does not extend into the roadless area.

AGNEW ROADLESS AREA

Potential for tungsten mineral resource is low in parts of the west half of the Agnew Roadless Area (fig. 2), as indicated by the following criteria: (1) favorable geologic environment of some marble in schist intruded by granitic rocks; (2) sparse tungsten claims (locs. 30, 31, fig. 2; table 1); (3) weakly anomalous concentrations of tungsten and molybdenum in some heavy-mineral concentrates; (4) sparse tactite containing anomalous concentrations of tungsten and some molybdenum; and (5) a magnetic anomaly indicating extension of a known tungsten deposit to moderate depth toward the southeast. Local weakly anomalous concentrations of uranium in phyllite east of the marble in the Boyden Cave roof pendant are not significant. Because of varying composition and locally high magnesium oxide content, the marble in the Boyden Cave roof pendant is not suitable as raw material for cement manufacture.

OAT MOUNTAIN ROADLESS AREA

Potential for tungsten mineral resource is low in the central part of the Oat Mountain Roadless Area (fig. 2), as indicated by the following criteria: (1) weakly to moderately anomalous concentrations of tungsten in heavy-mineral concentrates; and (2) a minimally favorable geologic environment of sparse marble interbedded with biotite schist intruded by granitic rocks. In the eastern part of the roadless area, rock samples from contact areas between metamorphic and granitic rocks yielded only trace amounts of tungsten and base metals. Ultramafic rocks from south (loc. 34, fig. 2; table 1) of the Low Pocket mine contain small amounts of chromium, nickel, and silver that are too low to constitute mineral resources. The two gold prospects on quartz veins (locs. 32, 33) show only traces of gold and silver, and quartz veins are extremely sparse.

REFERENCES CITED

Bateman, P. C., 1965, Geology and tungsten mineralization of the Bishop district, California, with a section on Gravity study of Owens Valley, by L. C. Pakiser and M. F. Kane, and a section on Seismic profile, by L. C. Pakiser: U.S. Geological Survey Profession Paper 470, 208 p.

Bateman, P. C., and Clark, L. D., 1974, Stratigraphic and structural setting of the Sierra Nevada batholith, California: Pacific Geology, v. 8, p.79-89.

Chen, J. H., and Moore, J. G., 1982, Uranium-lead isotopic ages from the Sierra Nevada batholith, California: Journal of Geophysical Research, v. 87, no. 6B, p. 4761-4784.

du Bray, E. A., 1981, Generalized bedrock geologic map of the John Muir Wilderness, Fresno, Inyo, and Mono Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1185-A, scale 1:125,000, 2 sheets.

du Bray, E. A., Dellinger, D. A., Oliver, H. W., Diggles, M. F., Johnson, F. L., Thurber, H. K., Morris, R. W., Peters, T. J., and Lindsey, D. S., 1982, Mineral resource potential map of the John Muir Wilderness, Fresno, Inyo, Madera, and Mono Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1185-C, 10 p., scale 1:125,000.

Girty, G. H., 1977, Cataclastic rocks in the Boyden Cave roof pendant, central Sierra Nevada, California abs.: Geological Society of America Abstracts with Programs, v. 9, no. 4, p. 423.

Jones, D. L., and Moore, J. G., 1973, Lower Jurassic ammonite from the south-central Sierra Nevada, California: U.S. Geological Survey Journal of Research, v. 1, no. 4, p. 453-458.

Krauskopf, K. B., 1953, Tungsten deposits of Madera, Fresno, and Tulare Counties, California: California Division of Mines Special Report 35, 83 p.

Logan, C. A., Braun, L. T., and Vernon, J. W., 1951, Mines and mineral resources of Fresno County, California: California Journal of Mines and Geology, v. 47, no. 3, p. 485-552.

Longwill, W. D., 1982, Mineral resources of the Kings River (B5-198) and Rancheria (C5-198) RARE II Areas, Fresno County, California: U.S. Bureau of Mines Open-File Report MLA 5-82, 25 p.

Matthews, R. A., and Burnett, J. L., compilers, 1965, Fresno sheet of Geologic map of California: California Division of Mines and Geology, scale 1:250,000.

