STATUS OF MINERAL RESOURCE INFORMATION FOR TWENTY-ONE INDIAN RESERVATIONS AND RANCHERIAS IN CASCADE RANGE, KLAMATH MOUNTAINS, NORTHERN COAST RANGES, AND GREAT VALLEY PROVINCES, CALIFORNIA

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SUMMARY AND CONCLUSIONS

The mineral resource potentials of reservations and rancherias that are administered by the Hoopa and Central California Indian Agencies and which are discussed in this report, appear generally low. Except for the Hoopa Valley, Hoopa Extension, and Round Valley Reservations, most of the Indian lands are too small to support any large-scale mining or quarrying operations. Several tracts have been, or are being, developed into residential areas or agricultural lands. Their disruption, even by small-scale mining, probably would not be the best use of the land. Sand and gravel and, in some cases, building stone could be extracted for local tribal needs from portions of the larger rancherias. The potential for nonmetallic mineral resources appears to be greater than for metallics. Virtually all the reservations and rancherias have sand and gravel deposits; many have rock materials suitable for crushed rock and perhaps, building stone. These commodities, however, are low-priced, bulk materials. Their economic potentials depend on market prices and demand, scarcity elsewhere, cost and availability of transportation, distance to markets, size and accessibility of deposits, developmental and mining costs, and federal, state, and local environmental and zoning regulations. Chromite, manganese, and mercury occurrences and deposits are numerous in the Northern Coast Ranges and Klamath Mountains Provinces. Many mercury deposits had significant production from the late 1800's until the 1950's. Environmental regulations, along with the exhaustion of economically recoverable ore, have resulted in the closure of most mercury mines. The chromite and manganese deposits are small, discontinuous, and low grade. Most known high-grade bodies were mined out during World Wars I and II. Without large changes in market conditions, future development of the remaining low-grade occurrences is unlikely.

The Hoopa Valley and the Hoopa Extension Reservations have potentials for copper, gold, zinc, lead, and, to a lesser extent, manganese, chromite, mercury, silver, and platinum. Only gold, copper, silver, lead, and zinc have been produced in significant quantities. The mineral resource potential of these two reservations could be better defined by field studies.

The exact location and extent of most reported mineral occurrences, as well as the geologic relationships of the rock units on the Hoopa Valley and Hoopa Extension tribal lands, are poorly known. Detailed geologic mapping, with special emphasis on the contacts of the metasedimentary rocks with ultramafic intrusive rocks, is needed. Stream sediment geochemical sampling might prove useful in delineating undiscovered mineralized zones. Soil geochemical sampling, combined with appropriate geophysical methods, could further define known mineral deposits, such as the sulfide body at the Cooper Bluff mine. In light of the increased price of gold, placer gold deposits should be test-pitted, sampled, and evaluated.

The Round Valley Reservation's mineral potential is generally unknown, but appears to be low. The numerous nearby manganese occurrences are small and low-grade; most have not been developed beyond the prospect stage, although a few had minor production before World War II. At

present, they are considered to have no economic potential. A stream sediment sampling program, in conjunction with detailed geologic mapping to tribal land, would be a useful initial step in defining the mineral potential of the Round Valley Reservation.

Although the Sulphur Bank Rancheria borders the famous Sulphur Bank mercury mine, the geologic units and structural controls which favored mercury deposition do not appear to extend on to Indian land. Abundant hot springs are present in the mine area, but exploratory drilling for geothermal source has been unsuccessful.

The Middletown and Dry Creek Rancherias, as well as the Sulphur Bank Rancheria, are in a known geothermal resource area (KGRA). Natural steam from geothermal wells at The Geysers hot springs is used to produce commercial power. Over the years, several other hot springs have supplied the needs of resorts and health spas. Hot springs are also present in the Big Bend, Laytonville, and Cortina Rancheria areas.

The Middletown Rancheria lies in the Eastern Mayacmas mining district, which is the second largest mercury-producing district in California. No mercury is reported from the rancheria, but several nearby mines once had significant production. The Dry Creek Rancheria is at the extreme southern edge of the Western Mayacmas mercury district.

The Cachil Dehe (Colusa) Rancheria is at the southern edge of the Compton Landing gas field, which was discovered in 1955. However, wells drilled near the rancheria were dry and have been abandoned; the potential for natural gas production is probably low.

The Resighini, Trinidad, Orleans-Karok, Big Bend, Montgomery Creek, Cachil Dehe (Colusa), Grindstone Creek, Rumsey, Laytonville, Sherwood Valley, and Manchester (Point Arena) Indian lands have sand and gravel resources. The Cortina, Stewarts Point, and Roaring Creek Rancherias may have some potential for sand and gravel and, perhaps, crushed rock. Except for the Hoopa Valley, Hoopa Extension, and Round Valley Reservations, no additional mineral resource studies seem warranted at this time. The other 19 Indian lands would have to be evaluated on individual bases as local demands or markets for particular commodities arise.

INTRODUCTION

General

This report was prepared for the U.S. Bureau of Indian Affairs (BIA) by personnel of the U.S. Bureau of Mines and the U.S. Geological Survey under an agreement to compile and summarize available information on the geology, minerals, energy resources, and potential for economic development of certain Indian lands. Primary sources of information were published and unpublished reports; the Mineral Industry Location System (MILS) files of the U.S. Bureau of Mines; and personal communications. No fieldwork was done.

The reservations and rancherias discussed in the report are listed in Table 1. Their locations are shown on physiographic outline maps of California and topographic index maps. Thirteen of the tracts are administered by the Central California Indian Agency, Sacramento, California; nine are under the jurisdiction of the Hoopa Indian Agency, Hoopa, California. Discussions of the Indian lands are arranged according to geologic provinces rather than by administrative agency or alphabetical order. A report on the mineral resource status of 19 other central California Indian reservations and rancherias has already been prepared by Bergquist, McNary, and Van Noy (1978).

TABLE 1

Central California Agency and Hoopa Agency Indian Reservations and Rancherias

Name	Approximate area (acres)	County
Central California Agency:		
Cachil Dehe (Colusa) Rancheria	269	Colusa
Cortina Rancheria	480	Colusa
Dry Creek Rancheria	75	Sonoma
Grindstone Creek Rancheria	80	Glenn
Laytonville Rancheria	200	Mendocino
Manchester (Point Arena) Rancheria	355	Mendocino
Middletown Rancheria	109	Lake
Round Valley Reservation	20,706	Mendocino, Trinity
Rumsey Rancheria	66	Yolo
Sherwood Valley Rancheria	292	Mendocino
Stewarts Point Rancheria	40	Sonoma
Sulphur Bank Rancheria	50	Lake
Hoopa Agency:		
Big Bend Rancheria	40	Shasta
Big Lagoon Rancheria	9	Humboldt
Hoopa Extension Reservation	7,028	Humboldt, Del Norte
Hoopa Valley Reservation	86,732	Humboldt
Montgomery Creek Rancheria	72	Shasta
Orleans-Karok Trust Land	7	Humboldt
Resighini (Coast Community Indian) Rancheria	239	Del Norte
Roaring Creek Rancheria	80	Shasta
Trinidad Rancheria	55	Humboldt

The mineral potential of each of the lands discussed is a result of its geology and geologic processes that have affected the area. To simplify the description and discussion of the geologic background, the tracts are grouped according to the geologic province in which they occur. The overall geology and known resources of the province are first described, followed by a discussion of each tract in which only the local geologic features having bearing on its mineral potential are emphasized. For each tract we have included a geologic map of the tract and a small area about it and a list of the most useful references, including both reports and geologic maps.

The small sizes of most reservations and rancherias require discussion of geology and mineral deposits of adjacent areas. Such information provides a clearer picture of the regional setting, and is especially important if mineralized geologic units or structural features of nearby ore bodies can be projected on to Indian lands. Depending on their extent, type, and relative importance, discussions of nearby mineral occurrences are generally restricted to those within 5 miles of the reservation boundaries.

Locations of reported mineral occurrences, as cited in the available literature, are rather vague. Because of the checkerboard land ownership pattern of the Hoopa Valley, Hoopa Extension, and Round Valley Indian Reservations, it is impossible to determine without courthouse record searches or actual field studies if many of the claims and prospects are on tribal, allotted, or non-Indian lands. For this preliminary mineral resource evaluation, however, land ownership is not critical. Many potentially mineralized rock units and structures probably extend across parcels of land in several different ownership categories. If further study of the above-mentioned reservations is requested by the tribes and the BIA, then more exact location of claims, prospects, and mineral occurrences, as well as land ownership, would be important.

Acknowledgments

Special acknowledgment is made to Barbara Ferris, Realty Officer, Hoopa Indian Agency, and to Emmet R. Lynch, Realty Officer, Central California Indian Agency, and their staffs, for their wholehearted cooperation in providing up-to-date maps, data, and information on the reservations and rancherias under their respective jurisdictions.

CASCADE RANGE PROVINCE

The Cascade Range province consists of geologically young lava flows and majestic volcanic peaks like Mt. Shasta and Mount Lassen. It extends from the north central part of California (Figure 1) northward through Oregon and Washington into British Columbia. The southern and eastern boundaries of the province are sharply defined by the limit of the overlap of the young volcanic rocks onto older sedimentary, metamorphic, and granitic rock. The eastern limit is less obvious because the Cascade volcanics merge with rather similar volcanic rocks of the Modoc Plateau province farther east. In general, however, the boundary here is usually drawn on the western limit of block fault structure, perhaps reflecting a change in the basement rocks below (Macdonald, 1966b).

The Cascade Range is built up on Late Cretaceous to Oligocene marine and nonmarine sedimentary rocks that are exposed in the deeper canyons cut through the lavas, especially along the west edge of the volcanic pile. On this basement during Miocene time a thickness of over 10,000 feet of basaltic, andesite and dacitic lava flows, beds of pyroclastic material, and local interbeds of nonmarine and shallow marine sediments were piled up in a slowly subsiding trough. During the interval from late Miocene to early Pliocene time these rocks were uplifted, tilted, and eroded to form a gently rolling landscape. A second episode of volcanism began during the early Pliocene and culminated in the formation of the High Cascades. The volcanic rocks range in composition from basalt to rhyolite, with pyroxene andesite being the most common. As the viscosity and silica content of the lava increased, explosive eruptions became more common and the proportion of pyroclastic material became greater. Composite volcanoes, such as Mt. Shasta, Burney Mountain, and Brokeoff Volcano were built up to great heights. Even today some of the volcanoes that form the present Cascade Range should be regarded as only dormant active volcanoes (Macdonald, 1966).

Economic Mineral Deposits of the Cascade Range

The young volcanic rocks of the Cascade Range, and associated lake beds, have been a source of pumice, cinders, stone, obsidian, diatomite, and other nonmetallic products. Although traces of gold, uranium, mercury, and copper have been seen, no viable metallic deposits have been found in the province. The sedimentary Montgomery Creek Formation of Eocene age and local accumulations of recent stream sediments have been quarried to satisfy local demand for sand and gravel (Gay, 1966).

Rocks lying beneath the young volcanic cover may contain mineral deposits, as such rocks contain deposits both east and west of the Cascade province. Most notable are the copper-zinc-gold deposits of the East and West Shasta districts, the eastern edge of which lies only about 20 miles west of the nearest Rancheria in the Cascade province. These districts have produced almost $200,000,000 in copper-lead-zinc, gold-silver, and pyrite from Paleozoic and early Mesozoic sedimentary and volcanic rocks, like those that extend beneath the Cascade province (Albers, 1966; Albers and Robertson, 1961). A few miles east of the province is the Hayden Hill gold district which has yielded more than $2,500,000 in gold from deposits in altered rhyolite tuff and breccia of Miocene age. Although the rocks beneath the young volcanic cover in the Cascade province probably also contain copper or gold deposits, they lie at such depths everywhere except along the western margin that it is not worthwhile to explore for them.

The widespread volcanic rocks have provided substantial amounts of nonmetallic commodities. One third of California's annual production of pumice and pumicite, totaling about 30,000 tons, are mined in northeastern Shasta, eastern Siskiyou, and western Modoc Counties. Volcanic cinders from cinder cones in the province have yielded more than 140,000 tons of cinders annually, almost three-quarters of California's annual production (Gay, 1966). The cinders are used for railroad ballast, road material, and fill. Various Tertiary and Quaternary lava flows, tuffs, and agglomerates in Lassen County provide sources of high-specification crushed stone used mainly for road building purposes. Tertiary tuffs are also economically useful as local sources of dimension stone and Quaternary obsidian masses are in limited demand by mineral collectors. Lakebed deposits, some of which are more than 200 feet thick, are a potential major source not now exploited here, though utilized in Oregon and Nevada. Lignite coal also occurs in some lakebed deposits but it is not likely to be used. Barite veins cutting volcanic rocks have been prospected. but they have not proved to be extensive enough to warrant mining in competition with the deposits in California or Nevada. Sand and gravel has been used, but owing to the high content of volcanic glass in many deposits the material, while adequate for road construction, is not suitable for high-specification concrete (Gay, 1966).

The mineral potential of the Cascade province and its contained Rancherias, therefore, lies in the low-cost bulk commodities like sand and gravel, pumice, cinders, etc, whose utilization is determined by their relative quality, ease of access, and an available market.

Big Bend Rancheria

Location

The Big Bend Rancheria of 40 acres is located in the NW¼NE¼ of sec. 36, T. 37 N., R. 1 W., in Shasta County, about 40 miles airline northeast of Redding (Figure 2). The Rancheria is on the flood plain of the Pit River, and bordering hills 1 mile east of the confluence of the Pit River and Kosk Creek and ½ mile northwest of the village of Big Bend. Elevations within the Rancheria range from 1,700 feet to 1,920 feet in its northwestern corner. Boundaries for the Big Bend Rancheria are not shown on the Big Bend, 15-minute quadrangle or the Alturas 2º sheet. A gravel road traversing the Rancheria connects at Big Bend with a paved county road which extends to Hillcrest, on Highway 299 and thence to Redding on U.S. Highway 99.

Access is by a paved county road north 15 miles from U.S. Highway 299 at Hillcrest, to the town of Big Bend. The dirt and gravel road from Big Bend to Kosk Creek passes through the rancheria. Commercial airline, bus, and train services are available in Redding.

The population of the rancheria in 1969 was 10 (U.S. Dept. of Commerce, 1974, p. 83).

Geology

The bedrock for the Big Bend Rancheria is the Montgomery Creek Formation of Eocene age (Figure 2). This formation is characterized by nonmarine conglomerate, arkosic sandstone, and shale units which have a maximum thickness of 2,600 feet. The arkosic sandstone, the dominant lithologic type, is composed of subangular to subrounded, poorly quartz and feldspar grains. It is interlayed with conglomerate lenses containing well rounded fine-grained igneous pebbles 1 to 8 inches in diameter and interbedded brown shale having minor beds of impure lignite (Sanborn, 1960). Along the floodplain of the Pit River the Montgomery Creek Formation is covered by recent alluvium.

Mineral Resource Potential

The loosely consolidated, nonmarine conglomerate and arkosic sandstone of the Montgomery Creek Formation may be a potential local source of sand and gravel. However, the commercial development of the rancheria deposits would depend on the physical and chemical characteristics, accessibility, local demand, and availability of similar material elsewhere. The Shasta County Department of Public Works has obtained gravel from the streambed and banks of Kosk Creek, about 1.5 miles to the northwest. In 1962, 12,000 cubic yards were crushed and stockpiled (Lydon and O'Brien, 1974, p. 150).

The East Shasta copper-zinc district is about 10 air miles southwest of the Big Bend Rancheria. From 1900 to 1952, this district produced nearly 60 million pounds of copper, 50 million pounds of zinc, and significant amounts of silver, gold, and lead. The total value of the metals produced was about $16 million, of which copper accounted for about $8 million (Albers and Robertson, 1961, p. 3).

The Canyon Creek copper claims are in sec. 4, T. 36 N., R. 1 W., about 8 miles by trail down the Pit River from Big Bend (Figure 2). Green copper minerals stain narrow fractures in metabasalt or meta-andesite. The solid rock beneath the fracture zone apparently does not contain copper minerals. Development consists of one 130-foot adit, another 30-foot adit, and several open cuts and trenches which are scattered for about a mile on the west side of the steep ridge between Canyon Creek and the Pit River (Averill, 1939, p. 126; Lydon and O'Brien, 1974, p. 105). These claims have been idle for many years and have had no known production.

The Kosk Creek copper claims are in sec. 23, T. 37 N., R. 1. W., about 1.5 miles northwest of the rancheria (Figure 2). Native copper is found along joints and fractures in dark basaltic rock along a 200-foot-wide zone. Development consists of a short adit and a shaft (Crawford, 1896, p. 63; Lydon and O'Brien, 1974, p. 107). The prospect has long been idle, and apparently had no production.

A coal (lignite) prospect has been reported in sec. 24, T. 37 N., R. 1 W., on Kosk Creek, about 2 miles north of the rancheria (Figure 2). This prospect was found during the late l9th century, but apparently was never developed into a commercial operation (Logan, 1926, p. 132).

Hot springs emerge within a few miles of the Rancheria, and at least one formerly provided the basis for a spa. Although temperatures as high as 180ºF have been reported the area is not believed to have any potential for useable geothermal power and it has not been designated as a Known Geothermal Resource Area (KGRA).

The Big Bend Hot Springs are in the NW¼ sec. 36, T. 37 N., R. 1 W., just across the Pit River, south of the rancheria (Figure 2). Several springs, having water temperatures of 140º to 180ºF (60º to 82ºC), issue from a 350-yard section of the south bank of the river. The largest spring has a flow of 25 gallons per minute. The Big Bend Hot Springs water contains calcium, iron, and sulfur, and was used locally for "rheumatic troubles" in the 1890's. In 1906, there was a small resort at the springs (Lydon and O'Brien, 1974, p. 143).

The Hunt Hot Springs (Kosk Creek Hot Springs) are in the NW¼SW¼ sec. 25, T. 37 N., R. 1 W., about three-quarters of a mile northwest of the rancheria (Figure 2). They consist of two springs which issue from near a porphyritic quartz diorite dike in sedimentary strata and have a combined flow of about 5 gallons per minute (Waring, 1965, p. 20, no. 23).

Table 2, modified from White and Williams (1975, p. 26-27), summarizes the physical and chemical characteristics of the Big Bend and Hunt Hot Springs (Kosk Creek Hot Springs).

TABLE 2

Chemical and Physical Characteristics of the Big Bend and Hunt (Kosk Creek) Hot Springs.
[Modified from White and Williams, 1975, p. 26-27]

	Big Bend Hot Springs	Hunt Hot Springs
Temperature (°C)		
Surface	82	58
Subsurface	140	105
Aquifer Temperature from Geochemical Thermometers (°C)		
Silica	121	101
Na-K-Ca	137	75
Reservoir Assumptions		
Subsurface area	1.5 km^2	1.5 km^2
Thickness	1.5 km	1.5 km
Volume	2.25 km^3	2.25 km^3
Heat Content (10^{18} cal)	.2	.1
Comments	6 springs 38 liters/min.	2 springs 8 liters/min.

Roaring Creek Rancheria

Location

The Roaring Creek Rancheria consists of 80 acres in the E½NE¼ sec. 15, T. 25 N., R. 1 W., MDBM, in Shasta County, approximately 44 miles northeast of Redding, 4 miles northwest of Hillcrest (U.S. Highway 299), and 10 miles south of Big Bend (Figure 3). It lies at an elevation between 1,600 and 2,000 feet, and is about one-quarter mile east of the Pit River on the east slope of the ridge between Marble Creek and Little Roaring Creek. The topography is steep and rugged.

Access is by way of Cove Road, an unpaved dirt and gravel road that runs northwest from U.S. Highway 299 at Hillcrest, passes near the northeast corner of the rancheria, and joins the Hillcrest-Big Bend road about 2.5 miles to the north. Commercial airline, train, and bus services are available in Redding. According to the U.S. Department of Commerce (1974, p. 134), the rancheria had a population of five in 1969.

Geology

The geology of the Roaring Creek Rancheria is poorly known and probably inaccurately shown on the 1:250,000 Shasta County geologic map (Lydon and O'Brien, 1974), which being the best map available provides the basis for the map included with this report (Figure 3). The two geologic units underlying the Rancheria are the Eocene Montgomery Creek Formation and the overlying younger Tuscan Formation. As both of these units are more or less flat-lying, their contact should be nearly level and follow a contour with the older Montgomery Creek Formation being exposed in the canyon walls and the overlying Tuscan Formation capping the ridges. Although this is the general distribution shown on the regional map, in detail, especially at the Roaring Creek Rancheria, the rock distribution does not properly fit the contours and gives the impression that the older unit lies above the younger.

The Montgomery Creek Formation consists of soft, friable arkosic sandstone, composed of subangular to subrounded, poorly sorted, grains of quartz and feldspar, with lenses of moderately consolidated dark-gray-green to brown conglomerate and coarse sandstone (Macdonald, 1966). Locally it contains thin interbeds of shale with small lenses of impure lignite. The Pliocene Tuscan Formation is essentially a series of volcanic mud flows, or lahars, from Lassen Peak and other vents farther north (Anderson, 1933; Anderson and Russell, 1939). It is composed of fine ash with an admixture of unsized blocks of volcanic rocks, some of which are as much as 5 feet in diameter. Near its base it may contain a prominent white tuff layer composed of pumice fragments embedded in a light-colored matrix of glass and crystal shards.