Moore, J. G., 1978, Geologic map of the Marion Peak quadrangle, Fresno County, California: U.S. Geological Survey Quadrangle Map GQ-1399, scale 1:62,500..

Moore, J. G., and Dodge, F. C. W., 1962, Mesozoic age of metamorphic rocks in the Kings River area, southern Sierra Nevada, California, art. 7 of Short papers in geology, hydrology, and topography: U.S. Geological Survey Professional Paper 450-B, p. B19-B21.

——1980, Late Cenozoic volcanic rocks of the southern Sierra Nevada, California: I. Geology and petrology: Summary: Geological Society of America Bulletin, pt. 1, v. 91, no. 9, p. 515-518.

——1981, Late Cenozoic volcanic rocks of the southern Sierra Nevada, California: II. Geochemistry: Summary: Geological Society of America Bulletin, pt. 1, v. 92, no. 12, p. 912-914.

Moore, J. G., and Marks, L. Y., 1972, Mineral resources of the High Sierra primitive area, California, with a section on Aeromagnetic interpretation, by H. W. Oliver: U.S. Geological Survey Bulletin 1371-A, p. A1-A40.

Moore, J. G., Nokleberg, W. J., Chen, J. H., Girty, G. H., and Saleeby, J. B., 1979, Geologic guide to the Kings Canyon Highway, central Sierra Nevada, California: Geological Society of America, Cordilleran Section Meeting, San Jose, Calif., 1979, Field Trip Guidebook, 33 p.

Newberry, R. J., 1982, Tungsten-bearing skarns of the Sierra Nevada. I. The Pine Creek mine, California: Economic Geology, v. 77, no. 4, p. 823-844.

Nokleberg, W. J., 1981, Geologic setting, petrology, and geochemistry of zoned tungsten-bearing skarns at the Strawberry mine, central Sierra Nevada, California: Economic Geology, v. 76, no. 1, p. 111-133.
Nokleberg, W. J., 1983, Wall rocks of the central Sierra Nevada batholith, California: A collage of accreted tectonostratigraphic terranes: U.S. Geological Survey Professional Paper 1255 in press .
Nokleberg, W. J., and Kistler, R. W., 1980, Paleozoic and Mesozoic deformations in the central Sierra Nevada, California: U.S. Geological Survey Professional Paper 1145, 24 p.
Saleeby, J. B., Goodin, S. E., Sharp, W. D., and Busby, C. J., 1978, Early Mesozoic paleotectonic-paleogeographic reconstruction of the southern Sierra Nevada region, in Howell, D. G., and McDougall, K. A., eds., Mesozoic paleogeography of the western United States: Pacific Coast Paleogeography Symposium 2, Los Angeles, Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 311-336.
Spear, J. M., 1982a, Mineral resources of the Agnew RARE II Area (No. 5199), Fresno County, California: U.S. Bureau of Mines Open-File Report MLA 19-82, 9 p.
——1982b, Mineral resources of the Oat Mountain RARE II Area (No. 5197), Fresno County, California: U.S. Bureau of Mines Open-File Report MLA 14-82, 9 p.
U.S. Geological Survey, 1982, Aeromagnetic map of the Kings River area, California: Open-File Report 82-657, scale 1:62,500.

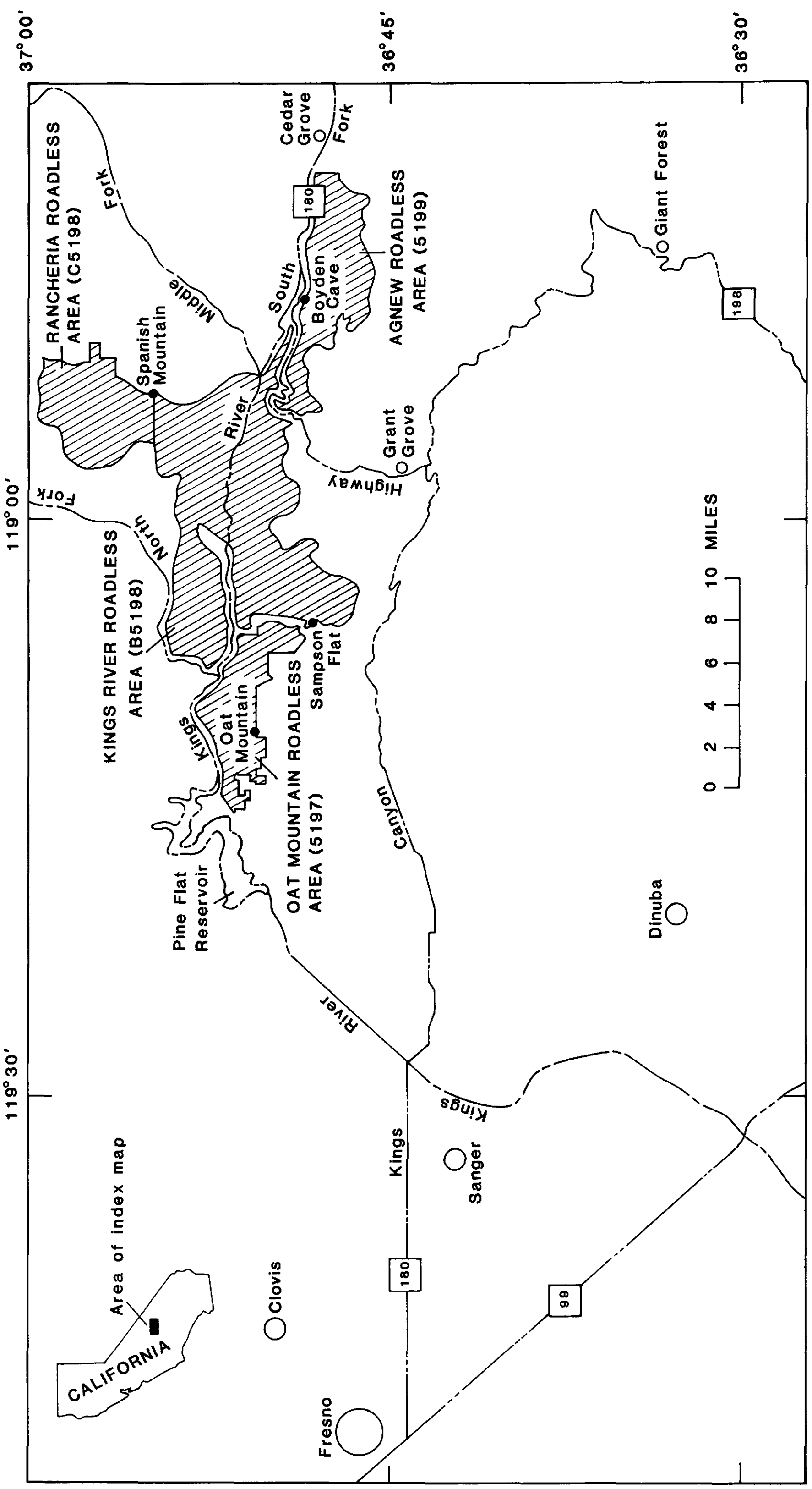

Figure 1.--Index map showing location of Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas, Fresno County, California.