Mineral Resource Potential

The friable arkosic sandstones and the conglomerate of the Montgomery Creek Formation, which crops out in the northern and western part of the rancheria, are potential local sources of sand and gravel. The volcanic deposits of the Tuscan

Formation in the southern part of the rancheria could provide a local source of pumice and stone. The development of these deposits would depend on such factors as accessibility, quality, demand, and availability of similar materials elsewhere in the area.

The Exposed Treasure barite prospect (not shown on Figure 3) is in sec. 33, T. 36 N., R. 1. W., about 3 miles northwest of the rancheria. A 4-foot-thick zone of dark gray barite, enclosed in what is probably Tertiary basalt, crops out intermittently along a strike length of about 3,000 feet. Several test pits have been dug, but no production is reported. The property has long been idle (Logan, 1926, p. 129-130; Lydon and O'Brien, 1974, p. 138). Manganese has also been reported from this prospect (Trask, 1950, p. 266).

Coal (lignite) has been found in the E½ sec. 11, and the N½ sec. 14, T. 35 N., R. 1 W., 1 mile northeast and one-half mile east, respectively, of the rancheria (Figure 3). The prospects have long been idle, with no production reported (Logan, l926, p. 132).

Montgomery Creek Rancheria

Location

The Montgomery Creek Rancheria occupies 72 acres in the NE¼ sec. 1, T. 34 N., R. 1 W., MDBM, in Shasta County, approximately 35 miles northeast of Redding, 2 miles south of Hillcrest, and one-quarter mile southeast of the community of Montgomery Creek (Figure 3). It lies at an elevation of 2,200 to 2,500 feet in an area of gently-rolling hills. Access is good via a dirt and gravel road from Highway 299, one-half mile west of the rancheria and 1 mile south of Montgomery Creek. Commercial airline, bus, and train services are available in Redding. In 1969, the rancheria had a population of four (U.S. Department of Commerce, 1974, p. 129).

Geology

The best geologic map available is the 1:250,000 County map of Lydon and O'Brien (1974) from which we have copied the data for Figure 3 accompanying this report. Parts of the map were made by reconnaissance, are generalized, and are obviously inaccurate. The area about the Montgomery Creek Rancheria appears to be one of the inaccurate areas as the relation of the geologic contacts to the topography is erratic.

As shown on the map, the Tuscan Formation underlies much of the Rancheria, and we suspect it really covers all of it. This formation is late Pliocene in age and consists of volcanic breccia formed by volcanic mudflows. It consists chiefly of dacitic tuff containing blocks of pumice or more massive lava. This volcanic cover has been extensively eroded perhaps exposing in the northern section of the Rancheria the underlying Montgomery Creek formation of Eocene age. This formation is composed of soft, friable, buff-colored arkosic sandstone, moderately consolidated dark gray-green to brown conglomerate and coarse sandstone, and thin interbeds of shale containing impure lignite. This assemblage of sediments was laid down in a deltaic and locally lacustrine environment (Lydon and O'Brien, 1974). Metamorphosed volcanic and sedimentary rocks that outcrop along the edge of the Klamath Mountains also may be present in a small area at the southwestern corner of the Rancheria.

Mineral Resource Potential

The friable arkosic sandstone and the moderately consolidated conglomerate of the Montgomery Creek Formation, which crops out in the northern part of the rancheria, are potential local sources of sand and gravel. The volcanic rocks of the Tuscan Formation, which cover 90 percent of the rancheria, could provide a local source of pumice, pumicite, and stone.

The Carroll sand and gravel pit in NW¼ sec. 36, T. 35 N., R. 1 W., one-quarter mile northwest of the town of Montgomery Creek (Figure 3) has been intermittently active since at least the late 1950's. The deposit consists of loosely consolidated, cross-bedded, pebbly, coarse sandstone of the Montgomery Creek Formation. Tests conducted in 1958 by the California Division of Highways showed the deposit to have 1.1 percent moisture, a sand equivalent of 30, R value 79, and sizes as follows (Lydon and O'Brien, 1974, p. 147):

Size	Percent pass
1 inch	100
¾ inch	99
⅜ inch	99
4 mesh	97
8 mesh	92
16 mesh	78
30 mesh	50
50 mesh	28
100 mesh	18
200 mesh	13

Lenses or veins of barite about 2 feet thick have been reported in sec. 2, T. 34 N., R. 1 W., about 1 mile west of the rancheria on Willow Creek (Figure 3). No mention could be found of the type of country rock associated with the barite. A few prospect cuts have been made on the vein, but there has been no production (Averill, 1939, p. 114; Lydon and O'Brien, 1974, p. 137).

The eastern margin of the East Shasta copper-zinc district is about 5 miles southwest of the rancheria near Round Mountain. This area contains a number of small prospects, some of which have had minor production of zinc, lead, and silver.

KLAMATH MOUNTAINS PROVINCE

The Klamath Mountains geologic province covers approximately 11,800 square miles in northwestern California and southwestern Oregon, extending from Redding at the north end of the Sacramento Valley northwestward nearly to Crescent City on the Pacific shore (Figure 4). It is a rugged, highly dissected mountainous terrane with crestlines generally reaching altitudes of 5,000-7,000 and locally to 9,000 feet. River canyons have steep sides with local relief of 3,000-4,000 feet. Most of the slopes are heavily wooded except for the higher peaks which extend above timberline. The province is sparsely populated and is becoming increasingly important as a summer recreational area.

Main access on the east is by Interstate 5, which follows the east edge of the province, and from the west by U.S. 101 which is generally within a few miles of its western boundary. Two main east-west roads connect these highways in California. On the south, State Highway 299 connects Redding with Eureka largely via the Trinity River valley, and in the north State Highway 96 extends chiefly along the Klamath River from Yreka to join State Highway 299 at Willow Creek.

Most of the Klamath Mountains is directly underlain by eugeosynclinal and plutonic rocks either deformed or intruded during the Nevadan orogeny that ended in Late Jurassic or Early Cretaceous time (Irwin, 1960, 1966). Unconformably overlying these in California are younger sedimentary rocks of Upper Cretaceous and Tertiary age which only occur where they lap over the edges of the province or lie as small patches isolated in the interior. The youngest rocks are unconsolidated fluviatile deposits that occur as fill in the broader valleys or channel filling and higher terraces along the present streams.

The older rocks are believed to be sections of oceanic crust and upper mantle, or marine sediments deposited on oceanic crust, which have been pushed against the North American continent as a result of sea floor spreading (Hamilton, 1969). These rocks have been divided into four distinct units based on lithology and age and arranged in concentric westward-facing arcuate belts which become older in going eastward. From west to east, these units are: the western Jurassic belt, the western Paleozoic and Triassic belt, the central metamorphic belt, and the eastern Klamath belt (Figure 5) (Irwin, 1977). Structurally these belts are thought to represent thrust plates of an east-dipping imbricate sequence (Irwin, 1977). The principal folds and faults trend parallel to the arcuate shape of the lithic belts and are the result of the Nevadan orogeny (Irwin, 1966). A stratigraphic column and lithologic descriptions of the formations present in the four belts in the Klamath Mountains is given in Table 3 (Irwin, 1966).

Ultramafic rocks, chiefly serpentinized peridotite and dunite, are an important constituent in each of the lithologic belts. Their outcrops tend to follow the arcuate trend of the lithic belts and most are found along contacts of different lithologies. Formerly these ultramafic bodies were believed to have intruded as plastic masses along faults as a result of regional thrusting (Irwin, 1964). More recently Irwin (1977) as well as others, have considered that many of these ultramafic bodies and accompanying masses of gabbro or diabase represent dismembered ophiolite sequences rather than intrusive masses. The Trinity ultramafic sheet, separating the eastern Klamath belt from the central metamorphic belt, is believed to underlie all the Paleozoic strata of the eastern Klamath belt (Irwin, 1966) and is the largest ultramafic mass in North America.

Granitic plutons and associated dikes are widespread within the Klamath Mountains, and are most common in the western Paleozoic and Triassic belt. The plutons range in size from 1 mile in diameter to about 100 square miles of surface exposure. A few small plutons north of Redding are Permian in age, but all the others that have been radiometrically dated were intruded during Late Jurassic or Early Cretaceous time. It has been suggested that additional unexposed plutons underlie parts of the eastern Klamath belt because of the abundance of base-metal sulfide deposits of the East and West Shasta districts and gold bearing quartz veins along the Devonian-Mississippian boundary (Irwin, 1966).

The Nevadan orogeny ended by middle Cretaceous time with regional emergence of both the Klamath Mountains and Sierra Nevada terranes above sea level, which resulted in vigorous erosion that exposed the once deeply buried batholithic rocks. The eroded detritus was deposited as a thick sequence of marine sandstone and shale in the bordering seas on the edges of the subjacent strata during the Cretaceous interval (Irwin, 1966). Later in Oligocene(?) and Miocene time continental deposits also derived from erosion of parts of the Klamath Mountains were laid down in a few places within the province. Quaternary alluvial deposits of sand and gravel occur along courses of the major rivers in the river beds, as terrace travels, and as filling of a few wider valleys, like those near Hayfork, Weaverville, or Scotts Valley.

Economic Mineral Deposits of the Klamath Mountains

The Klamath Mountains have been the source of ores of many metals including gold, silver, copper, zinc, lead, chromite, and mercury, as well as pyrite formerly used in the manufacture of sulfuric acid. Occurrences of ores of antimony, arsenic, molybdenum, nickel, tin, and tungsten are also known, but production is negligible. The most important nonmetallic products have been limestone, sand and gravel, building stone, crushed rock, riprap, and clay for brick. Noneconomic deposits of coal, graphite, ocher, and talc have also been discovered.

The mineral deposits have been grouped according to their host or source rocks by Albers (1966). Deposits of chromite, nickel, and both chrysotile and tremolite asbestos occur in the ultramafic rocks found throughout the Klamath Mountains. Deposits of gold, silver, copper, lead, zinc, and pyrite occur mainly in metamorphosed sedimentary and volcanic rocks, and they are believed to be genetically related to granitic intrusions. Mercury deposits that are associated with the later episodes of volcanic activity have been found in several kinds of rock. Manganese, placer gold and platinum, and construction materials occur in sedimentary rocks where they have been concentrated by sedimentary processes.

The approximate value of the mineral commodities from 1880 to 1963 as given by Albers (1966) is as follows:

Gold	$140,127,000
Copper, lead, zinc	139,503,000
Sand, gravel, stone	42,030,000
Pyrite	21,179,000
Silver	13,047,000
Chromite	8,975,000
Mercury	1,311,000
Platinum	185,000

Since 1963, sand, gravel, and stone have continued to be mined in considerable amounts, whereas very little of the other commodities has been recovered.

Hoopa Valley and Hoopa Extension Reservation

Location

The Hoopa Valley Indian Reservation of about 87,500 acres is located in northern Humboldt County about 30 miles airline northeast of Eureka and 75 miles northwest of Redding. The Hoopa Extension, which was established later, includes a mile-wide strip on either side of the Klamath River from the northern edge of the Hoopa Valley Reservation to the Pacific Ocean near Klamath. This strip, formerly known as the Klamath River Reservation, consists of about 14,700 acres checkerboarded among many tracts of non-Indian land. In this report, both areas will be treated together and referred to as the Hoopa Indian Reservation.

The townships either entirely or partly occupied by the Hoopa Indian Reservation are indicated by the following diagram:

Range East

Tps North	1	2	3	4	5	6	7
14	X						
13	X	X					
12		X					
11		X	X				
10			X	X			
9			X	X	X		
8			X	X	X	X	
7				X	X		

The Reservation area is accurately delineated on the geologic map accompanying this report (Figure 6), and is correctly shown on the Blue Lake, Willow Creek, Hoopa, and Coyote Creek 15-minute quadrangles and the Weed 2º map. It is incorrectly shown on the Tectah Creek, Ship Mountain, and Klamath 15-minute quadrangles. The incorrect maps terminate the Hoopa Extension 20 miles down the Klamath River from the Hoopa Valley Reservation rather than extending it downstream to the Pacific Coast.

Except for the relatively flat Hoopa Valley, most of the Reservation is steep and heavily forested. Elevations range from near sea level at Klamath to over 5,000 feet on the Hostler Ridge east of Hoopa Valley. Most of the slightly more than 1,000 inhabitants reside in the 2,500 acre Hoopa Valley. Access is easiest from Eureka via Highway 299 to Willow Creek and hence northward along the Trinity River on State Highway 96 to Hoopa Valley. From Hoopa Valley Highway 93 follows down the Trinity River to Weitchpec and then northeast up the Klamath River for 127 miles to reach Interstate Highway 5 at a point 10 miles north of Yreka. A road extends down the Klamath River from Weitchpec through the Hoopa Extension Reservation for about 18 miles to Johnsons, but apparently there is no road going farther down the Klamath River to connect through to Klamath. The northern part of the Hoopa Extension is accessible by a 4-mile road from Klamath on U.S. Highway 101. Of the total area, about 1,331 acres are allotted and 85,401 are tribally owned. Much of the valley floor along the Trinity River is in private ownership. In 1972, the reservation had a population of 1,074 (U.S. Department of Commerce, 1974, p. 112).

Geology

The Hoopa Indian Reservation is partly in the Klamath Mountains geologic province and partly in the Coast Ranges. The Hoopa Valley part is chiefly in the Klamath Mountains whereas the Extension is entirely in the Coast Ranges. A northerly trending, generally steep, thrust fault, the South Fork Mountain fault, separates the two provinces (Irwin, 1966) (Figure 6). On the upper, or eastern plate, are mildly metamorphosed shale, phyllite, thin-bedded chert, and altered volcanic rocks assigned to the Galice Formation of the western Jurassic belt together with other metamorphosed clastic sediments, chert, and volcanic rocks of the western Paleozoic and Triassic belt (Irwin, 1960). In the lower, or western, plate are metagraywacke, chert, and volcanic rocks of the Franciscan Formation that are more fully described in the section on geology of the Coast Ranges. Just below the thrust these underlying rocks are somewhat more metamorphosed than elsewhere and are referred to as the South Fork Mountain schist (Irwin, 1966). Along the sole of the thrust is a sheet of serpentinized peridotite of variable thickness that comprises a nearly continuous belt extending northward into Oregon. Other thinner bands of serpentine with northerly trend found farther east are believed to have been injected along steep faults. The east edge of the Hoopa Valley Reservation cuts across a bulge on the western side of the extensive granitic Ironside Mountain batholith. The rock here is chiefly quartz diorite or diorite and has been radiometrically dated as 165-167 million years old (Jurassic).

Along Beaver Creek about 4 miles north of Hoopa are small patches of sandstone, shale, conglomerate, and lignite that are poorly known. They may be Oligocene equivalents of the Weaverville Formation that contains coal near Hyampom and Hayfork, or they may be a landward extension of the Miocene Wimer Formation of Maxson (1933).

Scattered cappings of Tertiary terrace deposits which have been slightly deformed and contain deeply weathered boulders occur in the southern portion of the Reservation (Strand, 1963). Quaternary nonmarine, unconsolidated sand, clay, and gravel terrace deposits have filled the Hoopa Valley, and Recent stream channel, flood plain, and alluvial fan deposits consisting of unconsolidated clay, silt, sand, and gravel occur at the mouth of the Klamath River in the northern portion of the Reservation. The youngest deposits found within the Reservation are well sorted dune sands along the Pacific coast.

Mineral Resource Potential

Both lode and placer deposits have been mined successfully on the Hoopa Reservation and sand and gravel has been scooped up for local use. The Reservation has some potential for copper (including byproduct gold and zinc) and mercury lode deposits, and for recovery of gold and platinum from placer deposits. Resources of sand, gravel, and stone are large, but their use depends on local requirements. Less likely to be usable are small or low-grade deposits of manganese, chromite, coal, and graphite. Mineral occurrences in and near the

Hoopa and the Hoopa Extension Reservation are shown on Figure 7 and Figure 8.

Gold occurs as small pieces of the metal in quartz veins or as "dust" in pyrite in polymetallic ores, as for example, in copper vein or replacement deposits. If the quartz veins are rich enough they can be mined for their gold content alone, but much gold is now recovered as a byproduct from ores processed chiefly for other metals. Because gold is a heavy, chemically nonreactive, element it is concentrated by normal weathering and erosion processes in stream and terrace sands or gravels to form placer deposits. On the Reservation, gold has been recovered from both placer and lode deposits, and although none is now being recovered it is still a potential resource.

A gold-bearing quartz vein that is exposed in the upper part of Mill Creek close to the east edge of the Reservation has been sampled but not mined. According to an Indian Agent at Hoopa, samples yielded assays of a little more than an ounce of gold per ton (Averill, 1941).

Another lode deposit first explored for gold but later developed as a copper deposit is that of the Copper Bluff mine discussed below. Its copper ores contain less than ½ ounce of gold per ton, but a considerable although unknown amount has been recovered as a byproduct of the copper mining.

The sand and gravel along the Klamath and Trinity Rivers was extensively mined in the last half of the 19th century for placer gold with occasional recovery of the much smaller amounts of platinum that accompanies the gold. The gold found in the placers originally was present in veins in the Late Jurassic granitic intrusives. Most of the Tertiary and Quaternary sedimentary formations in the Klamath Mountains contain detrital gold, but the richer deposits occur in the Quaternary and Recent terrace and stream gravels. Their higher grade is the result of reconcentration from large volumes of older sediments to which were added the gold directly derived from lodes during the recent sedimentary cycles (Irwin, 1960). Platinum in the placers has a similar history but differs in that it was derived originally from the ultramafic rocks rather than from granitic rocks.

The Hoopa Valley contains a large amount of alluvial material that is doubtless gold-bearing but has not been mined because, according to early reports of the State Mining Bureau, placer mining was not allowed on the Reservation. The only placer known on the Hoopa Valley Reservation is just above Weitchpec and perhaps at one time considered to be beyond the northern limit of the Reservation. Downstream along the part of the Klamath River now in the Hoopa Extension Reservation there have been several small placer operations (Irwin, 1960), but because of the patchy distribution of the Indian lands along the river they may be on non-Indian parcels.

Doubtless much gold and some platinum still remains in the stream deposits along the Trinity and Klamath Rivers, but at present its recovery is not economical. The greatest resource is in Hoopa Valley, but the land here is better for farming, cattle grazing, and residential use.

The only known deposit of copper on the Hoopa Reservation, or nearby, is that mined between 1957 and 1962 at the Copper Bluff mine on the east bank of the Trinity River near the center of the Hoopa Valley Reservation. The mine is on the site of an initial discovery of gold ore made in 1928 but was not extensively explored until leased in 1937 by Henry J. Kaiser. By 1953, after the mine had changed hands several times, an ore body 5 feet thick, exposed for 140 feet along strike and 110 feet down dip, was estimated to contain 22,000 tons of ore averaging 2.0 percent copper, 4.5 percent zinc, with some gold and silver. In 1953, the Providence-Tuolumne Gold Mines, Inc. obtained an exploration loan from the Defense Minerals Exploration Administration to finance driving of additional underground workings and diamond drilling. By 1955, ore reserves were estimated to be 100,000 tons with 3 percent copper, 3.5 percent zinc, 0.1 ounce gold, and 2.0 ounces silver. In 1957, a concentrating mill was completed and the mine was put into production. In 1962, the $22,921 loan had been repaid from 5 percent of the gross value of ore shipment, indicating a production having a value of at least $460,000. In mid-1962 the mine and mill were closed down, and we have no record of further activity.

The Copper Bluff mine is developed on bodies of massive sulfide (pyrite) ore that contain a few percent of chalcopyrite and sphalerite and occur as bedded replacements in quartz-sericite and chlorite schist that forms a part of the Western Jurassic belt. The chalcopyrite-rich lenses range from 1 inch to 2 feet thick in a mineralized bed that locally reaches a thickness of 7 feet. Ore bodies are discontinuous, but the ore zone has been followed for 1,000 feet along the strike and down dip for at least 400 feet. The explored ground is broken by faults that offset the ore zone, generally less than 10 feet.

Although no other copper mineralization has been found on the Hoopa Reservation the geology in at least the eastern part does not preclude additional discoveries. With the present (1978) price of copper and mining costs, however, it is doubtful if deposits large and rich enough to be of economic value are likely to be found. The Copper Bluff deposit was located very favorably for development, as it was close to the highway and near an abundant supply of water. It seems at best to have been a marginal operation and apparently has been uneconomic since 1962. If other copper deposits are discovered by accident, perhaps through bulldozing for new logging roads, they should of course be thoroughly examined. However, as one can only anticipate the discovery of small deposits, only low cost exploration, like geochemical exploration by means of streams sediment sampling, is advisable.