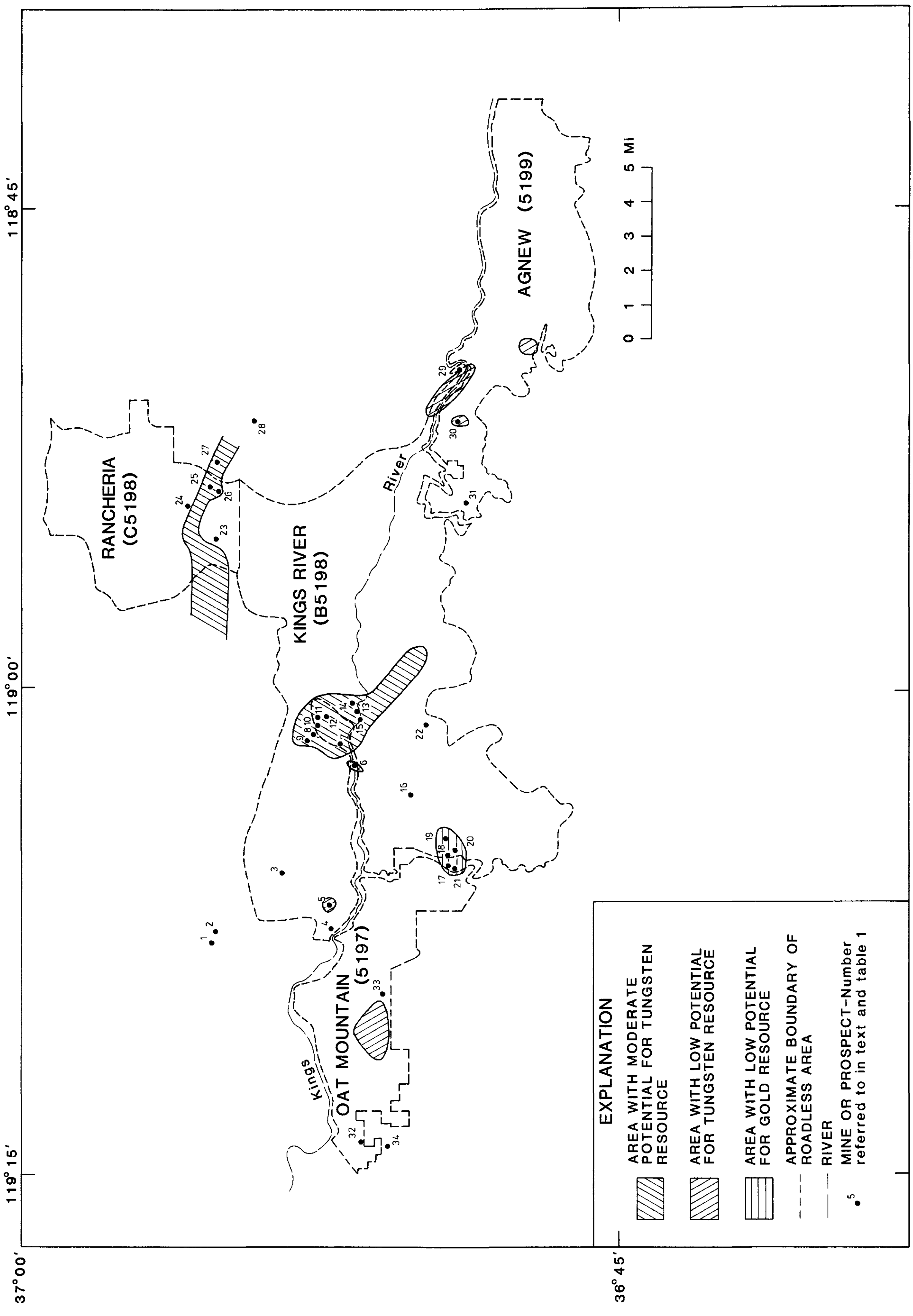

Figure 2.--Map showing mineral resource potential and locations of mines and prospects in the Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas, Fresno County, California.

Table 1.--Mines and prospects within or adjacent to the Kings River, Rancheria, Agnew, and Oat Mountain Roadless Areas, California

[Italicized entries indicate properties with mineral resources]

Map No.	Name (commodity)	Summary	Workings	Resource estimate, assay data, and production
		Mines and prospects within the Kings River Roadless Area		
3	Unnamed prospect (tungsten)	Strongly oxidized zone of red soil, about 100 ft long by 50 ft wide. Some pegmatite float.	None --------	Grab sample from across oxidized zone showed no anomalous concentrations.
4	Ruth prospect (tungsten)	Shear zone, as much as 4 ft wide, with brecciated vein quartz at contact between marble and migmatitic schist. Zone strikes N. 20° E., dips 60° SE.	Bulldozer roadcuts --	2 chip samples contained as much as 1.4 troy oz silver per ton and 0.02 to 0.04 weight percent U_3O_8.
5	Blue Star prospect (tungsten)	Marble lens in biotite schist, as much as 50 ft wide, containing a few tactite stringers. Poorly exposed.	One trench, 8 by 10 by 4 ft.	3 chip samples from across zone each contained 0.2 weight percent WO_3 but no other anomalous metallic concentrations. No production.
8	Spring prospect (tungsten)	Irregularly shaped marble and schist xenolith in quartz monzonite with thin sporadically distributed tactite stringers. Poorly exposed over an area 200 by 50 ft.	One small pit, 15 by 8 by 4 ft.	8 chip samples from tactite stringers contained as much as 0.01 weight percent WO_3 and 0.2 troy oz silver per ton. Ultraviolet-lamp scans of tactite showed only a few scattered scheelite crystals.
9	*Wet Spot prospect* (tungsten)	Four tactite masses in marble beds exposed at intervals over a distance of 300 ft in a 100-ft-wide zone. Marble and tactite form central part of a small pendant, about 400 by 200 ft. Scheelite occurs as tiny disseminations mainly in tactite mass at north end near contact with quartz monzonite.	One trench, 20 by 10 by 10 ft.	19 samples yielded values from 0.01 to 1.36 weight percent WO_3. Silver values ranged as high as 0.8 troy oz per ton, with a weighted average of 0.34 troy oz per ton. Other metallic values were insignificant. About 56,000 tons of inferred subeconomic resources averaging 0.27 weight percent WO_3 is present. No production.
13	Marble Contact prospect (tungsten)	Marble lens, striking N. 40° W. and dipping 60° E., with sporadically distributed tactite stringers near contact with diorite.	20-ft-long open cut leading to 80-ft-long adit.	2 chip samples from tactite stringers in adit contained less than 0.02 weight percent WO_3. Ultraviolet-lamp scans showed that tactite is barren of scheelite. No production.
14	Big Buck prospect (tungsten)	Marble lens at contact with diorite; lens strikes N. 35° W., dips 80° E. A few thin tactite pods and stringers.	25-ft-long open cut in steep hill leading to 85-ft-long adit.	Chip sample from contact zone in adit contained no anomalous metallic concentrations. Ultraviolet-lamp scans showed no scheelite. No production.
15	Fox Canyon prospect (tungsten)	Mill tailings from Garnet Dike mill occur in scattered piles over flood plain of the Kings River at junction with Fox Creek.	None --------	2 grab samples from different piles contained 0.12 and 0.20 weight percent WO_3.
16	Unnamed prospect (gold)	Thin shear zone in hybrid rocks of schist and diorite.	None --------	Chip sample from across zone showed no significant mineral values.
18	Southern Extension of Nugget mine No. 2 prospect (gold)	Quartz veins, as much as 4 ft thick, in diorite. Veins are of massive white quartz containing as much as 1 percent sulfides, mostly pyrite. Three poorly exposed segments of veins were found within the study area. One of two patented lode claims shown on Mineral Survey 6338; patented August 28, 1958.	Five small trenches and pits. A 150-ft-long adit with an 80-ft-long inclined raise.	7 grab samples of vein material from surface. Gold content ranged from a trace to 0.061 troy oz per ton, and silver values from less than 0.2 to 0.8 troy oz per ton. One chip sample from vein in adit (outside area) contained 0.108 troy oz gold per ton; other samples contained no more than a trace of gold and 0.2 troy oz silver per ton.
19	Red Spot prospect (tungsten)	Pegmatite dike exposed in migmatitic schist in diorite. Strongly oxidized, stained brown to red. Poor exposure in steep hillside. Thin quartz veinlets are common in dike.	None --------	Samples showed no anomalous concentrations.
20	Olympia prospect (gold)	Several poorly exposed 3- to 5 ft-long segments of quartz vein in diorite, as much as 2 ft thick, exposed in scattered trenches and pits. Quartz veins contain as much as 1 percent pyrite.	Six shallow pits and trenches.	4 grab samples of vein material. Highest gold content was from dump sample, which contained 0.157 troy oz gold per ton and 0.4 troy oz silver per ton; other samples contained from a trace to 0.01 troy oz gold per ton and 0.2 to 0.4 troy oz silver per ton. Production unknown.
22	Hoist Ridge prospect (tungsten)	Marble lens, about 4 ft thick, interbedded with migmatitic schist.	None --------	One sample from across zone showed no anomalous metallic concentrations.
29	Sierra Scientific prospect (gold)	Shear zone, as much as 18 in. wide, with brecciated vein quartz in quartzite. Some sulfide minerals, mostly pyrite. Zone strikes N. 20° W., dips 35° SE.	None; exposed in abandoned road-metal-quarry site.	Sample from across shear zone contained 0.4 troy oz silver per ton.