Mercury ore has been mined from several small deposits at the headwaters of Mill Creek just east of the eastern boundary of the Hoopa Valley Reservation, but little information regarding these occurrences is available. At one deposit discovered in 1928 a few tons of ore retorted on the property yielded 30 flasks of mercury. In 1964, a mine in this area known as the Running Silver mine reported a production of 4 flasks of mercury. The rocks of the area are metavolcanics cut by a lens of serpentine, but we have no data regarding the mineralization. The area of mines and prospects is accessible by road, and the limited development at known deposits indicates they are small and unpromising.

It is quite possible that other small deposits of mercury ore occurs either in the Mill Creek area or elsewhere, as some productive deposits have been found in both the Klamath Mountains and the neighboring parts of the Coast Ranges. The chief ore mineral, however, is the bright red mercury sulfide, cinnabar, that is readily detected by panning, and considering the intensive search for gold made by panning the creek beds in this region it seems unlikely any major deposits of mercury ore has escaped detection.

The Sam Brown manganese deposit in sec. 15, T. 8 N., R. 4 E., 4 miles northeast of Hoopa has been known for many years but has remained undeveloped (Trask and others, 1942). The ore is a bed of dense rhodonite averaging 6 feet in thickness in a lens of recrystallized chert. The manganese silicate rhodonite is not useful because of the problems involved in its treatment, and only a small amount of the more desirable oxide ore is found here. Over 200 deposits of manganese deposits are known in the northern Coast Ranges and only seven have yielded more than 1,000 tons of ore (Irwin, 1960). Virtually all these deposits are uneconomic except at times of high prices resulting from wartime demand and Government purchase programs.

A deposit of coal in sec. 3, T. 8 N., R. 4 E., on the north side of Beaver Creek 4 miles northwest of Hoopa has been known for many years. In 1940 the property was leased and explored but there is no record of production. Lignite occurs here as a bed having a reported thickness of 7 feet in a faulted sequence of strata of possible Oligocene age. Analyses given by Averill (1941, p. 507) indicate volatile content of 44-58 percent, fixed carbon of 36-53 percent and ash of 3 to 7.5 percent on a dry weight basis. The faulted nature of the deposit has discouraged further development.

Graphite has been reported to occur in the Franciscan rocks in T. 10 N., R. 4 E., on the Hoopa Extension Reservation about 3 miles northwest of Weitchpec (Irwin, 1960, p. 74). This is but one of several small low grade deposits known in the northern Coast Range, and it has no economic potential.

The sand and gravel deposits of the Hoopa Reservation has been mined for use nearby in road or building construction. The quantity available is enormous, and no doubt this material will continue to be used wherever there is sufficient local demand. Chromite float has been reported from Hostler Ridge in the southeast corner of the Hoopa Valley Research in secs. 15 and 23, T. 8 N., R. 5 E, (Averill, 1941, p. 505).

Orleans Karok Trust Land

Location

The Orleans Karok Trust Land occupies about 6.6 acres in Parcel 1 of SW¼NW¼ sec. 32, T. 11 N., R. 6 E., HBM, in northeastern Humboldt County, one-half mile east of the town of Orleans, 16 miles northeast of Weitehpec, and 28 miles northeast of Hoopa (Figure 9). It occupies a flat river terrace at an elevation of 450 feet and is less than 100 feet above the flood plain of the Klamath

River, which flows about 1,000 feet to the west. Cheenitch Creek forms the southern boundary, and State Highway 96 bounds the trust land to the northwest.

As it was recently acquired, it is not delineated on the Orleans 15-minute quadrangle or the Weed 2º sheet.

Geology

The Orleans-Karok Trust Land is on a terrace and alluvial fan composed of boulders, gravel, and silt washed in from higher ground (Figure 9). These alluvial deposits contain appreciable detrital gold and similar material on the adjacent Perch Creek mine property has been exploited. Bedrock beneath the gravel consists of westward dipping phyllite, metagraywacke, and chlorite schist of the Lower Jurassic Galice Formation.

Mineral Resource Potential

The Orleans Karok Trust Land is in the Orleans placer-gold mining district, which was worked almost continuously from 1850 until the early 1900's. Mining has continued intermittently to the present. No production figures for the district could be found.

Placer gold production in the Orleans district came from a succession of benches and terraces which lie from 50 to 200 feet above the present channel of the Klamath River and its tributaries. The terraces extend for several miles along the river valley, and in places, are cut by younger, deeper channels. The active streams were mined by hand methods, wing dams, flumes, tunnels, and more recently by dragline dredges. The older bench and terrace gravels were worked by hydraulic methods, ground sluicing, and drift mining (Clark, 1970, p. 139), with hydraulic methods being the most common in the vicinity of the trust land.

The Perch [Pearch] hydraulic mine is less than 1,000 feet northeast of the Orleans Karok Trust Land in the NW¼ sec. 32, T. 11 N., R. 6 E. Originally, it occupied 180 acres on an old river terrace above the southeast bank of the Klamath River. The first claims were located in the 1870's (Lowell, 1915, p. 404). In 1941, the hydraulic pit of the Perch mine exposed an 80-foot thick bench deposit, which consisted of a layer of boulders having a maximum diameter of 18 inches which were overlain by a thick layer of fine overburden and soil. Bedrock is about 50 feet above the present river channel and consists of steeply-dipping slate and chloritic schist. In 1939, 154 ounces of gold and 23 ounces of silver were recovered by cleaning the bedrock (Averill, 1941, p. 512-513).

Platinum has been recovered from the gravels of several of the Klamath River gold placers near Orleans. However, it has not been found in concentrations that would permit mining solely for platinum, and thus appears to be commercially recoverable only as a by-product of gold (Pacific Southwest Field Committee, 1956, p. 21-22, fig. 3).

COAST RANGES PROVINCE

The Coast Ranges province extends for nearly 600 miles along the Pacific margin of California from the Oregon border south nearly to Pt. Conception, and from the coast inland about 100 miles to the west margins of the Great Valley and Klamath Mountains provinces (Figure 10). As all the Indian lands discussed in this report are in the northern half of the province, only this part is discussed in the following paragraphs.

Much of the northern Coast Ranges province consists of mountainous timbered ridges with individual peaks rising to elevations of 6,000 to 7,000 feet. Intervening valleys trend generally northwest, and while most are narrow and steep-walled, locally they widen to form broad flat basins in which cities, ranches, farms, and vineyards are located. The coastline is generally very steep, but marginal flat areas occur where the main rivers reach the shore. Along some parts of the coast remnants of old raised beach terraces lie at elevations up to several hundred feet above the present day shoreline.

The geology of the northern Coast Ranges is exceedingly complex in detail and much of the area is still inadequately mapped (Jennings, 1978a,b). The gross pattern of rock distribution, however, is fairly simple. By far the most widespread and abundant rock unit is the Franciscan Formation of Late Jurassic and Cretaceous age (Bailey and others, 1964a). This is a tremendously thick pile of graywacke (dirty sandstone), shale, greenstone (altered mafic volcanic rocks), chert, sparse limestone, and serpentine. All these rocks are rather chaotically deformed and metamorphosed to grades ranging from lower zeolite to blueschist facies. A second very thick accumulation of conglomerate, sandstone, and shale of the same age, known as the Great Valley sequence, once formed a continuous sheet thrust over the Franciscan rocks throughout the entire province, but now due to erosion occurs only as small infaulted remnants. Additional overthrust patches of slightly older sedimentary and metamorphic rocks, like those characteristic of the Klamath Mountains Province, extend from the coast about 50 miles north of Eureka, southeast for about 50 miles.

Latest Cretaceous and Cenozoic marine sandstone and shale occur in the Eel River embayment south of Eureka (Ogle, 1953), in a few patches extending from the embayment southeast to Clear Lake (Berkland, 1973), and along the coast from Pt. Arena southward. Volcanic eruptions in the area between Clear Lake and the north end of San Francisco Bay occurred intermittently from Pliocene until only a few thousand years ago and have resulted in the accumulations of thousands of feet of flows and ash beds of basaltic to rhyolitic composition (Hearn and others, 1976). Quaternary sedimentary deposits of alluvium fill the broader valleys and drowned river mouths, and beach deposits lie on older raised terraces and are accumulating along the present shoreline.

The pre-Pliocene rocks of the Coast Ranges are folded into west-northwesterly trending structures, but deformation within these older rocks, including both folding and faulting, has been so intense that individual folds can rarely be delineated. The folded rocks are cut by a multitude of northwest-trending faults, of which the best known is the active San Andreas fault that extends along the western margin, in places on land and elsewhere just offshore, from Cape Mendocino south to the southern end of the province. The San Andreas fault has strike-slip offset of more than 100 km with the west side shifted north relative to the eastern side, and rocks on the two sides are generally quite different. Other parallel faults may have some similar strike-slip movement, but they appear to be chiefly normal faults. The other great fault present in the northern Coast Ranges, and also forming the eastern edge of the province in most places, is the Coast Range thrust fault (Bailey and others, 1970) and its northern extension the South Fork Mountain thrust fault. This folded thrust separates the underlying Franciscan rocks from the overriding plates consisting of older rocks of the Klamath Mountains province and farther south the coeval rocks of the Great Valley sequence. Structures within the young volcanic rocks are broad folds and scattered intrusive centers. Geophysical evidence indicates that in an area lying south of Clear Lake and extending to The Geysers geothermal field there is at a depth of about 10 km a magma chamber holding as yet unsolidified magma (Chapman, 1975; Isherwood, 1976).

Economic Mineral Products of the Northern Coast Ranges

The northern part of the California Coast Ranges has not been a major producer of mineral products as compared to some other provinces in California; however, a surprising number of mineral commodities have been successfully mined or quarried (Irwin, 1960; Davis, 1966). Serious prospecting in the northern Coast Ranges probably began with a search for deposits of mercury following the successful mining of mercury ores in 1845 at New Almaden (Bailey and Everhart, 1964). Only a little later gold was also sought as a result of its discovery in 1848 in the Sierra Nevada and Klamath Mountains. Many mercury deposits were found, especially in the area south of Clear Lake, and the search also lead to the discovery of other minerals in the Coast Ranges, such as gold, chromite, manganese oxide, and copper sulfide. With increased population a demand grew for nonmetallic products, such as clay for brick, limestone for cement making, building stone, and especially sand and gravel for building and road construction. For fuel and power, coal was mined in the late 1880's, and since 1937 dry gas has been recovered from wells near Fortuna, south of Eureka. In 1960, the natural steam obtained from wells at The Geysers was first utilized for generation of electricity, and it has since become a major source of energy for northern California.

A close relation commonly exists between the kind of rock or formation and mineral occurrences. In the northern Coast Ranges various rocks of the widespread Franciscan Formation are the host for mercury deposits (Bailey, 1946; Davis, 1957b; Davis and Bailey, 1966), chert found in this unit may contain deposits of manganese oxide (Jenkins, 1943; Davis, 1957a), and Franciscan volcanic rocks contained the Island Mountain copper deposit, which produced 9 million pounds of copper (Stinson, 1957). Serpentine which is widespread in the Franciscan Formation may contain chromite (Rice, 1957b; Thayer, 1966) or asbestos (Wiebelt and Smith, 1959; Rice, 1957a; 1963; 1966), and a hydrothermal alteration of it called silica-carbonate rock is the host for several major mercury deposits. Weathered serpentine is mined in southern Oregon for its nickel content, and a similar deposit east of Leggett has been explored (Hotz, 1964; 1966). The older Cenozoic sedimentary rocks have been the source of coal, and younger sandstone has yielded gas and a little oil (Bowen, 1962). These rocks, as well as the uppermost Cretaceous sandstones, formerly were quarried for building stone. The young terrace and river deposits are a source of sand and gravel (Goldman, 1961; 1966), and beach and river gravels also have been exploited for their content of gold, platinum, and chromite in the northernmost part of the province (Clark, 1966). Volcanic rocks of the Clear Lake area were once mined for sulphur, and more recently for mercury (Everhart, 1946) with the rock that has been heated to extract the mercury being later used as aggregate for concrete blocks. The fragmental volcanic material is used as aggregate for roads, and fine-grained or diatomaceous beds are quarried for chicken scratch. Waters from volcanic sources were a source of borax at two localities near Clear Lake (Vonsen and Hanna, 1936), and CO_2 gases were recovered from wells near Hopland (Edgerton, 1966). Geothermal steam heated by magma is an important and increasing source of electrical power generation (White and Williams. 1975).

Resighini Rancheria

Location

The Resighini Rancheria, containing 238.8 acres, is in secs. 13 and 14, T. 13 N., R. 1 E., HBM, about a mile southeast of Klamath, in southwestern Del Norte County (Figure 11).

The area is correctly delineated (but with slightly different spelling) on the Requa 7.5-minute quadrangle, incorrectly outlined on the Klamath 15-minute quadrangle, and not outlined on the Eureka 1:250,000 sheet of the U.S. Geological Survey. All of the tract is on a flat developed along the south side of a prominent bend in the Klamath River, and altitudes range from near sea level to about 100 feet. Most of the area is either barren or poor grassland, but some bushes border the river. The land is apparently unoccupied, but a part is occasionally used for grazing or dry farming (California Dept. Water Res., 1965). The Rancheria is adjacent to U.S. Highway 101 and is served by a road branching from the highway and extending westward across the entire tract.

Geology

The flat containing the Resighini Rancheria is underlain by fine to coarse sand deposited by the Klamath River (Figure 12). The thickness is unknown but can be estimated to range from zero at the south edge of the Rancheria to several tens of feet closer to the Klamath River. The rocks beneath the sand are hard indurated, but fractured, graywacke and shale of the Franciscan Formation.

Mineral Resource Potential

The sand deposited as alluvium by the Klamath River is a potential source of sand, and perhaps gravel, for local use. Similar material is, however, widespread in the area about Klamath, and whether or not it can be utilized is a matter of relative costs in quarrying and hauling to the point of use. If used, care would be required in selecting a quarry site, as at least part of the flat is subject to flooding at times of unusually high water, as during the 1955 or 1964 floods. The sand also doubtless contains heavy resistant minerals such as gold, platinum group metals, and chromite, but their concentration is believed to be too low to be of economic interest with the prices that prevailed in 1978.

Big Lagoon Rancheria

Location

The Big Lagoon Rancheria consists of 9.26 acres in sec. 13, T. 9 N., R. 1 E., HBM, Humboldt County, about 8 miles north of Trinidad (Figure 13). The tract is delineated on the Rodgers Peak 7.5-minute quadrangle, the Trinidad 15-minute quadrangle, and the area is included in the Eureka 1:250,000 sheet of the U.S. Geological Survey. The Rancheria is a small parcel on the south shore of Big Lagoon, and altitudes range from 6 feet to about 45 feet. The area is open land with a sparse grass cover. It is readily accessible by road from U.S. Highway 101 and from the village of Big Lagoon. Two houses and a boathouse at the edge of the Lagoon indicate it has been inhabited at times.

Geology

The Big Lagoon Rancheria lies on sand alluvium and lake shore deposits thinly covering older terrace gravels which are dominantly mud and sand but locally contain beds of conglomerate (Figure 13). Underlying the terrace gravels at shallow depth is graywacke, shale, and altered mafic volcanic rock of the Franciscan Formation.

Mineral Resource Potential

The mineral potential of the Big Lagoon Rancheria is low. Gold was discovered in the Big Lagoon sands in the 1850's, and was intermittently mined on a small scale by sluice and rocker for the next 40 years. It was reportedly present throughout the 3. 5-mile long by half a mile wide sandbar which separates Big Lagoon from the ocean (Figure 13). The gold is extremely fine-grained and difficult to concentrate. The Big Lagoon sands, unlike most auriferous sands of the California coast, contain very little black sand (Watts, 1893, p. 230-231). Watts believed that Big Lagoon contained vast amounts of low-grade auriferous sand. However, the gold-bearing sands were apparently worked out and most mining activity and ceased early in the 20 century (Laizure, 1925, p. 300).

Some placer mining has been done near the mouth of Maple Creek, where it drains into Big

Lagoon, about half a mile east of the rancheria (Averill, 1946, pl. 4) (Figure 13).

Trinidad Rancheria

Location

The Trinidad Rancheria, consisting of about 55 acres, borders the Pacific Ocean in the E½ NW¼ sec. 25, T. 8 N., R. 1 W., HBM, one half mile southeast of the town of Trinidad and 22 miles north of Eureka (Figure 14). A relatively flat terrace about 200 feet above sea level gives way to steeper land nearer the coast. Maps provided by the Hoopa Indian Agency indicate that the terrace has been subdivided into residential lots.

U.S. Highway 101, a 4-lane road, crosses the northeast corner of the rancheria. Old Highway 101, also known as the Trinidad Scenic Drive, passes through the southern part. In 1969, the rancheria had a population of 26 (U.S. Department of Commerce, 1974, p. 159).

Geology

The subdivided mesa is underlain by nearly flat-lying marine terrace deposits consisting of sand, shale, and some thin conglomerate beds (Figure 14). The terrace directly overlies hard, fractured graywacke and shale of the Franciscan Formation which is exposed along the sea cliff and canyon walls.

Mineral Resource Potential

The marine terrace deposits on the Trinidad Rancheria are a potential local source of sand and gravel. It is doubtful, however, that disruption of prime residential land for quarries would be permitted.

Gold and platinum were mined many years ago near the mouth of Little River, about 3 miles south of the rancheria (U.S. Bur. Mines, WFOC MILS files).

Round Valley Reservation

Location

The Round Valley Indian Reservation consists of about 20,700 acres in parts of Tps. 22, 23, and 24 N., Rs. 11, 12, 13, and 14 W., MDBM, in northern Mendocino County; and secs. 28, 29, and 30, T. 5 S., R. 8 E., HBM, and sec. 36, T. 5 S., R. 7 E., HBM, in southern Trinity County. It is just north of the town of Covelo, and is approximately 50 miles north of Willits and 67 miles north of Ukiah (Figure 15). The main part of the reservation lies in T. 23 N., Rs. 12, 13, and 14 W., and is bounded by the Eel River on the west and is approximately bounded by Williams Creek on the east. Isolated parcels of tribal land are found near the headwaters of Williams and Hulls Creeks. Several tracts of land extend along the south bank of the North Fork of the Eel River northeastward from its confluence with the main Eel River (Figure 15).

Elevations in the area are from about 650 feet near the confluence of the Eel River and the North Fork of the Eel River, to more than 6,500 feet at Leech Lake Mountain. The Eel River and its tributaries are deeply incised, forming steep-sided canyons. Most of the land is heavily forested. Round Valley, near Covelo, is flat and suitable for agriculture.

A paved road connects Covelo to Dos Rios, about 16 miles to the southwest. California Highway 261 connects Dos Rios with U.S. Highway 101, 12 miles north of Willits. A light-duty dirt and gravel road crosses the reservation northwestward from Covelo to Mina and the North Fork of the Eel River. An unpaved forest road runs eastward from Covelo over Mendocino Pass. Forest roads and jeep trails provide access on the reservation. The main branch of the Northwestern Pacific (Southern Pacific) Railroad parallels the west bank of the Eel River adjacent to the reservation. Bus and train facilities are available in Willits, and commercial airlines serve Ukiah. In 1971 the reservation's population was 340 (U.S. Dept. of Commerce, 1974, p. 140).

Geology

The Round Valley Reservation is located in a central part of the Coast Ranges dominated by rocks of the Franciscan Formation (see Figure 16). This formation is composed of sandstone, shale, and conglomerate with smaller masses of chert, greenstone, ultrabasic rock, limestone, basalt, glaucophane schist, and related metamorphic rocks (Bailey and others, 1964). They are tightly folded and faulted with distinguishable units arranged in north-northwest trending units (Gucwa, 1974). Some of the units, for example the relatively thin chert beds, are of possible economic importance, but they are too small to have been delineated on available geologic maps. Present within the Franciscan terrane are bodies of ultrabasic rock, dominantly serpentinized peridotite with minor occurrences of dunite (Irwin, 1960), which have some importance as possible host rock for chromite, asbestos, or jade. A particularly large ultrabasic body present in the Reservation in sections 2 and 3, T. 23 N., R. 13 W. is shown on the geologic map, but there are many other masses too small to be shown at this scale.

Overlying the Franciscan Formation west and south of Round Valley are beds of undivided Cretaceous and Eocene marine sandstone, shale, and conglomerates lying along a structural depression extending from Clear Lake to the lower part of the Eel River. Miocene sedimentary rocks assigned to the Temblor Formation occur near these sediments but do not lie directly on them. The Temblor Formation has been described by Clark, (1940), as consisting mainly of sandstone, conglomerate, and interbedded shale, with a few interbeds of low rank coal (Irwin, 1960).

Pleistocene nonmarine river and stream terrace deposits consisting of gravel, sand, silt, and clay cover small portions of the Reservation. Recent deposits of alluvium consisting of conglomerate, sand, and silt are prominent only where they fill Round Valley, (Muir and Webster, 1977) (Figure 17), but they also occur along all the larger streams. The alluvium deposits in Round Valley are more than 500 feet thick and occupy a depression between to north-northwesterly trending faults along which the valley has subsided (Figure 17). They not only provide a flat area suitable for agriculture in the midst of rugged mountainous terrane but also constitute a large ground water reservoir.