Mines and prospects adjacent to the Kings River Roadless Area				
1	Kings River tungsten (Houghton Bros.) prospect (tungsten)	Marble xenolith in quartz monzonite, 150 by 60 ft, exposed on a steep slope. Tactite occurs as pods and stringers.	Open cut, 60 by 30 ft high, on steep slope. One 50-ft-long adit and one 20-ft-long adit.	Some ore milled 1942-44 (Krauskopf, 1953, p. 77). Production unknown.
2	Poorman prospect (tungsten)	Several irregularly distributed tactite bodies in marble xenolith in quartz monzonite.	Several small pits --	Most tactite exposures are barren of scheelite. One mass, about 120 by 60 ft, contains about 0.3 weight percent WO_3 (Krauskopf, 1953, p. 78). Production unknown.
6	Southerland prospect (gold)	Shear zone with two quartz veins in diorite. One vein exposure is 10 in. thick, the other 12 in. thick. Zone strikes N. 30° E., dips 86° SE. Only exposure is in the riverbank.	20-ft-wide open cut in riverbank.	Chip sample from across 10-in.-thick vein contained 0.266 troy oz gold per ton and 0.2 troy oz silver per ton. Values in 12-in.-thick brecciated vein were 0.89 troy oz gold per ton and a trace of silver. Wallrock samples contained a trace to 0.018 troy oz gold per ton and a trace to 0.4 troy oz silver per ton. No production.
7	Quigley mine (tungsten)	Discontinuous marble lens in schist near diorite, as much as 8 ft thick, with sporadic tactite pockets and stringers containing scattered concentrations of as much as 2 percent scheelite at contacts.	Two open cuts on steep slope, about 40 by 30 by 15 ft and 50 by 25 by 25 ft. Two 30-ft-long adits and several pits.	About 500 short-ton units[1/] of WO_3 mined in 1941 (Krauskopf, 1953, p. 14). Highest WO_3 content of four chip samples from adits and cuts was 0.24 weight percent.
10	Quigley Kings River (Bazuik) mine (tungsten)	Tactite xenolith in diorite, about 80 ft wide, exposed upslope for 200 ft, where it is truncated by aplite dike.	Open cut, 40 by 40 ft.	About 600 short-ton units[1/] of WO_3 mined in 1941-42. Most high-grade ore mined out; remaining resources estimated to average less than 0.3 weight percent WO_3 (Krauskopf, 1953, p. 14).
11	Garnet Dike mine (tungsten)	Discontinuous tactite mass at north tip of a large marble pendant. Individual ore shoots of a few thousand tons each occur at marble-diorite contact beneath flat-lying pegmatite dikes.	Three open cuts with underground workings of four adits, drifts, raises, and stopes totaling more than 1,000 ft in length. Workings in disrepair and mostly inaccessible.	About 20,000 tons of ore yielding more than 20,000 short-ton units[1/] of WO_3 reportedly mined between 1940 and 1954. Ore averaging 1 weight percent WO_3 was treated at a 25-ton-per-day mill on property. Mine owner C. H. Sheridan estimates that about 100,000 tons of similar-grade ore remains.
12	Lime Ridge mine (tungsten)	Tactite layer, less than 1 ft thick, between marble-diorite contact on west side of Garnet Dike pendant, 200 ft south of Garnet Dike mine.	Open cut and two adits, 70 ft and 130 ft long. Workings caved and inaccessible.	About 400 short ton units[1/] of WO_3 produced between 1943-45 from ore averaging 0.7 weight percent WO_3 (Krauskopf, 1953, p. 14).
17	Mineral Spring prospect (gold)	Quartz veins in diorite, as much as 2 ft thick, poorly exposed in several shallow pits. Veins are massive and contain minor amounts of sulfides, mostly pyrite. Adjoins west line of Southern Extension of Nugget mine No. 2 prospect.	Seven shallow pits and one 100 by 10 by 6 ft trench.	8 grab samples of vein material. One sample contained 0.023 troy oz gold per ton; other samples contained only traces of gold and silver. Production unknown.
21	Peeler No. 1 prospect (gold)	Quartz vein, as much as 1 ft thick, on footwall of lamprophyre dike in diorite exposed in adit. Vein is of massive white quartz and minor pyrite. Lode claim shown on Mineral Survey 6338; patented May 13, 1953.	One 40-ft-long adit with short drift. One caved adit.	3 chip samples from vein and wallrock in adit contained a trace of gold and 0.2 to 0.4 troy oz silver per ton. Three select samples from vein material on dump of caved adit contained a trace to 0.16 troy oz gold per ton and 0.2 to 0.4 troy oz silver per ton. Production unknown.