Mineral Resource Potential

The Round Valley Reservation has yielded a modest amount of mineral products in the past and has some potential for production in the future, though better grade ore, higher prices, or new discoveries will be required to justify development. Minerals most likely to be of importance are jade, manganese, sand and gravel, crushed rock, and possibly chromite, asbestos, and copper.

Manganese ore has been mined on a very small scale from a deposit in Franciscan chert on the Reservation, and many other small deposits within a few miles of the Reservation have been prospected or mined (Trask, 1950). The ore is chiefly manganese oxide formed as a result of surface oxidation of layers of manganese carbonate interbedded with Franciscan chert. Similar ores occur in many places in the California Coast Ranges but because of their limited extent and low grade, have been mined only during times when better and cheaper manganese ore from foreign sources is not available, especially during World War I and II. Although they constitute a reserve for emergency conditions, only under very exceptional circumstances will such deposits be mined again in the foreseeable future.

The serpentine lenses of the Round Valley Reservation have an unknown potential as a source of chromite, asbestos, and especially jade. The chromite occurs either as small massive, high grade, pods or larger but lower grade masses containing disseminations in dunite. Such deposits in the northern Coast Ranges have been exploited during war periods but are not competitive with foreign imports in normal times.

The serpentine also locally contains blocks of jadeite, as at Leech Lake Mountain just east of the Reservation. Some of the jade is of gem quality and has been utilized by amateur "rockhounds" or shipped to Germany where it is carved into small sculptures and jewelry. Most of the Covello area jade is not gem quality but when sawed into thin slabs finds a ready market among those who enjoy rock polishing as a hobby. Since the discovery on Leech Lake Mountain in 1950 all the nearby canyons draining the area have been thoroughly examined for boulders washed down from the outcrop and little of value remains. However, there is a small possibility that other serpentine masses in the rugged terrane of the Reservation may contain undiscovered deposits of jade.

Asbestos also occurs in serpentine and minor deposits occur throughout the northern Coast Ranges. None of these have proved to be good enough to support a mine and it is not likely a viable deposit will be found in the Round Valley Reservation.

Copper, and accompanying gold and silver, have been recovered from the Island Mountain mine about 6 miles down the Eel River from the most northwestern part of the Reservation

(Stinson, 1957). The pyrite-pyrrhotite-chalcopyrite ore of this deposit is unique in the northern Coast Ranges, and it is unlikely a similar deposit occurs on the Reservation. In addition, although the mine yielded nearly 5,000 tons of copper, the grade of ore was so low that with present prices the remaining ore cannot be mined.

Alluvial deposits along the Eel River or lesser streams provide small sources of sand and gravel that can be used locally. Although the Northwestern Pacific traverses the Eel River canyon, and might provide cheap haulage for these bulky low value commodities, it is unlikely that the alluvium can be exploited because of its poor quality and limited extent of deposits. On the other hand, parts of the channel contain large boulders of very hard blueschists that might have potential as riprap for breakwaters or highway or railroad facing to prevent erosion.

Coal of sub-bituminous rank and noncoking grade occurs in beds up to 15 feet thick in the Miocene Temblor Formation on both sides of the Eel River a few miles south of the Reservation. It has been mined on a small scale at various times since the early days of settlement and most recently in 1948 (Clark, 1940; Jennings, 1957). The coal-bearing strata are not known to extend onto the Reservation, but geological mapping is so incomplete that there could be small unmapped areas. As the better exposed and more accessible coal seams are regarded as uneconomic under present conditions, any search for coal on the Reservation is unwarranted.

Laytonville Rancheria

Location

The Laytonville Rancheria is comprised of 200 acres in the S½ sec. 14, T. 21 N., R. 15 W., MDBM, in Mendocino County, 2 miles southwest of Laytonville and 25 miles north of Willits (Figure 18). It lies at elevations from 1620 to 1840 feet in an area of rolling hills along the Cahto Creek valley. U.S. Highway 101, the major north-south route through northwestern California, passes through Laytonville.

Bus service is available in Laytonville, train service in Willits, and commercial airlines in Ukiah. In 1972, the rancheria had a population of 65 (U.S. Department of Commerce, 1974, p. 120).

The Rancheria is correctly delineated on the Cahto Peak and Laytonville 7½-minute quadrangles, and on the Laytonville and Branscomb 15-minute quadrangles, but is incorrectly delineated on the Ukiah 2º sheet. This area is easily accessible via Branscomb Road which connects to Highway 101 in Laytonville.

Geology

The Laytonville Rancheria is situated on dissected alluvial terraces and bedrock that border the west side of the Laytonville Valley (Figure 18). The northeastern part of the Rancheria lies chiefly on the erosional remnants of a Pleistocene terrace consisting of poorly sorted, crossbedded, unconsolidated gravel and sand with, varying amounts of silt and clay, and local lenses of sand and gravel

(Cardwell, 1965). A minor portion of this area is covered with recent river alluvium of similar character. The remaining southwestern part of the Rancheria is on bedrock composed of the Franciscan Formation, which here consists of folded and broken consolidated graywacke sandstone and shale, with perhaps local bodies of chert, greenstone, serpentine, and blueschist.

Mineral Resource Potential

Little mining activity has been reported in the vicinity of the Laytonville Rancheria. An occurrence of the rare minerals howieite, deerite, and zussmanite in sec. 6, T. 20 N., R. 14 W., 5 miles south of Laytonville (Agrell, 1965; Rice, 1966; Chesterman, 1966) has been eagerly exploited by amateur mineral collectors, and Franciscan limestone was formerly quarried in the E½ and NW¼ of sec. 36, T. 22 N., R. 15 W. (O'Brien, 1953), 2 miles north of Laytonville.

The Pleistocene terrace deposits are a potential source of sand and gravel for roadway or building construction. As there has been little development of sand and gravel deposits in the vicinity (Goldman, 1961), perhaps a local source could be developed on the Rancheria.

Numerous springs are found in the Laytonville area. Waring, (1965, p. 21) reports a thermal spring in the SE¼ sec. 1, T. 21 N., R. 15 W., about ½ mile north of Laytonville. The spring waters, which issue from the Franciscan Formation, have a temperature of 70ºF (21ºC) and flow at the rate of 200 gallons per minute. They contain hydrogen sulfide and have been used in health spas.

A hard, fine-grained, pink to yellow limestone, known as the Fisher Ranch limestone deposit, crops out in two small hills in the E½ and NW¼ sec. 36, T. 22 N., R. 15 W., about 2 miles north of Laytonville, but has not been developed (O'Brien, 1953, p. 361).

Sherwood Valley Rancheria

Location

The Sherwood Valley Rancheria occupies about 292 acres in the SE¼ sec. 35, T. 20 N., R. 15 W., and the NE¼NE¼ sec. 2, T. 19 N., R. 15 W., MDBM, in Mendocino County, approximately 13 miles by road northwest of Willits and 3 air-miles west of Longvale. Its elevations go from 2,140 to 2,480 feet, in an area of rolling hills on the north side of Sherwood Valley (Figure 14). Accessibility is good over a light-duty gravel road from U.S. Highway 101 near Willits. In 1969 the rancheria apparently was uninhabited (U.S. Dept. of Commerce, 1974, p. 150).

Geology

The geology of the Sherwood Rancheria consists of rocks of the Franciscan Formation overlain by a thin cover of river alluvium (Figure 19). The Franciscan Formation, which is the dominant lithology of the northern portion of the Rancheria, here consists mainly of sandstone, shale, and conglomerate beds that have been severely folded and faulted. This formation has been dissected and overlain in the southern portions of the Rancheria by Recent river alluvium consisting of unconsolidated sands, silts, and clays with lenses of gravel.

Mineral Resource Potential

Recent river alluvium found in the Sherwood Rancheria offers a potential source of sand and gravel. However, the Harms Brothers sand and gravel pit in operation in sec. 3, T. 19 N., R. 14 W. near Highway 101 along Outlet Creek probably can supply the needs of the area. Two occurrences of manganese ore in Franciscan cherts have been reported north of Longvale and approximately 5 miles northeast of the Rancheria. These are the Graham claim in T. 20 N., R. 14 W. and the Wishbone claim in sec. 16., T. 20 N., R. 14 W (O'Brien, 1953). The ore bodies are small examples of the many manganese oxide deposits formed by oxidation of layers of manganese carbonate interlayered with cherts occurring in the northern Coast Ranges (Davis and Hewett, 1966). No chert is known to be present on this small Rancheria, and the possibility of finding useful manganese ore is very small.

Sulphur Bank Rancheria

Location

The Sulphur Bank Rancheria consists of an irregular shaped area of less than ¼ sq mi on the tip of a promontory projecting into the east edge of Clear Lake in Lake County. It is mainly in sec. 6, T. 13 N., R. 7 W., but a small part is in sec. 5, as shown on the Clearlake Oaks 7.5-minute and 15-minute quadrangles of the U.S. Geological Survey. Its location, without boundaries, is also shown on the Ukiah 1:250,000 sheet. Most of the area is nearly flat shoreland, but one hill in the northwest corner rises to about 40 feet above the lake level and a similar altitude is reached along the southeastern limits of the Rancheria (Figure 20). Along the lake shore in most places are either bushes or marshland, but the remainder of the area is grassland with scattered oaks. Unsurfaced roads extend into the area from Sulphur Bank Drive, which diverges from State Highway 20 about a mile east of Clearlake Oaks. Several families occupy a few houses on the Rancheria.

Geology

The Sulphur Bank Rancheria is immediately adjacent to the Sulphur Bank mercury mine, which with a production of about 130,000 flasks of mercury is one of the major producers in the United States. The deposit has been known and mined for nearly 100 years, and because it is of exceptional scientific interest, owing to the relation of the mercury to hot springs, it has been intensively studied by many geologists. As a result, the geology of the area, including the Rancheria, has been the subject of many reports and is unusually well known (Becker, 1888; Forstner, 1903; Bradley, 1918; Everhart, 1946; White and Roberson, 1962).

The oldest rocks are part of the Franciscan Formation consisting of mildly metamorphosed graywacke and shale (Figure 21). They do not crop out on the Rancheria, though they underlie it and are exposed in the adjacent mine area in the deep pits dug to remove the mercury ore. Overlying the Franciscan rocks, and again exposed only around the pits, are old lake sediments which are 200 feet thick on the south part of the deepest pit but thin rapidly to the north and west. Overlying these sediments is a Recent flow of andesite erupted from a vent about a mile to the east and piled up in the mine area to a maximum thickness of more than 100 feet. Cutting through the massive lava are small pipes of similar rock but in blocks, lapilli, or bombs; they may represent small eruptive vents or secondary cones (hornitas). Overlapping the andesite along the margin of Clear Lake are muds and fine sands deposited along the shore when it stood at a slightly higher elevation.

The Sulphur Bank mercury ore deposit lay on the south and west flank of the lava hill shown in Figure 21. Cinnabar, the only important ore mineral, was deposited by hot waters that rose along an east-northeast trending shear zone now exposed in the deep Herman pit. A little cinnabar was deposited along the shear zone in the Franciscan graywacke, and a little more impregnated the overlying pre-andesite lake beds; however, most of the cinnabar was deposited in the andesite flow just below the water table slightly above the present lake level (White and Roberson, 1962). Above the water table almost no cinnabar was deposited, but escaping steam and other gases permeated the andesite, altered it extensively, and deposited large amounts of sulfur. The alteration of the andesite above the water table is spectacular, as initially it is deep brown in color but becomes leached to snow-white, nearly pure, silica. Steam is still escaping in the area, and minor amounts of mercury and antimony are being deposited today (White and Roberson, 1962; Dickson and Tunell, George, 1968).

As its name implies, the Sulphur Bank deposit was first worked in 1865 for sulphur occurring near the surface in the bleached lavas. A few years later, after the recovery of more than 1,000 tons of sulphur, mining was terminated owing to a decrease in the price of sulphur and increasing contamination by cinnabar as the mining reached depths of 15-25 feet below the surface. In 1873, when the price of mercury was high, mining of the cinnabar was begun, chiefly from the zone lying in the andesite just below the water table. As the shallow ore was depleted, shafts several hundred feet deep were sunk, but production of deep ores was very difficult because of hot water, acrid dust, and suffocating gases. From 1896 until open-pit mining was begun in 1927, production was intermittent and never very large. From 1927 through the World War II period, and again in 1955-57, surface mining resulted in substantial production and a total output through 1957 of 129,418 flasks of mercury (White and Roberson, 1962). Since then no large scale mining has been done, but exploratory drill holes were put down in search of both cinnabar ore and possible commercial qualities of steam for power generation (McNitt, 1963).

Mineral Resource Potential

In spite of its proximity to the great Sulphur Bank mine, the Sulphur Bank Rancheria is believed to have little potential for mining of mineral products. The Sulphur Bank mercury ores were deposited by hot waters and vapors rising along the well-defined shear zone exposed in the Herman pit, and the results of their activity are very apparent in the bleaching of the andesite near the zone. No similar faults are known to pass through the Rancheria, and the absence of extensive bleaching suggests no ore forming solutions have reached the surface in this area. It is conceivable, but unlikely, that hot waters or steam that might be used for power generation are trapped below the Rancheria and could be tapped by drilling; however, none of the wells drilled in the Clear Lake area have encountered an exploitable geothermal reservoir and none seems likely here.

A planimetric map provided by the Central California Indian Agency in Sacramento outlines two areas of mine dumps on Indian land. One is north of the northwest pit of the Sulphur Bank mine, and the other is in the northwest corner of the rancheria, near Clear Lake.

Manchester (Point Arena) Rancheria

Location

The Manchester (Point Arena) Rancheria consists of two parcels of land (referred to as areas A and B) totaling 355 acres, in Mendocino County, between the towns of Manchester and Point Arena. Area A occupies approximately 254 acres in the NE¼NE¼ sec. 1, T. 12 N., R. 17 W., and the W½ sec. 6, T. 12 N., R. 16 W., MDBM. It lies at elevations of between 120 and 240 feet in an area of gently-rolling hills, about 2 miles north of Point Arena on the Windy Hollow Road (Figure 22).

Area B comprises 101 acres in the NW¼ sec. 32, T. 13 N., R. 16 W., approximately 1.5 miles south of Manchester and 1.5 miles east of Highway 1 on Mountain View Road. The Garcia River flows through area B. These areas are correctly delineated on the Point Arena 7½-minute quadrangle and the Point Arena 15-minute quadrangle, but they are incorrectly delineated on the Santa Rosa 2º sheet. In 1972, the rancheria had a population of about 65 (U.S. Dept. of Commerce, 1974, p. 125).

Geology

No detailed geologic map of the Manchester Rancheria is published, and we have used the data on the Santa Rosa 2º geologic map sheet (Koenig, 1963) as the basis for Figure 23. The northwesterly trending San Andreas fault which is less than one-half mile east of the eastern tract (Area B), separates rocks of the Franciscan Formation on the east from much less deformed Eocene and younger rocks on the west. The Franciscan Formation here is the "coastal belt" unit of Bailey and others (1964) and consists of altered graywacke, shale, and minor conglomerate. Eocene rocks west of the fault are similar marine sediments but in much less deformed and altered condition. The Miocene rocks that underlie most of both parcels are also generally fine-grained marine sediments that have been assigned to the Point Arena Beds and the Galloway Beds of Weaver (1943). These two units have a combined thickness of about 5,000 feet and are moderately folded into northwesterly trending anticlines and synclines that parallel the San Andreas fault (Irwin, 1960). Following folding, they were planed off and in Pleistocene time they were blanketed by the marine sandstone and shale now comprising the Millerton Formation. In Recent time this blanket has been dissected by the Garcia River and its tributaries leaving the Millerton deposits as caps on the hills. Lastly, deposits of silt, sand, gravel, and larger boulders were deposited in the river channel and floodplain.

Mineral Resource Potential

The flood plain and channel deposits of the Garcia River in area B are potential local sources of sand and gravel. However, this commodity appears to be readily available elsewhere in the Point Arena-Manchester area (Goldman, 1961, pl. 1).

In the early 1960' s the Ellison Gravel Company operated a sand and gravel plant near the Garcia River in sec. 31, T. 13 N., R. 16 W., 2 miles north of Point Arena and 0.6 mile east of Highway 1 (Figure 22). Stream channel deposits were dredged to a depth of 3 feet by a dragline, and the material was hauled by truck to a nearby concrete plant. The deposits consist of subangular to subrounded gravel averaging 2 inches in diameter, and have a composition of about 96 percent graywacke, 3 percent greenstone, 1 percent chert, and less than 1 percent vein quartz. Production was estimated to be 100 cubic yards per day (Goldman, 1961, p. 21).

For more than 100 years, the bituminous sandstone deposits northwest of the town of Point Arena have been of recurrent interest as possible sources of petroleum and paving material. The deposits were first worked in 1864, in an attempt to extract oil by distillation. This project, and later attempts to use the deposits for paving material, failed. Only a few hundred tons of material were mined (Jennings, 1957, p. 67).

"The bituminous deposits are exposed in Miocene Monterey strata along the steep east flank and south end of an asymmetrical syncline. The principal outcrops are near Arena Cove and a mile to the north**** (Figure 22). The main asphaltic bed is believed to extend between these two areas beneath a thin cover of terrace deposits. The largest layer of bituminous sandstone in the Arena Cove area is about 30 feet thick and dips 18º to 30º north. It extends from the sea cliffs eastward about 1,650 feet and then swings to the north;**** (Another sandstone bed is about 20 feet thick and dips 50º to 55º southwest.) Three smaller beds also crop out (west of Flumeville).

The indicated and inferred reserves of the main bituminous sandstone layer, as projected between the two areas, total about 3,232,000 tons and contain an estimated 1,207,000 barrels of bitumen. Perhaps 60 to 90 percent of this near-surface part of the deposit could be recovered in mining, depending on the methods used. The deposits contain an estimated average of about 6.5 percent bitumen by weight or about 15.6 gallons of bitumen per ton" (Jennings, 1957, p. 67-68).

Nine exploratory wells have been drilled in the Point Arena area, but no production has been reported. Seven of the nine wells were drilled before 1941, and two in 1963. All were uncompleted or abandoned (Oakeshott, Braun, Jennings, and Wells, 1962, p. 26; O'Brien, 1953, p. 366;

Munger, 1977, map W-5). The approximate locations of seven wells are shown on Figure 22.

Stewarts Point Rancheria

Location

The Stewarts Point Rancheria consists of 40 acres in the unsurveyed SW¼NW¼ sec. 5, T. 9 N., R. 13 W., MDBM, in Sonoma County, approximately 4.5 miles east of Stewarts Point (Pacific Ocean, California Highway 1), 25 miles west of Skaggs Springs, and 34 miles west of Geyserville (Figure 24). It lies at elevations from 900 to 1,050 feet on a flat-topped ridge separating the South Fork and the Wheatfield Fork of the Gualala River. The topography of the area is rugged and consists of narrow, steep-sided canyons and flat-topped ridges. Almost all of the twenty four buildings present on the Rancheria are on the flat ridge crest in the southern portion of this parcel of land. The boundaries for the Stewarts Point Rancheria are correctly delineated on the Annapolis 7½-minute quadrangle and the Santa Rosa 2° sheet. The paved, winding road that leads from Skaggs Springs to Stewarts Point passes through the rancheria, which in 1971 had a population of 35 (U.S. Dept. of Commerce, 1974, p. 152).

Geology

The ridge on which the Stewarts Point Rancheria lies is blanketed by flat-lying beds of the Ohlson Ranch Formation of Pliocene age (Figure 24). This formation here consist of fossiliferous, fine- to medium-grained marine sandstone, siltstone, and silty clay, with interbedded gravels and some conglomerate. At the Rancheria the formation is compact, weakly consolidated, and deeply weathered. Although elsewhere it reaches a thickness of over l,000 feet, at the Rancheria it is only 200 feet thick (Higgins, 1960). Cretaceous graywacke and shale of the "coastal belt" unit of the Franciscan Formation (Bailey and others, 1964) underlies the Ohlson Ranch strata and may be exposed in the forested lower parts of the steep slope on the north side of the Rancheria. The active San Andreas fault extends along the canyon of the Gualala River 1½ miles west of the Stewarts Point Rancheria.

Mineral Resources Potential

The mineral potential of the Stewarts Point Rancheria appears to be low. The Dillon and Seefeldt Manganese prospect (not shown on Figure 24) lies about 2 miles southwest of the rancheria at an elevation of approximately 900 feet. The deposit is reported to have produced 36 tons of ore in 1918 (Trask, 1950, p. 283). It apparently has not been worked since that time. No reference could be found to any other mineral occurrences in the area.

Dry Creek Rancheria

Location

The Dry Creek Rancheria occupies 75 acres in unsurveyed sec. 21, T. 10 N., R. 9 W., MDBM, in Sonoma County, approximately 11 miles by road north of Healdsburg and 3.5 miles east of Geyserville and U.S. Highway 101 (Figure 25). It lies at elevations from 280 to 720 feet in the rugged foothills north of Alexander Valley and the Russian River floodplain. Access is along the northeast edge of the valley via a dirt and gravel road from Highway 128, 0.3 mile to the south. In 1972, the rancheria had a population of 14 (U.S. Dept. of Commerce, 1974, p. 101).

Geology

The geology of the Dry Creek Rancheria consists of faulted rocks of the Franciscan Formation, and serpentine (Figure 26). The Franciscan here is made up of sheared graywacke and metagraywacke, shale, lenticular bodies of radiolarian chert, and altered mafic volcanic rocks termed greenstone. Much of the Franciscan here is a sheared breccia of melange which has been mapped as the Chianti fault zone (Gealey, 1951). Because of its sheared character, the rocks are very susceptible to landsliding, and parts of the upper slopes of the Rancheria have been mapped as landslide.

Mineral Resource Potential

The Dry Creek Rancheria lies at the extreme southwestern margin of the Western Mayacmas mercury mining district, which, between 1861 and 1944, produced about 36,000 flasks of mercury. Within the district, nearly vertical bodies of serpentine, intruded along northwest-trending shear zones, cut a thick sequence of Franciscan sedimentary and volcanic rocks. The borders of these serpentine intrusions have in places been silicified and carbonatized by hydrothermal alteration to silica-carbonate rock (Bailey, 1946, p. 201).

Most ore bodies in the district are in lenses of silica-carbonate rock where hydrothermal solutions ascended along deep fractures near major fault or shear zones and deposited cinnabar or native mercury. The ore minerals generally were deposited in small openings, forming stockworks, irregular veins, or pipes. All ore bodies are small and have been mined to a depth of less than 400 feet below the outcrop (Bailey, 1946, p. 201, 215).

Two small lenses of silica-carbonate rock, associated with Franciscan greenstone, in sec. 8, T. 10 N., R. 9 W., about 2.5 miles northwest of the rancheria, reportedly contain mercury (Figure 25) (Gealey, 1951, pl. 1). No records of development or production could be found.

The Old Chapman mercury mine lies in sec. 25, T. 10 N., R. 9 W., and sec. 30, T. 10 N., R. 8 W., about 3.5 miles southeast of the rancheria (Figure 25). Cinnabar is present in silica-carbonate rock and shattered Franciscan sandstone along the Maacama fault (Gealey, 1951, p. 47). The prospect has had no production and has been abandoned since the early 1900's (Honke and Ver Planck, 1950, 105).

Franciscan greenstone crops out in the southern part of the Dry Creek Rancheria, and serpentine intrudes Franciscan sandstone and shale across the central part (Gealey, 1951, pl. 1). However, silica-carbonate rocks and major shear zones, features that are associated with the mercury deposits elsewhere in the Mayacmas district, appear to be absent in the area. No mention could be found of any mercury minerals on the rancherias.

During the late 19th century, a gray, finely crystalline marble (metamorphosed Franciscan limestone) was quarried and burned for lime in sec. 14, T. 10 N., R. 9 W., about 2 miles northeast of the rancheria (Figure 25). Gealey (1951, p. 46) considers the deposit too small for present-day commercial development.

In 1935, the Mortara Oil Company drilled a dry hole in sec. 22, T. 10 N., R. 9 W, about three-quarters of a mile east of the rancheria (Figure 25). Oil was sought by drilling to a depth of 200 feet in Franciscan rocks (Gealey, 1951). They are mildly metamorphosed, highly fractured, and offer virtually no chance of yielding oil.

The Dry Creek Rancheria lies within the Geysers-Calistoga Known Geothermal Resource Area (K.G.R.A.) as shown on the map of NOAA (1977). Geothermal heat has been utilized to generate electricity at The Geysers, 7 miles northeast of the Rancheria, and hot water is utilized for health spas, greenhouses, and space heating at Calistoga less than 20 miles to the southeast. Test wells drilled in Alexander Valley near Geyserville, a mile or two west of the Rancheria, reached hot water, as at Calistoga, but failed to find dry steam, like that used at The Geysers. On the Rancheria wells drilled to considerable depth would doubtless encounter hot water, but probably not in sufficient quantity to be of commercial use.

Greenstone, or altered mafic volcanic rock, underlies the southern part of the Rancheria and is a potential source of crushed rock for use in road construction. However, this is a common rock in the Franciscan Formation in the Mayacmas Mountains, and its utilization would be in competition with many other sources.

Middletown Rancheria

Location

The Middletown Rancheria consists of 109 acres in the W½ sec. 10, T. 10 N., R. 7 W., MDBM, in Lake County, approximately 1 mile south of Middletown and 15 miles north of Calistoga (Figure 27). Its elevations are from 1,200 to 1,360 feet, and it lies on the southwest side of the Collayomi Valley. Most of the land occupies a relatively flat alluvial valley.

Access is via State Highway 29, which forms the eastern boundary of the rancheria and connects Middletown and Calistoga. Airline, train, and bus services are available in Ukiah, 90 miles to the west. In 1969 the rancheria had a population of 21 (U.S. Dept. of Commerce, 1974, p. 128).

Geology

Bedrock in the Rancheria is the Franciscan Formation which crops out in the western foothills but is blanketed by stream deposits in the eastern valley (Figure 28). The Franciscan Formation here is composed largely of mildly metamorphosed graywacke and shale with variable amounts of chert, greenstone, and schist (Gealey, 1951; McLaughlin, 1977). It is folded, broken, and intruded along northwesterly trending faults by serpentine. Within a few miles to the west and south, the Franciscan Formation is overlain by late Tertiary and Recent volcanic rocks ranging in composition from basalt to rhyolite, and geophysical evidence indicates it may be underlain at a depth of about 10 km by molten magma (Chapman, 1975, Isherwood, 1975). Valley fill, consisting of Recent stream deposits of silty clay, silt, sand, and gravel lenses, overlies the Franciscan bedrock in Collayomi Valley. Hot springs, which form the bases for spas, occur within a few miles to the northwest and southeast, but none are known on the Rancheria.

Mineral Resource Potential

The Middletown Rancheria is about a mile north of the middle of the Eastern Mayacmas mercury district, which has yielded nearly a half-million flasks of mercury since 1864 (Yates and Hilpert, 1946). Major mines within 3 miles of the Indian land and all in T. 10 N., R. 7 W., are the following:

(1) Great Western, sec. 16, 21, and 22, more than 100,000 flasks production.

(2) Mirabel mine, sec. 14, 22, and 23, more than 40,000 flasks production.

(3) Bullion mine, sec. 23, several thousand flasks production.

(4) Plymouth mine, sec. 24, small production.

All of the mercury ore bodies have been in silica-carbonate rock formed as an alteration of serpentine; however, elsewhere in the Mayacmas district equally productive deposits have been found in Franciscan graywacke (Yates and Hilpert, 1946). On the Rancheria, there is no silica-carbonate rock and only a little serpentine. Because of the ease with which surficial deposits of mercury can be detected by panning and the diligence of prospectors in the late 19th century, there is little likelihood that the Rancheria contains mercury ore reaching the surface. A remote possibility exists that mercury ore might be hidden below, but because the Rancheria is a little northeast of the ore-bearing belt it would not be practical to attempt blind underground exploration by drilling or other means.

Small amounts of chromite have been recovered from the serpentine masses near the Rancheria. According to Dow and Thayer (1946) the more prominent mines in T. 10 N., R. 7 W. are:

(1) Black Bart, sec. 16, few hundred tons of chromite shipped.

(2) Holmstedt, sec. 22, few tons shipped in World War I.

(3) Sutro, sec. 26, few tons were mined.

Although minor amounts of chromite might be found in the serpentine on the Rancheria, it should not be actively sought because most Coast Range chromite deposits have been only marginally economic even during periods of high prices when foreign sources were unavailable, as during World Wars I and II.

Manganese has been reported in several prospects about 3 to 3.5 miles west and southwest of Middletown. The manganese occurs as veins or lenses in Franciscan chert and greenstone. The Smythe manganese deposit in sec. 6, T. 10 N., R. 7 W. and the Downy Estate prospect in the NW¼ sec. 8, T. 10 N., R. 7 W. (Figure 27), apparently never have been developed (Hamilton, 1921, p. 79; Trask, 1950, p. 90, 97).

The Von Glahn manganese prospects are in the SW¼ sec. 5, T. 10 N., R. 7 W., 3.5 miles west of Middletown (Figure 27). In 1935, about 20 tons of ore, assaying 18 to 47 percent manganese, reportedly were shipped. The ore was high in silica (Trask, 1950, p. 98-99).

The Middletown Rancheria has real but untested potential for geothermal resources. It lies within the Geysers-Calistoga Known Geothermal Resource Area (K.G.R.A.), as shown on the map of NOAA (1977), less than 5 miles southeast of the easternmost successful wells drilled for geothermal steam, and essentially along the trend of the productive belt. This belt, which is now known to extend for nearly 10 miles, includes The Geysers, where dry steam is currently being used to generate more than 500,000 kw of electrical power. The older wells lie near the northwestern end of the belt and active drilling is extending the known area to the southeast. Present indications are that the reservoirs of usable dry steam die out about 2 miles northwest of the Rancheria (Goff and others, 1977), but not enough drilling has been done to be certain they do not extend closer to the Rancheria. The nearest well is believed to be one drilled near the Great Western mercury mine in 1976 by Shell Oil Co. and reported to be unsuccessful. The Rancheria lands have potential for geothermal leases, though present indications are that deep drilling would yield hot water but not the more desirable dry steam.

GREAT VALLEY PROVINCE

The Great Valley of California is a low-lying alluvial plain 450 miles long and 50 miles wide, extending from the Tehachapi Mountains on the south to the Klamath Mountains on the north, and from the Sierra Nevada on the east to the Coast Ranges on the west (Figure 29). The Valley is divided midway by the subsurface Stockton Arch into two smaller valleys, the Sacramento Valley to the north and the San Joaquin Valley to the south. The Indian lands considered in this report are all in the Sacramento Valley part of the province, which is dealt with in the following paragraphs.

Geologically, the Great Valley province is an elongate, northwest-trending asymmetrical trough or syncline with gentle dips toward the center on the eastern side and steep to vertical dips along the western edge. Periodically, beginning in late Jurassic time, the trough subsided as material eroded from the rising Sierra Nevada filled westward against the eastern flank of an island arc or the rising Coast Ranges (Bailey and others, 1964; Repenning, 1966). Within the trough now is a sequence of sedimentary rocks tens of thousands of feet thick and ranging in age from Jurassic to Recent. Along the eastern and northern sides of the Great Valley, these sedimentary rocks lie on the kinds of deformed pre-Nevadan metamorphic and igneous rocks that are exposed in the Sierra Mevada foothills (Hackel, 1966). On the western side of the valley, the sedimentary rocks were deposited on oceanic crust, or ophiolite, now exposed beneath the upturned strata all along the boundary between the Sacramento Valley and the

Coast Range province (Bailey and others, 1970). The sediments that fill the valley are dominantly fine to medium grained clastics of marine origin mantled by a thin veneer of continental strata deposited in late Tertiary and Recent time. In the central part of the Sacramento Valley the Marysville or Sutter Buttes rise some 2,000 feet above the level plain forming the only prominent topographic eminence in the entire Great Valley. The Buttes are the eroded remnant of a former large andesitic volcano much like Mt. Shasta, and by many they are considered to be an isolated outlier of the Cascade province (Williams, 1929; Garrison, 1962).

Economic Mineral Deposits of the Great Valley

The Great Valley has yielded at least 15 mineral commodities, but by far the most valuable has been oil and gas found in various locations throughout its entire extent. Current figures are not readily available, but in 1964 the mineral wealth from the valley had a value of almost $490,000,000 or 31 percent of the total mineral production of California (Hart, 1966). Over 90 percent of this revenue was from the production of fuels--petroleum, natural gas, and natural gas liquids. Nearly all of the petroleum and "wet" natural gas came from reservoirs under the San Joaquin Valley, and dry natural gas is mainly from reservoirs under the Sacramento and the northern San Joaquin Valleys. In the San Joaquin Valley, the petroleum is recovered chiefly from rocks of Miocene and younger age, but some comes from sediments as old as Cretaceous. In contrast, in the Sacramento Valley, most of the gas is from Late Cretaceous or Eocene strata with only minor production from the younger rocks.

The second largest mineral commodity of the Great Valley is sand and gravel, which provides 9 percent of the province's total mineral revenue. Almost 28 million tons, or 25 percent of the sand and gravel produced in California in 1964, came from the Great Valley (Hart, 1966). These deposits were mostly used in construction of portland cement concrete, macadam, or bituminous bound aggregate highways (Gay, 1957).

The remaining rather inconsequential 1 percent of the total mineral revenue in the Great Valley was derived from deposits of gold, gypsum, clay, peat, coal, pumicite, carbon dioxide, stone, silver, platinum, and gemstones (Hart, 1966).

Grindstone Creek Rancheria

Location

The Grindstone Creek Rancheria consists of 80 acres in the S½SE¼ sec. 15, T. 21 N., R. 6 W., MDBM, in Glenn County, approximately 5 miles north of the town of Elk Creek and 26 miles northwest of Willows (Figure 30). It is at an elevation of 600 feet on the flat alluvial bottomland along Stony Creek, at the extreme western margin of the Great Valley Province. Stony Creek joins Grindstone Creek one-quarter mile to the west, and then flows east through the rancheria. It is correctly shown on the Chrome 7.5-minute quadrangle, the

Elk Creek 15-minute quadrangle, and the Ukiah 2º sheet.

Access is by a paved county road which runs one-quarter of a mile west of the rancheria and connects with State Highway 261 just north of Elk Creek. A dirt and gravel road leaves the county highway about 1 mile northwest of the confluence of Grindstone and Stony Creeks, and passes through the northern part of the rancheria.

The nearest commercial airlines are in Red Bluff, 50 miles north. Train and bus services are available in Willows. In 1971, the rancheria had a population of 13 (U.S. Dept. of Commerce, 1974, p. 110).

Geology

The bedrock for the Grindstone Creek Rancheria is marine shale, siltstone, thin sandstone, and dense limestone of Lower Cretaceous age comprising a part of the Great Valley sequence (Bailey and others, 1964). A thin veneer of Recent river deposit of gravel, sand, silt, and clay overlies the Cretaceous strata in the confines of the tract (Figure 30). No mining activity on or near the Rancheria has been reported (O'Brien and Braun, 1952).

Mineral Resource Potential

No mineral occurrences are reported near the Grindstone Creek Rancheria. The alluvial deposits along Stony Creek are a potential source of sand and gravel. This commodity, however, is abundant throughout the area.

Cachil Dehe (Colusa) Rancheria

Location

The Cachil Dehe Rancheria consists of two parcels of land (referred to as areas A and B) totaling 269 acres in Colusa County, approximately 12 miles east of Williams and 60 miles northwest of Sacramento. The rancheria lies on a flat alluvial plain west of the Sacramento River at an elevation of 60 feet. Because of their proximity to the river, parts of the Rancheria are subject to inundation during periods of high water. Much of the land is leased to non-Indians, and is used primarily for irrigated farms and orchards.

Area A includes parts of sec. 7, T. 16 N., R. 1 W., and sec. 12, T. 16 N., R. 2 W., MDBM, 3 miles north of Colusa between State Highway 45 and the Sacramento River (Figure 31). A branch line of the Southern Pacific railroad passes through the center of the area. Originally, this parcel of the Rancheria had an area of 40 acres. Due to point bar accretion along the Rancheria's eastern boundary, the total area has increased to 58 acres.

Area B is comprised of part of sec. 30, T. 17 N., R. 1 W., MDBM, about 6 miles north of Colusa and three-fourths of a mile east of Highway 45 (Figure 31). The Southern Pacific railroad passes one-half mile to the west. The Sacramento River forms the northern and eastern boundaries of the area.

Both areas are correctly delineated on the Moulton Weir and Colusa 7.5-minute quadrangles and the Maxwell and Colusa 15-minute quadrangles but are not delineated on the Ukiah 2º sheet.

Access to the Rancheria is good. State Highways 45 and 20 connect with Interstate 5, the major north-south route through Central California, at Williams. The nearest commercial airlines are in Sacramento. Train service is available in Williams. Commercial and local bus services are available in Colusa. In 1971 the rancheria had a population of 12 (U.S. Dept. of Commerce, 1974, p. 98).

Geology

The Cachil Dehe (Colusa) Rancheria and the surrounding area is covered by river deposits of the Sacramento River. These channel, floodplain, natural levee, and point bar deposits are composed of gravel, sand, silt, and clay. The northernmost parcel of the Rancheria (Area B) has extensive point bar deposits along its eastern boundary adjacent to the Sacramento River, and since the original purchase 18 acres of land have been added due to point bar accretion. Such point bar deposits are composed of gravel to clay size particles in a sequence that generally fines upwards (Reineck and Singh, 1975).

Below these river deposits, a series of sedimentary beds, ranging in age from upper Mesozoic to Pliocene, dip to the east and drape over the Sierran Basement. Many of these beds contain exploitable natural gas and oil fields throughout the Sacramento Valley. Three field are located near the Rancheria; the Butte Slough gas area in sec. 35, T. 16 N., R. 1 W., the Compton Landing gas field in sec. 12, T. 17 N., R. 2 W., and the Moon Bend gas area in sec. 3, T. 15 N., R. 1 W. (Bowen, 1962). The gas producing horizons are a part of the Kione and the Tehama Formations.

A series of sandstone beds have been mined near sites at the Colusa Sandstone Company Quarry in S½SE¼, sec. 20, and SW¼SW¼, sec. 21, T. 17 N., R. 4 W. and at the McGilvray Quarry in sec. 28, 29, T. 17 N., R. 4 W. Both quarries are presently idle (Logan, 1929).

Mineral Resource Potential

Sand and Gravel.--The alluvial terraces, abandoned flood plains, and channel deposits of the Sacramento River on and near the rancheria are potential sources of sand and gravel. This commodity, however, appears to be abundant in the Colusa area. Therefore, it is unlikely that prime agricultural land will be utilized for new gravel pits. During the 1940's a gravel quarry was operated on the Indian rancheria between Colusa and Princeton. The gravel was loaded on 5-cubic yard dump trucks and delivered to the Colusa area (O'Brien, 1948, p. 336). Neither the exact location of this operation nor any additional information about it could be found.

Natural Gas.--The Rancheria may have potential for natural gas. The Compton Landing gas field occupies an area about 3 miles long and 2 miles wide east of the Sacramento River, just north of Rancheria area B. Other present, or past producing gas fields that lie within 10 miles of the rancheria are the Princeton, Colusa, Moon Bend, Marysville Buttes, Butte Slough, and Wild Goose gas fields (Bowen, 1962, p. 24). None of these are shown on the accompanying map (Figure 31). A number of exploratory wells have been drilled west of area B (Figure 31). Most of these have not been completed and are abandoned (Munger, 1977, maps W-10, W-11).

The Compton Landing gas field was discovered in July 1955 according to Bruce (1958, p. 59-61).

Commercial gas deliveries did not begin until September 1957. As of December 31, 1976, the cumulative gas production was 8,134,474 Mcf, and the estimated reserves were 960,000 Mcf. Production at the end of 1976 was from one well, and there were two standby wells. The part of the field known as the South Compton Landing gas field had no production, one shut-in well, and estimated gas reserves of 650,000 Mcf (Calif. Div. of Oil and Gas, 1976, p. 69).

The Compton Landing gas field occupies a northwest-southeast trending anticline which is truncated on the north end and west flank by a narrow Eocene "gorge".

Gas accumulated in several east-dipping beds of Cretaceous marine sands which have been truncated by the "gorge" (Figure 32). Gas migration was controlled by a combination of structure, lensing of the sands, and truncation of the sands by the "gorge". Post-Pliocene faulting of both the "gorge" and the anticline apparently did not affect gas accumulation (Bruce, 1958, p. 60-61).

Gas production in the Compton Landing field is from three main zones: The Upper Carter, the Lower Carter, and the Tuttle Zone. The Lower Carter Zone is subdivided into the Carter A, Carter B, and Main Carter (Figure 32). The general stratigraphy is shown in Figure 32 modified from Bowen (1962, p. 252).

Rancheria Area B is west of the fault on the downthrown block of the truncated anticline that forms a structural trap for gas accumulation in the Compton Landing gas field (Figure 32). Thus it is possible that those horizons east of the fault which produce gas may be present at depth west of the fault.

Cortina Rancheria

Location

The Cortina rancheria consists of 480 acres in sec. 34, T. 14 N., R. 4 W., MDBM, in Colusa County, approximately 15 miles southwest of Williams and 14 miles north of Rumsey (Figure 33). It lies at an elevation of about 1,200 feet on the western margin of the Great Valley Province. The topography is moderately rugged and is characterized by dissected, north-south trending ridges formed by eastward-dipping Upper Cretaceous sandstone beds (Rich, 1971, map). The trellis-like drainage pattern of the streams reflects the differences in resistance to erosion of the underlying north-striking sedimentary units. The land appears to be utilized primarily for grazing and orchards.

State Highway 20, from Williams to Ukiah, passes 3 miles west of the rancheria, where it is joined by State Highway 16, which leads to Rumsey and Woodland. According to the U.S. Department of Commerce (1974, p. 99), no road leads directly to the Rancheria. The Wilbur Springs 15 minute quadrangle maps shows a jeep trail connecting the Spring Creek road in the north with the Cortina Creek road from the east. However, a more recent (1975) map of the Rancheria, provided by the Central California Indian Agency in Sacramento, indicates that this jeep trail is now a county road.