		Mines and prospects within the Rancheria Roadless Area		
23	Garlic Meadow prospect (gold)	Thin irregular shear zone at contact of coarse-grained diorite.	None	Sample contained no anomalous metallic concentrations.
24	Spanish Lake prospect (uranium)	Sample from fine-grained gray basalt	None	Sample contained no anomalous metallic concentrations. Gamma radiation was twice background.
25	Lodge Pole prospect (tungsten)	Three discontinuous tactite masses with a maximum exposure of 200 by 15 ft in a 1,500-ft-long zone of schist and hornfels. Tactite composed of garnet, pyroxene, epidote, quartz, and calcite, with some stringers and patches of marble. Largest tactite masses near granodiorite contacts.	One 20-ft-long trench, seven shallow prospect pits.	Sample values range from barren to as much as 1.4 weight percent WO_3. About 12,000 tons of inferred subeconomic resources averaging 0.34 weight percent WO_3 are estimated to occur in three blocks in the tactite zones. No production.
26	Ground Hog prospect (tungsten)	Irregular tactite body in porphyritic quartz monzonite, about 150 ft long and averaging 50 ft in width.	None	Most tactite was barren of scheelite. Four chip samples contained less than 0.01 weight percent WO_3. Highest value was 0.27 weight percent WO_3 in a pod 10 ft long.
		Mines and prospects adjacent to the Rancheria Roadless Area		
27	Geraldine Lakes prospect (tungsten)	Marble layer with irregularly distributed pockets and layers of tactite.	12 small pits over a distance of of 0.5 mi.	10 samples contained less than 0.02 weight percent WO_3. Select sample contained 0.59 weight percent WO_3; another sample contained 300 ppm silver.
28	Obelisk prospect (tungsten)	Marble lens near granodiorite contact; two tactite layers average 3 ft and 2 ft in thickness over length of 100 ft. Drilling results of 1956 program indicate that maximum length of tactite layers is 300 ft.	Several shallow pits.	The following data are from Moore and Marks (1972, p. A32). Surface samples ranged from 0.27 to 1.32 weight percent WO_3; samples from drill holes ranged from 0.06 to 1.31 weight percent WO_3. An estimated 8,000 tons of tungsten resource averaging 1 weight percent WO_3 is believed to remain in deposit. A small amount of ore was mined during the 1950's.
		Mines and prospects within the Agnew Roadless Area		
30	Tehipite prospect (tungsten)	Discontinuous tactite masses in diorite, covered by brush and alluvium.	One short adit	Most tactite barren of scheelite. One sample contained 0.10 weight percent WO_3.
31	Scheelite Queen prospect (tungsten)	Probable tactite masses in diorite. Not found in this study.	Small pits?	Unconfirmed report to U.S. Bureau of Mines indicated that vein is traceable for several hundred yards and that three samples contained more than 1 weight percent WO_3.
		Mines and prospects within and adjacent to the Oat Mountain Roadless Area		
32	Low Pocket prospect (gold)	Subhorizontal quartz vein in biotite schist, striking northwest, about 800 ft long, averages 3 ft thick.	Four trenches, seven pits, two shafts, and roadcut.	13 samples contained only traces of gold and silver.
33	Unnamed prospect (gold)	Quartz vein in biotite schist, about 3 ft thick. Highly fractured, limonite stained.	Small pit	Traces of precious and base metals.
34	Unnamed prospect (chromium, nickel)	Peridotite and serpentinite inclusion in diorite	Short trenches	4 samples contained as much as 0.33 weight percent Cr and traces of nickel and silver.

1/ A short-ton unit (stu) contains 20 lbs of tungsten trioxide (WO_3) or 15.86 lb of tungsten.