Train and bus services are available in Williams. The nearest commercial airlines are in Yuba City, 50 miles to the east (U.S. Department of Commerce, 1974, p. 99).

Geology

The rocks underlying the Cortina Rancheria and surrounding area belong to two major groups: the Upper Cretaceous part of the Great Valley sequence and the overlapping Pliocene Tehama Formation. The Great Valley sequence rocks are units of sandstone and shale that comprise the upturned, east-dipping western limb of the valley syncline. Because of differential erosion they now form a series of prominent north-trending ridges and valleys. The alternating units of dominantly sandstone and dominantly shale have been given different formational names by different geologists who have studied them. They were called the Venado, Yolo, Sites, and Funks Formation by Kirby (1943) and Lawton (1956) used Fiske and Brophy Canyon Formations for the older units. Rich (1971), whose map we have used as the basis for Figure 33, rejected most of these terms and showed only unnamed units of sandstone, mudstone, and shale. The aggregate thickness of these Cretaceous rocks is more than 10,000 feet, and they are underlain by an equal thickness of similar marine sediments of Late Jurassic and Early Cretaceous age.

The eastern third of the Rancheria is covered by consolidated blue-green claystone and lenses of poorly indurated conglomerate, sandstone, and siltstone of the Tehama Formation (Lachenbruch, 1962). These are Pliocene floodplain deposits laid down on a low-lying land surface and many of the sands and gravels are strongly crossbedded (Wilmarth, 1938). Near the base of the Tehama Formation, a massive coarse-grained pumice tuff unit, referred to as the Nomlaki tuff, is locally present.

Mineral Resource Potential

The Tehama Formation may be a potential source of sand and gravel, and if the Nomlaki tuff member is present near its base it may provide a source for pumice or pumicite. The older sandstones of the Great Valley sequence could be a source of building stone, as years ago similar rock was quarried from exposures a few miles to the north. It is believed, however, that none of these resources can be economically utilized because of the difficult access to the Rancheria and their abundance in areas that are both more accessible and less remote from potential markets.

Numerous oil seeps have been found near Wilbur Springs along Bear Creek. Gas has also been reported in wells drilled near Mountain House and on Salt Creek, which are about 8 miles north of the rancheria (Logan, 1929, p. 293-294). Numerous exploratory wells have been drilled, but no production has resulted.

The potential of the area for petroleum or gas cannot be properly assessed, but the dipping homoclinal structure is not favorable for retention of hydrocarbons unless downslip stratigraphic traps exist.

Approximately 7 miles west of the Rancheria in the Wilbur Springs district deposits of mercury and gold have been mined, and hot springs have provided the basis for a once-successful resort (Moisseeff, 1966; 1968). The mineralization and the thermal activity may be related to the proximity of the Coast Range thrust or the nearby Clear Lake volcanic field. Similar conditions do not exist at the Cortina Rancheria, and the nearby occurrences of mineral deposits and hot springs do not suggest mineral potential on the Rancheria.

Rumsey Rancheria

Location

The Rumsey Rancheria consists of 66 acres in unsurveyed secs. 35 and 36, T. 10 N., R. 3 W., MDBM, in Yolo County, approximately 26 miles northwest of Woodland, 44 miles northwest of Sacramento, and one-half mile southeast of Tancred (Figure 34). It lies at an elevation of 300 feet on flat bottomland in the Capay Valley. The rancheria is bounded on the east by Cache Creek and on the west by State Highway 16, which passes northwest through the Capay Valley from Woodland.

Commercial airline, train, and bus services are available in Woodland. In 1969 the rancheria had a population of three (U.S. Dept. of Commerce, 1974, p. 142). Its outline is shown on the Guinda 7½ minute quadrangle and the Guinda 15-minute quadrangle but is not on the Santa Rosa 2º sheet.

Geology

The Rumsey Rancheria is situated on a floodplain floored by alluvial materials deposited by Cache Creek (Figure 34). These unconsolidated deposits have been used in the area as a source of sand, gravel, and coarser material, and large amounts remain for future mining. They have been extensively studied and subjected to laboratory tests by Klein and Goldman (1958). Although the creek deposits are the only rocks exposed in the Rancheria, their composition and resulting suitability for aggregate use is dependent on the properties of the surrounding geologic units from which they were derived. Hence, the older formations about the Rancheria will also be briefly described.

The old rocks comprising the Vaca Mountains to the west and the Rumsey Hills to the east of Capay Valley are a part of the enormously thick Great Valley sequence of marine sediments (Bailey and others, 1964). In most places along the west side of the Sacramento Valley they dip steeply eastward forming the west limb of the Great Valley syncline. They consist of shale and mudstone, indurated graywacke, and sandstone, with local beds of conglomerate. On erosion the softer sands and shales become desegregated, some of the harder graywacke beds form flattened pebbles, and the pebbles of hard crystalline igneous and metamorphic rocks from the conglomerates are merely freed from their matrix and redeposited in the recent stream channels and floodplains. The rocks of the Great Valley sequence nearest the Rancheria are sandstone and shale of the Eocene Capay Formation, the underlying sandstone of the Guinda Formation, and the shales and mudstones of the Late Cretaceous Funks Formation (Kirby, 1943a, b). They are not significant as a source of gravels as they are too soft and too fine grained, so the major part of the pebbles derived from the rocks of the Great Valley sequence comes from the Early Cretaceous and Late Jurassic rocks exposed at some distance north and west of Capay Valley.

Directly beneath the recent gravels and exposed along the edges of Capay Valley are Plio-Pleistocene river deposits comprising the Tehama Formation. Under the Rancheria they are only a few hundred feet thick, but where they extend eastward beneath the Sacramento Valley they attain a thickness of several thousand feet. They are widely exposed in the Rumsey Hills east of the Rancheria and along the upper drainage area of Cache Creek east of Clear Lake. They are mostly composed of weakly cemented conglomerate, and in outcrop the pebbles generally show some effects of weathering. When reworked by the waters of Cache Creek, however, the weathered material is eliminated leaving only the more resistant and durable pebbles to form a major part of the recent river gravels.

Mineral Resource Potential

The channel and flood plain deposits of Cache Creek are potential sources of sand and gravel. Klein and Goldman (1958, p. 239) estimate that 3,000,000 cubic yards of sand and gravel near Rumsey, and 5,000,000 cubic yards near Brooks, are suitable for concrete aggregate. The general availability of abundant quantities of this commodity throughout the Capay Valley could preclude development of deposits near the rancheria.

The gravel in the Rumsey-Brooks area is composed of about 60 percent metamorphosed and unmetamorphosed graywacke-type sandstone, 15 percent greenstone, 10 to 18 percent chert, and about 10 percent quartz veinlets. Other constituents that together comprise not greater than 5 percent of the gravel are serpentine, limestone, granitic rocks, metavolcanic porphyries, and amphibolites. Weathered sandstones, soft serpentine, and badly fractured quartz veinlets are the principal physically unsound rock types which would be undesirable for concrete aggregate (Klein and Goldman, 1958, p. 265).

The sand in the deposits is highly lithic and consists of rock particles of the same types mentioned above. The fine sand fraction is composed predominantly of grains of quartz and feldspar, largely derived from Mesozoic marine sandstones. Less than 5 percent of the sand is composed of physically unsound grains, of which deeply weathered, soft sandstone is the most prominent (Klein and Goldman, 1958, p. 265). Tests conducted by the U.S. Bureau of Reclamation on the undeveloped sand and gravel deposits along Cache Creek show that they meet the low and medium-strength and abrasion-resistance requirements for concrete used in a moderate climate (Klein and Goldman, 1958, p. 265, 269).

The Rumsey Hills area, east of Rumsey, and 5 to 10 miles north of the rancheria, has been explored for oil and gas. The Rumsey Hills anticline trends northwest along the western foothills, east of Capay Valley. The discovery of natural gas in the area springs stimulated interest in commercial petroleum possibilities. Since 1900 a number of exploratory wells have been drilled, but no commercial quantities of oil or gas have been discovered (O'Brien, 1950, p. 431-432).

ENVIRONMENTAL AND SOCIAL ASPECTS

This preliminary evaluation indicates little potential for large open-pit mines in the Hoopa Valley, Hoopa Extension, and Round Valley Reservations. With proper mine planning and reclamation, the surface disturbances resulting from small underground operations could be held to a minimum. The rather remote locations of most reported mineral occurrences might require construction of access roads, which probably would disturb more land than mining itself. Residences, cultivated land, and main roads are primarily in the major river valleys, and would not be adversely affected by mining. An exception would be the development of large-scale sand and gravel quarries and placer-gold mining operations. These necessarily would be along the major river valleys and tributary streams, especially those of the Klamath and Trinity Rivers. These operations would quite likely be visible from the main roads, and, in some cases, would be near agricultural or residential lands.

Commercial mining operations on or near the Hoopa Valley, Hoopa Extension, and Round Valley Reservation would afford employment for tribal members. Goods and services required by the mines would also provide income for the tribe.

On the smaller reservations and rancherias, especially those comprising less than 100 acres, mining could heavily impact land that is now used for homesites, pastures, and agriculture. No matter how carefully mining or quarrying is planned and executed, a certain amount of land will be disrupted. Noise and dirt from mining or quarrying will generally render the immediate vicinity unsuitable for homes and, perhaps, for agriculture.

However, portions of several Indian Lands are not currently being used for homesites, pastures, or agricultural purposes, and may be suitable for small mining operations. Carefully planned sand and gravel, crushed rock, or building stone quarries could provide the tribe with material for its own use, as well as an income from sales to non-tribal members.

RECOMMENDATIONS FOR FURTHER WORK

Hoopa Valley and Hoopa Extension Reservations

The Hoopa Valley and Hoopa Extension Reservations have potential for copper, zinc, lead, chromite, mercury, manganese, platinum, and silver, as well as for placer gold, and sand and gravel. Much of the available mineral resource information for the area is out-of-date and, in some cases, incorrect. Field examinations of many prospects and deposits have not been made for more than 50 years.

Specific recommendations regarding a field study of the Hoopa Valley and Hoopa Extension Reservations are as follows:

(1) Stream sediment geochemical sampling, including panned concentrates, of the tributaries of the Klamath and Trinity Rivers on the reservations.

(2) Possible extensions of the mineralized zones at the Copper Bluff mine could be investigated by soil geochemical sampling and appropriate geophysical methods.

(3) Soil geochemical sampling and detailed geologic mapping and sampling of all known and reported mineral occurrences.

(4) Geologic mapping and detailed examination of reservation areas underlain by ultramafic intrusive rocks. Special attention would be given to contact and alteration zones.

(5) Trenching and test pitting of stream gravels having placer gold potential.

(6) Examination of mineralized zones and prospects adjacent to the Hoopa Valley and Hoopa Extension Reservations for possible projections on to Indian land.

Round Valley Reservation

The Round Valley Indian Reservation has some potential for manganese and perhaps, for nephrite jade and chromite. Several nearby manganese prospects could be examined for possible extensions onto tribal land. Contacts and alteration zones associated with ultramafic intrusions might be mineralized and could be mapped. A stream sediment geochemical sampling program would probably be the best initial approach to any field study. The results would provide a base for additional work.

Other Reservations and Rancherias

None of the other reservations and rancherias discussed in this report appears to warrant additional study at this time.

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APPENDIX

Figure 35a, Figure 35b, Figure 35c, and Figure 35d.--Index to U.S. Geological Survey topographic maps for areas described in the text.

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Table 3.-- Stratigraphic column of subjacent formations of the eastern Klamath Mountains, California.

Age	Formation	Thickness in feet	General features	References
Jurassic	Potem Formation	1,000	Argillite and tuffaceous sandstones, with minor beds of conglomerate, pyroclastics, and limestone. Lower beds are probably Early Jurassic. Upper beds are Middle Jurassic (Bajocian). Upper limit not exposed. Overlain by post-Jurassic rocks with great unconformity.	Diller (1906) Sanborn (1960)
	Bagley Andesite	700	Andesitic flows and pyroclastics. Overlies and interfingers with lower part of Potem Formation according to Sanborn.	Diller (1906) Sanborn (1953, 1960)
	Arvison Formation of Sanborn (1953)	5,090	Interbedded volcanic breccia, conglomerate, tuff, and minor andesitic lava flows. Fossil fragments in many tuff and sandstone beds. Ammonites indicate Early Jurassic (Sinemurian) age. Probably gradational contact with Potem Formation.	Sanborn (1960)
Triassic	Modin Formation	5,500	Basal member of volcanic conglomerate, breccia, tuff, and porphyry, with limestone fragments from the Hosselkus. Middle member is massive fossiliferous limestones and calcareous sandstones. Upper member is dark thin-bedded argillite with interbedded andesitic pyroclastic rocks. Formation considered Jurassic by Diller. Probably unconformable beneath Arvison Formation.	Diller (1906) Sanborn (1960)
	Brock Shale	400	Dark massive argillite interlayered with tuff or tuffaceous sandstone. Locally fossiliferous. Thought to be Late Triassic (Norian) in age. Probably unconformable with overlying Modin Formation.	Diller (1906) Sanborn (1960)
	Hosselkus Limestone	0–250	Thin-bedded to massive light-gray limestone. Fossils indicate Late Triassic (Karnian) age. Conformable with underlying Pit Formation and overlying Brock Shale. May be lenticular bodies.	Sanborn (1960) Albers and Robertson (1961)
	Pit Formation	2,000–4,400	Predominantly dark shale and siltstone, with abundant lenses of metadacite and quartz-keratophyre tuffs. Includes lenses of limestone and lava flows. Fossils in limestones, including brachiopods, ammonites, and belemnites, indicate Middle and Late Triassic age. Generally overlies, but partly intertongues with, Bully Hill Rhyolite.	Albers and Robertson (1961)
	Bully Hill Rhyolite	100–2,500	Lava flows and pyroclastic rocks, with subordinate hypabyssal intrusive bodies. Contacts gradational; interbedded with and intrusive into Dekkas Andesite below, and interbedded with Pit Formation above.	Albers and Robertson (1961)
Permian	Dekkas Andesite	1,000–3,500	Chiefly fragmental lava and pyroclastic rocks, but includes mudstone and tuffaceous sandstone. Interfingers with underlying Nosoni Formation. Fossils in tuffaceous beds indicate Permian (Capitan) age, but formation probably ranges into Triassic.	Albers and Robertson (1961)
	Nosoni Formation	0–2,000	Mudstone and fine-grained tuff, with minor coarse mafic pyroclastic rocks and lava. Fusulinids, brachiopods, and bryozoans are common. Formation separated from McCloud Limestone, locally by mafic intrusion and elsewhere by disconformity.	Albers and Robertson (1961)
	McCloud Limestone	0–2,500	Thin-bedded to massive light-gray limestone, with local beds and nodules of chert. Abundant corals and fusulinids indicate Wolfcamp and probable Leonard (Early Permian) age. Relations to adjacent younger and older formations not clear, owing to mafic intrusions along much of the contacts.	Albers and Robertson (1961)
Pennsylvanian	Baird Formation	3,000–5,000	Pyroclastic rocks, mudstone, and keratophyre flows in lower part; siliceous mudstone, with minor limestone, chert, and tuff in middle part; and greenstone, quartz keratophyre, and mafic pyroclastic rocks and flow breccia in upper part. Abundant shallow-water marine fossils from middle part indicate Visean age. Uppermost part contains Early Pennsylvanian fusulinids.	Albers and Robertson (1961) Skinner and Wilde (1965)
Mississippian	Bragdon Formation	6,000±	Interbedded shale and sandstone, with grit and chert-pebble conglomerate abundant in upper part. Minor pyroclastic rocks and radiolarian chert. Fossils sparse. Essentially conformable with overlying Baird Formation. Rests variably on Kennett Formation, Balaklala Rhyolite, or Copley Greenstone.	Diller (1906) Kinkel, Hall, Albers (1956) Albers and Robertson (1961) Albers (1964) Irwin (1963)
Devonian	Kennett Formation	0–400	Dark, thin-bedded, siliceous mudstone and tuff. Limestone in upper part. Fossils from mudstone and limestone include corals and brachiopods of late Middle Devonian age. In places is structurally conformable with overlying Bragdon Formation. Rests in Balaklala Rhyolite in some places, and on Copley Greenstone in others. Thin or absent in westernmost part of belt.	Kinkel, Hall, Albers (1956) Albers and Robertson (1961) Albers (1964)
	Balaklala Rhyolite	0–3,500	Light-colored quartz-keratophyre flows and pyroclastics. Conformable with, and grades upward into Kennett Formation. Greatly variable thickness. Thin or absent in westernmost part of the belt. Nonfossiliferous. Presumably Middle Devonian.	Kinkel, Hall, Albers (1956) Albers and Robertson (1961) Albers (1964)
Devonian(?)	Copley Greenstone	3,700+	Keratophyric and spilitic pillow lavas and pyroclastic rocks. Intertongues with overlying Balaklala Rhyolite. Overlain in some places by Kennett Formation, and in others by Bragdon Formation. Nonfossiliferous. Probably Middle Devonian. Base not exposed.	Kinkel, Hall, Albers (1956) Albers and Robertson (1961) Albers (1964)
Silurian	Gazelle Formation	2,400+	Siliceous graywackes, mudstone, chert-pebble conglomerate, tuff, and limestone. Limestone contains corals, brachiopods, and trilobites indicative of Middle and Late(?) Silurian age. Graptolites in shale indicate latest Early or Middle Silurian. Devonian rocks in Grouse Creek area, formerly included in Gazelle (Merriam, 1961) should be excluded (Merriam, oral communication, 1965). Fault contacts with Duzel Formation.	Wells, Walker, Merriam (1959) Churkin and Langenheim (1960) Churkin (1961, 1965) Merriam (1961)
Ordovician(?)	Duzel Formation	1,250+	Thinly layered phyllitic graywacke, locally with radiolarian chert and limestone. Limestone has large coral and brachiopod fauna. Top and bottom of formation not known. Locally small overturned folds. Formation involved in northward-plunging synclinorium, and locally thrust over Gazelle Formation.	Wells, Walker, Merriam (1959)

CASCADE RANGE PROVINCE

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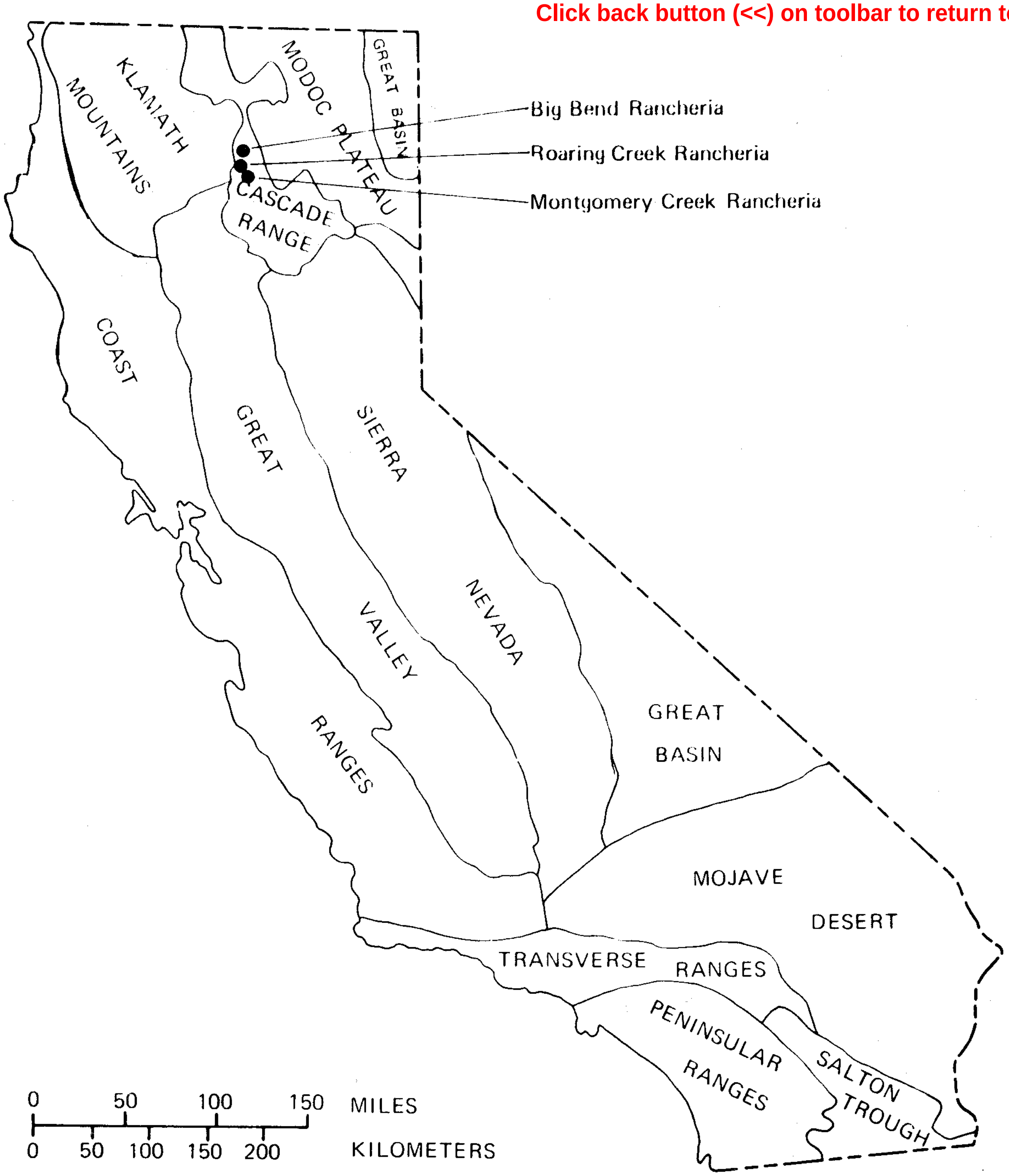

Figure 1. Index map of Indian lands in the Cascade Range Province, California.

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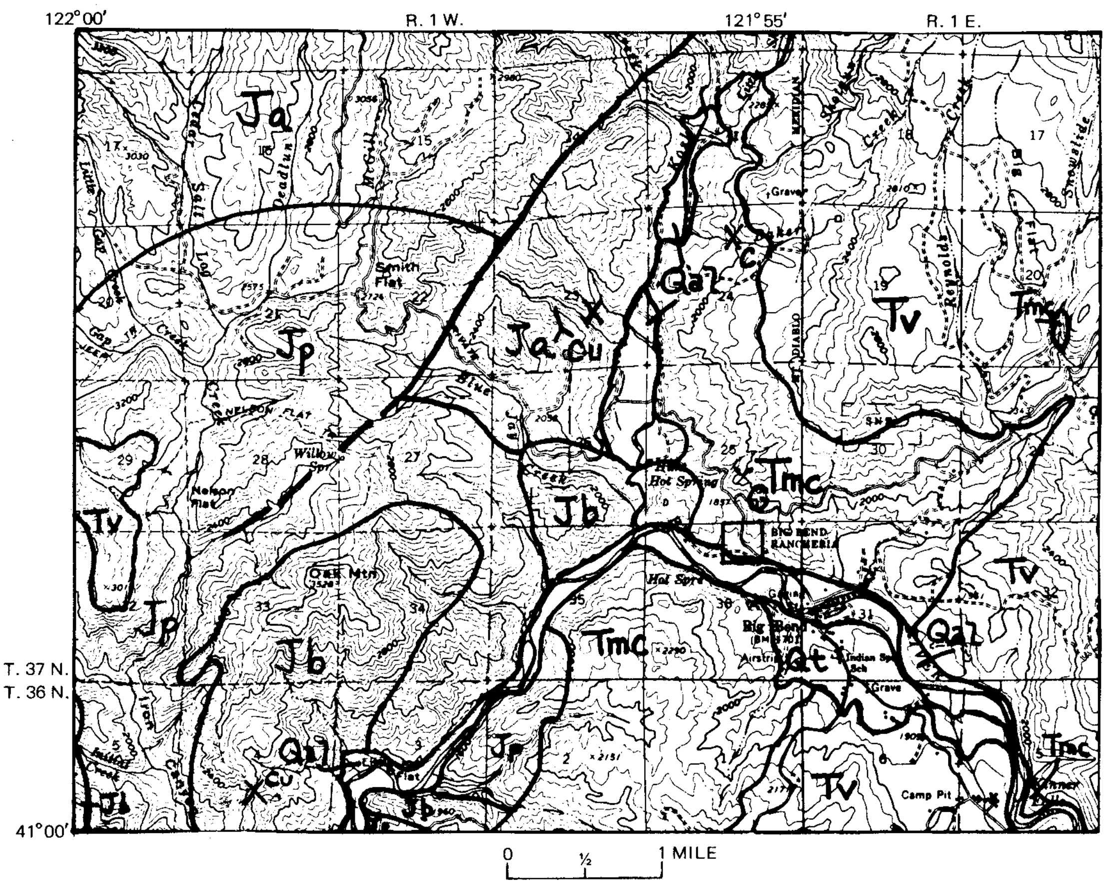

EXPLANATION

Recent	Qal	Alluvium; gravel, sand, and clay
	Qt	Terrace deposit of sand and gravel
Pliocene	Tv	Volcanic rocks; chiefly andesite
Eocene	Tmc	Montgomery Creek Formation; nonmarine conglomerate, arkosic sandstone, and shale
Jurassic	Jp	Potem Formation; thin-bedded sandstone and slaty shale
	Jb	Bagley Andesite; chiefly andesitic tuff
	Ja	Arvison Formation; pyroclastic rocks and minor andesitic flows

——— Fault

Cu	Copper	X	Prospect
C	Coal	≻—	Adit
G	Sand and gravel	✗	Quarry or gravel pit

Figure 2. Geology and mineral occurrences of the Big Bend Rancheria area, California.

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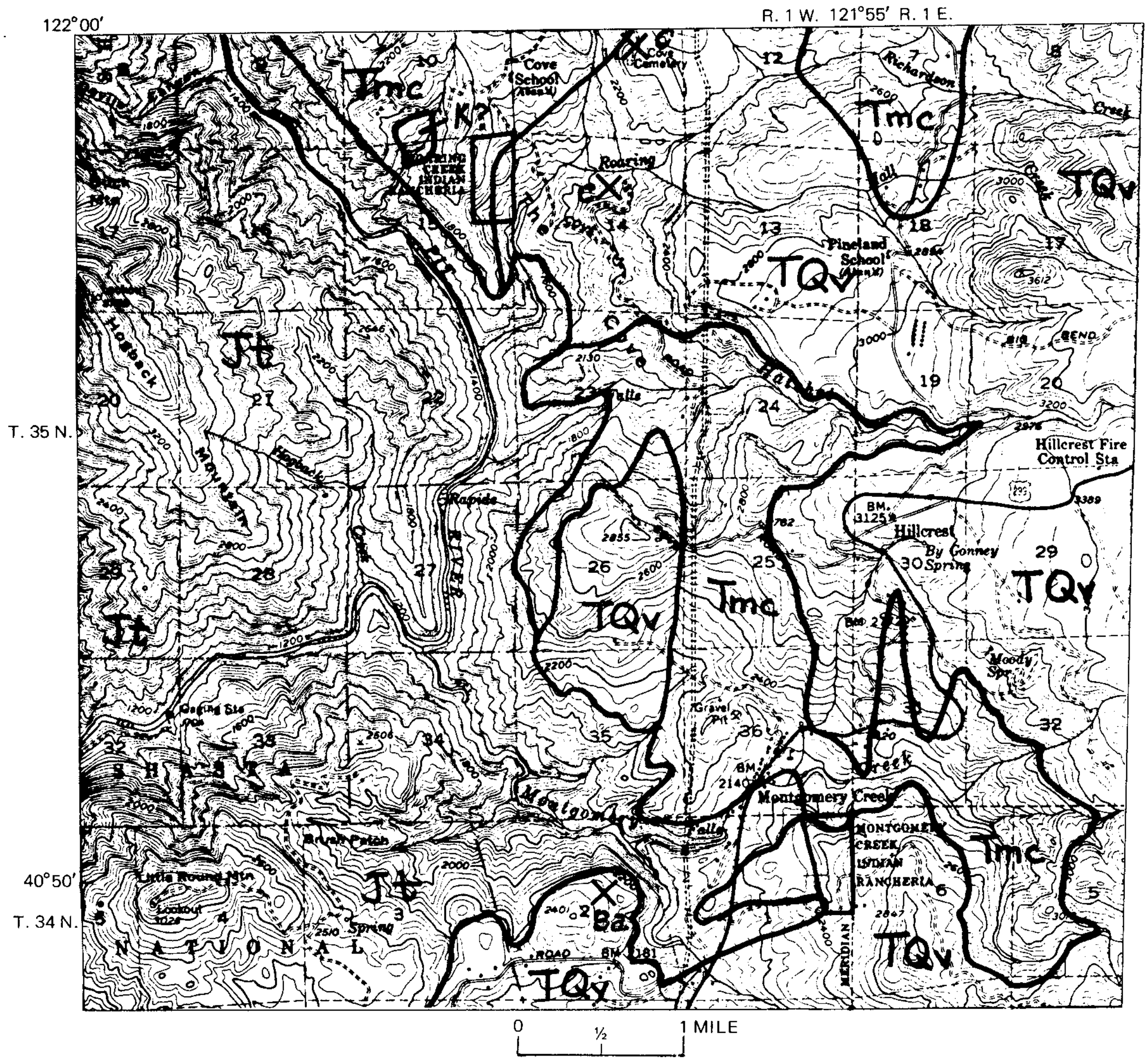

EXPLANATION

Age	Unit	Description
Holocene	TQv	Tuscan Formation; composed of brecciated volcanic mudflows
Eocene	Tmc	Montgomery Creek Formation; composed of friable arkosic sandstone, conglomerate, and shale with minor interbeds of impure lignite
Cretaceous	K?	Chico Formation; marine sedimentary rocks
Jurassic-Triassic	Jt	Metamorphosed volcnaic and sedimentary rocks
	Ba	Barium
	C	Coal
	X	Prospect

Figure 3. Geology and mineral occurrences of the Roaring Creek and Montgomery Creek Rancherias area, California.

KLAMATH MOUNTAINS PROVINCE

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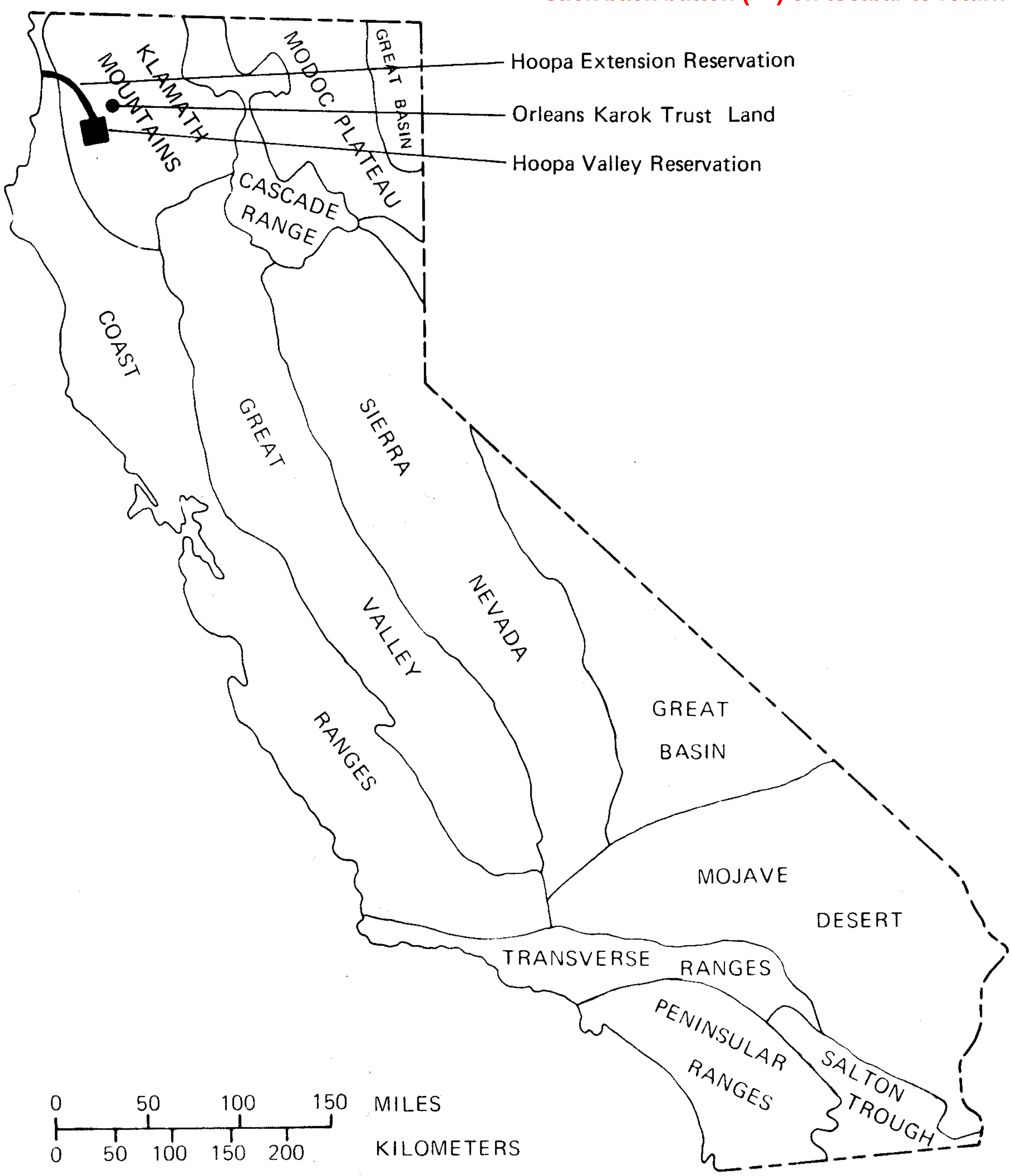

Figure 4. Index map of Indian lands in the Klamath Mountains Province, California.

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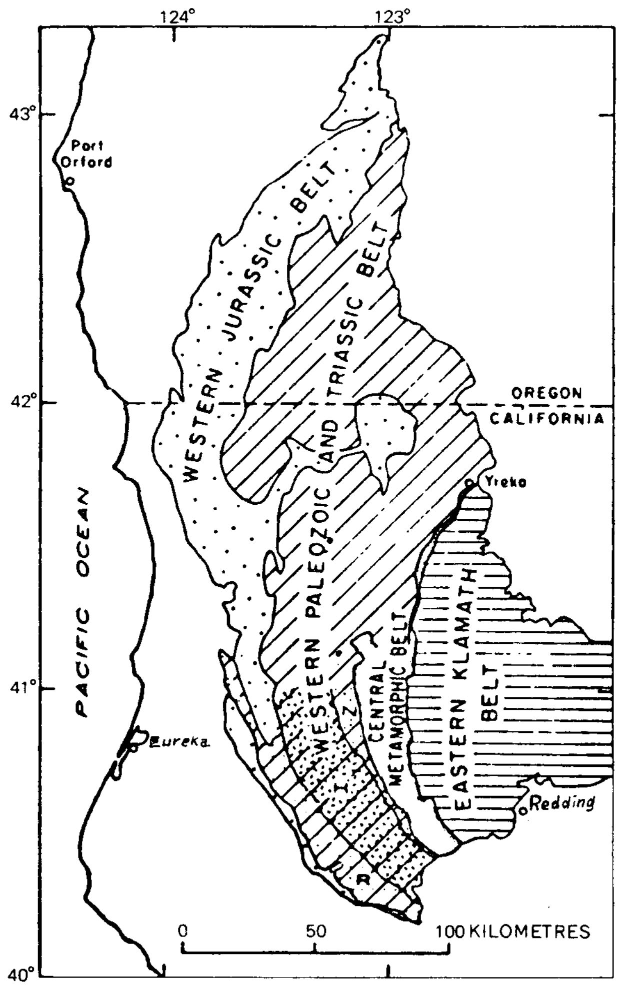

Figure 5. Generalized map showing lithic belts of the Klamath Mountains province in California and Oregon. Subdivisions of the western Paleozoic and Triassic belt are indicated by letter symbol: R, Rattlesnake Creek terrane; H, Hayfork terrane; N, North Fork terrane (from Irwin, 1977).

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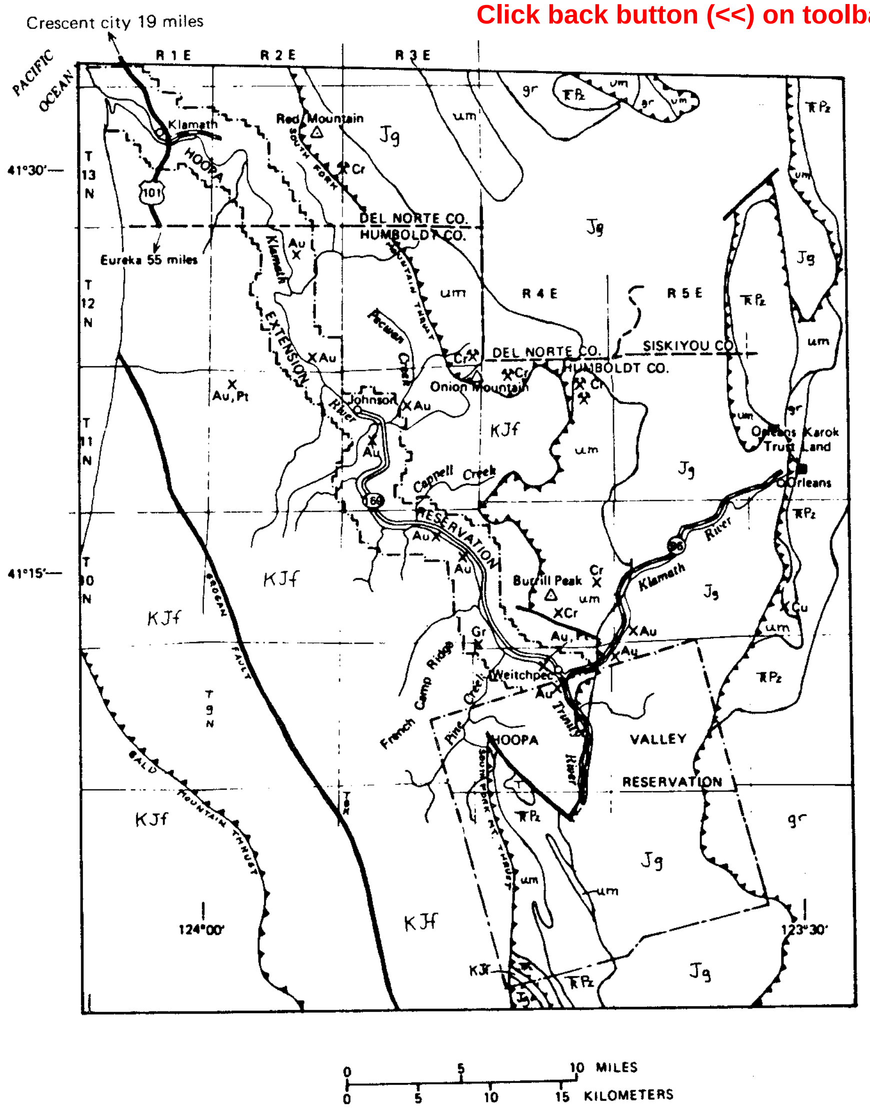

EXPLANATION

(Quaternary stream deposits not shown on map)

Tertiary

T	Weaverville Formation(?); sandstone, shale, conglomerate, and lignite

Below South Fork Mt. thrust

Jurassic and Cretaceous

KJf	Franciscan Foramtion; metagray-wacke, shale, chert, mafic volcanic rocks

Above South Fork Mt. thrust

Jurassic / **pre–Jurassic**

gr	Granitic rocks, chiefly diorite
Jg	Galice Formation; phyllite, chert, volcanic rocks
um	Serpentinized ultramafic rocks
TRPz	Metamorphosed sedimentary and volcanic rocks

Figure 6. Geology of the Hoopa Reservations (from Jennings, 1978).

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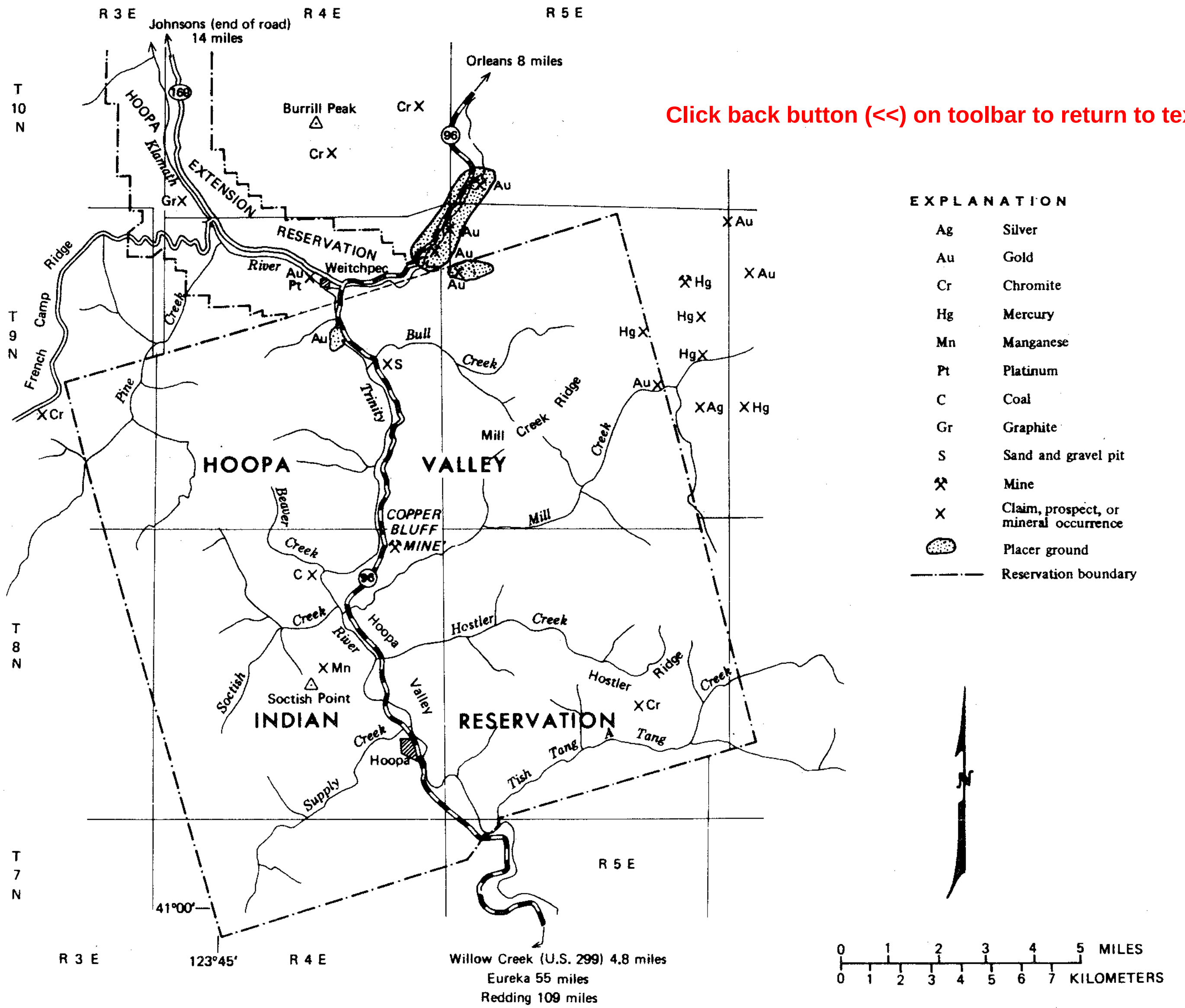

Figure 7. Mineral occurrences of the Hoopa Valley Reservation area, California.

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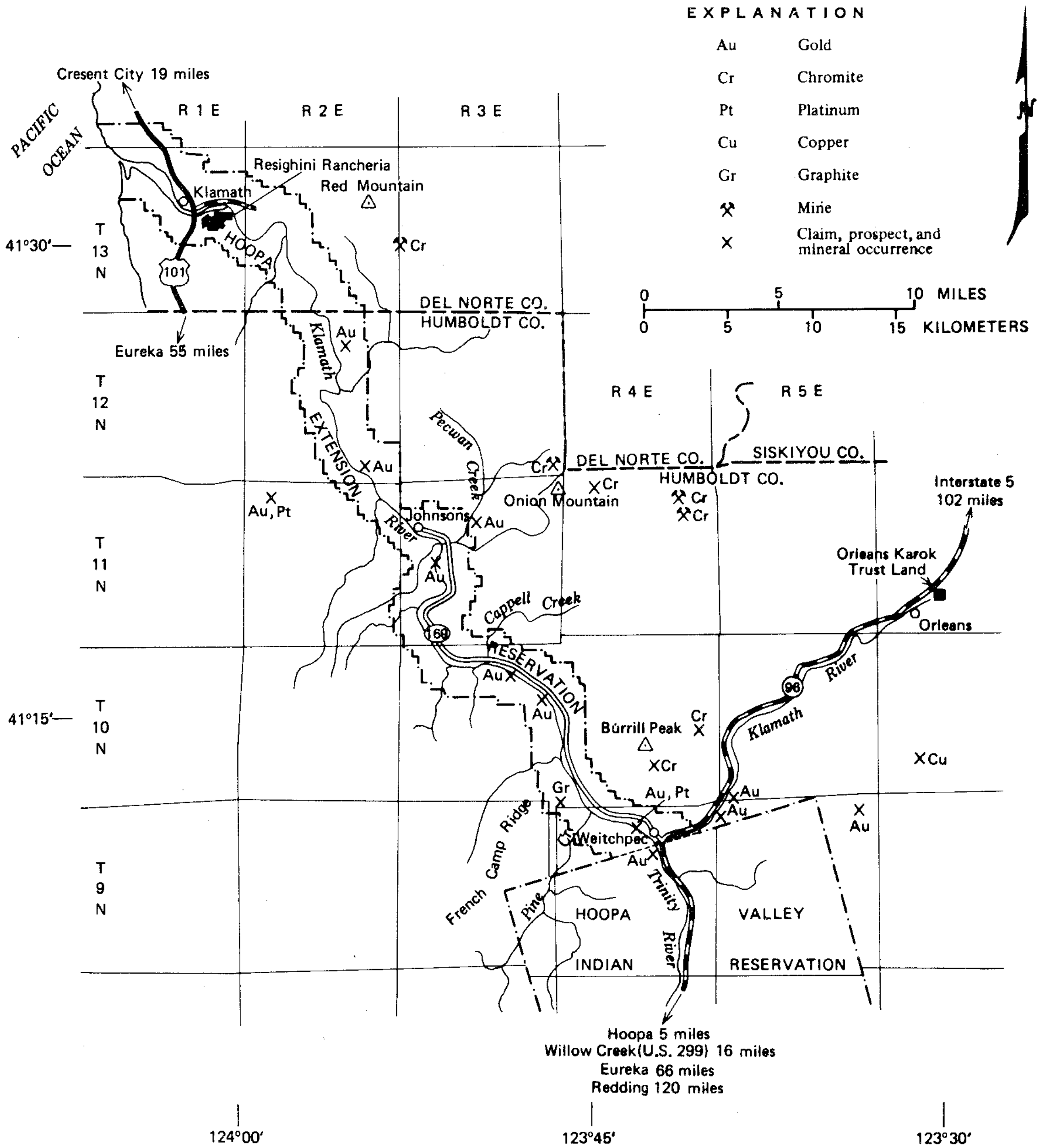

Figure 8. Mineral occurrences of the Hoopa Extension Reservation area, California.

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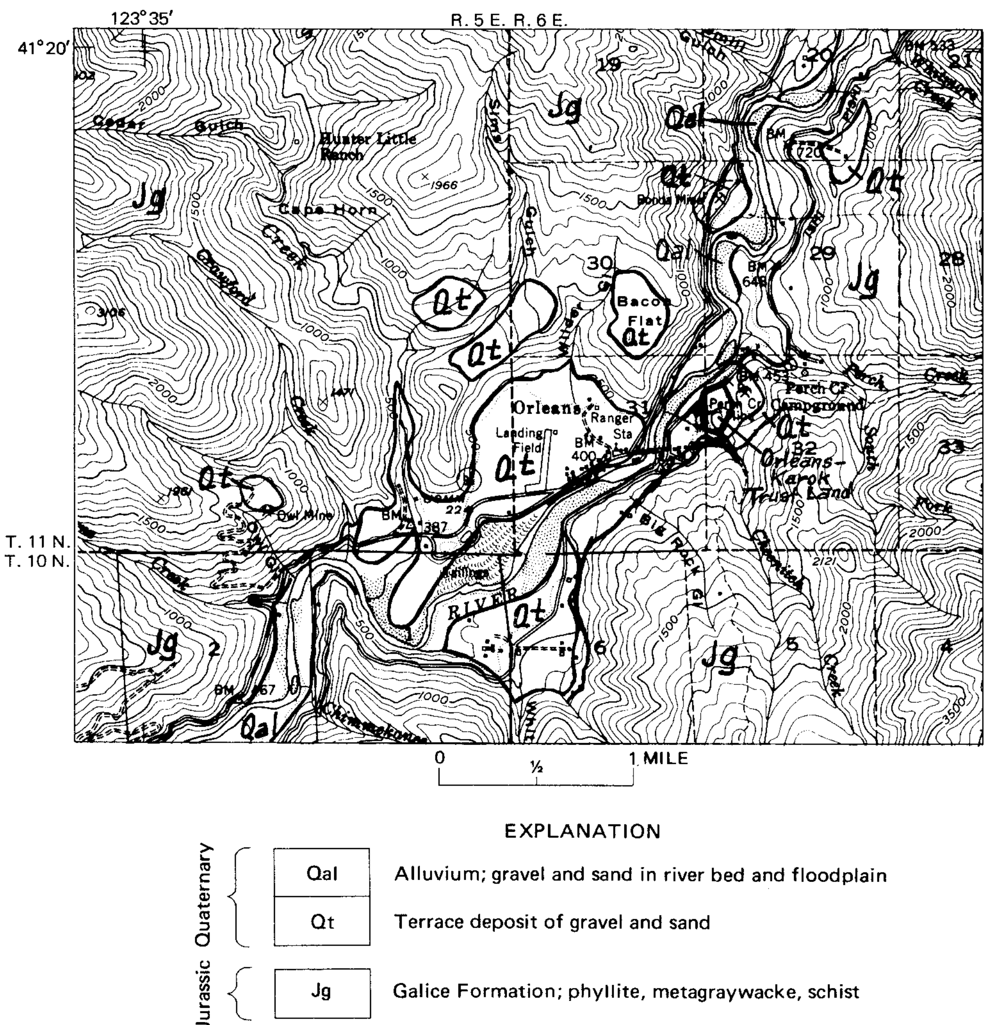

Figure 9. Mineral occurrences of the Orleans Karok Trust Land area, California.

COAST RANGES PROVINCE

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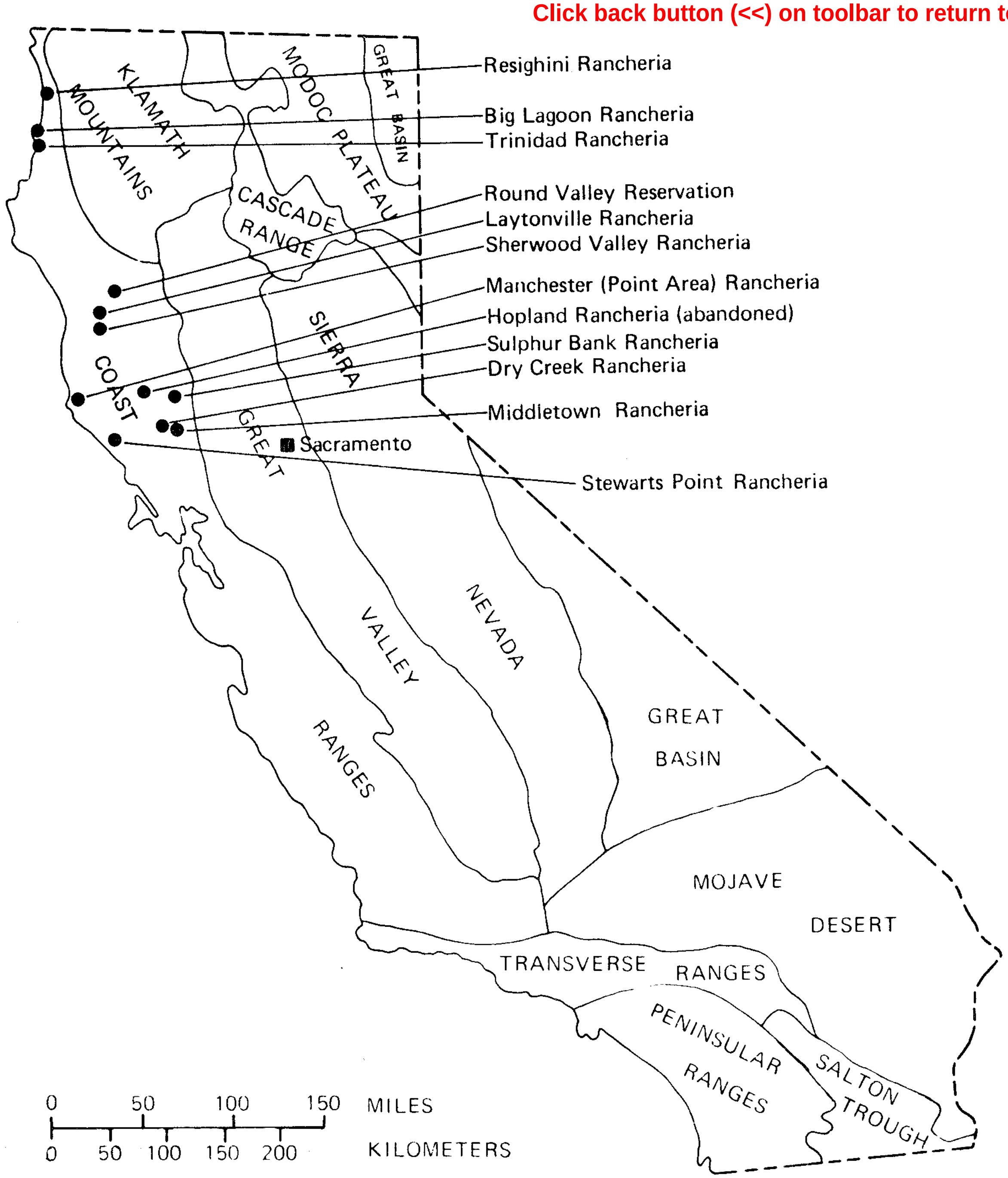

Figure 10. Index map of Indian lands in the Coast Ranges Province, California.

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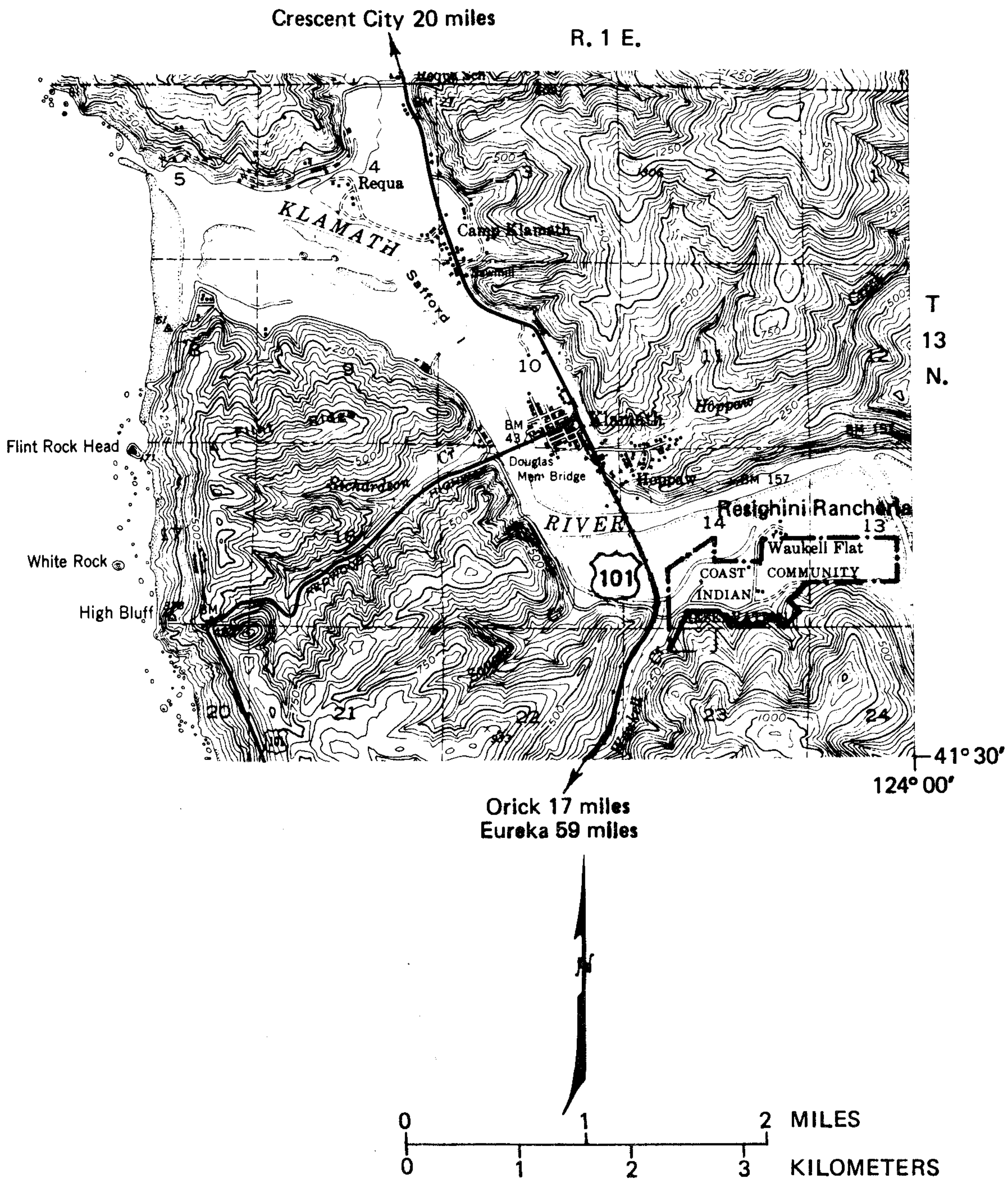

Figure 11. Index map of the Resighini (Coast Community Indian) Rancheria area, California.

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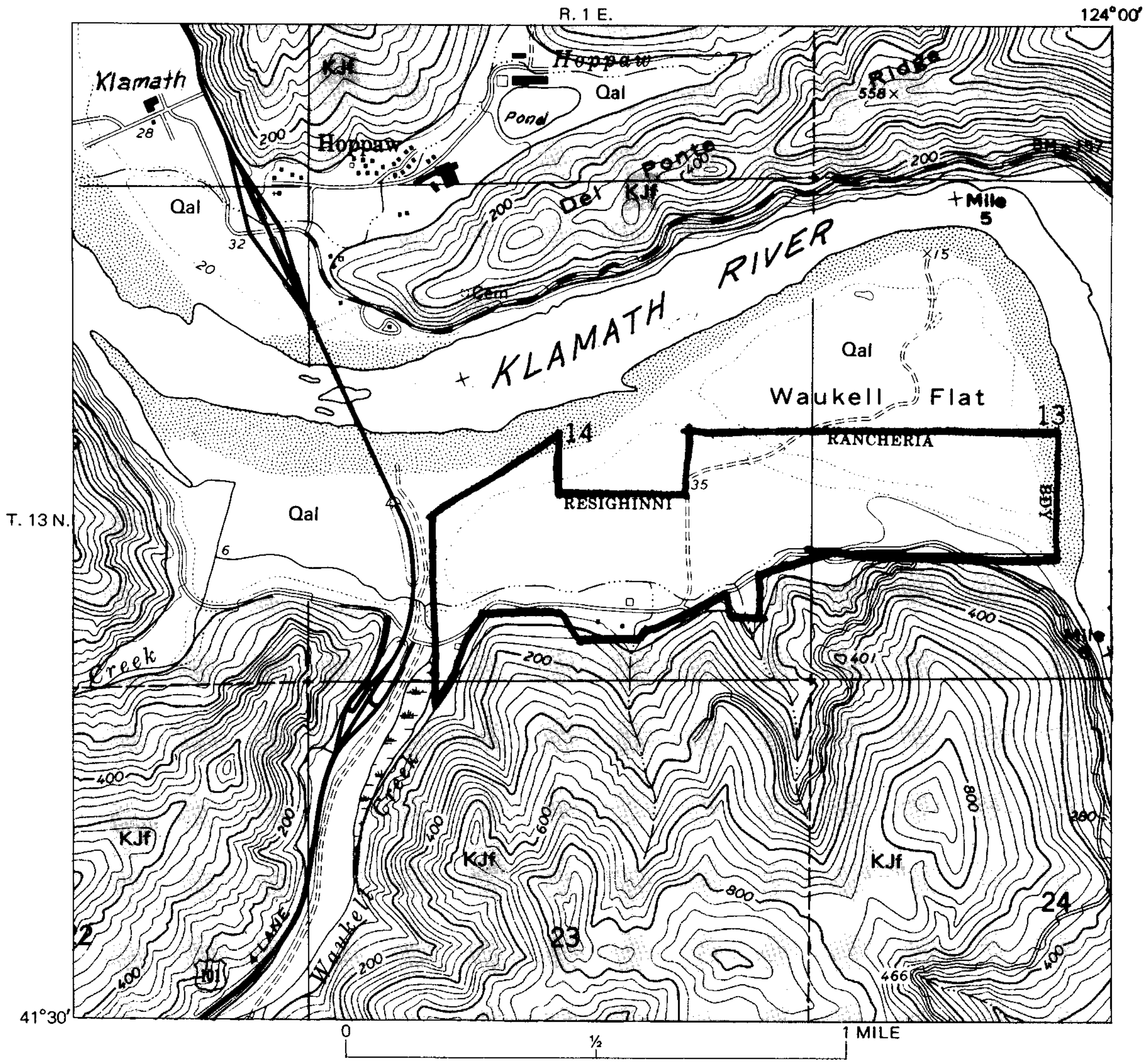

EXPLANATION

Recent	Qal	Alluvium; sand and gravel deposits of Klamath River and tributaries
Upper Jurassic and Cretaceous	KJf	Franciscan Formation; chiefly graywacke and shale

Figure 12. Geology of the Resighini Rancheria area (from Strand, 1963).

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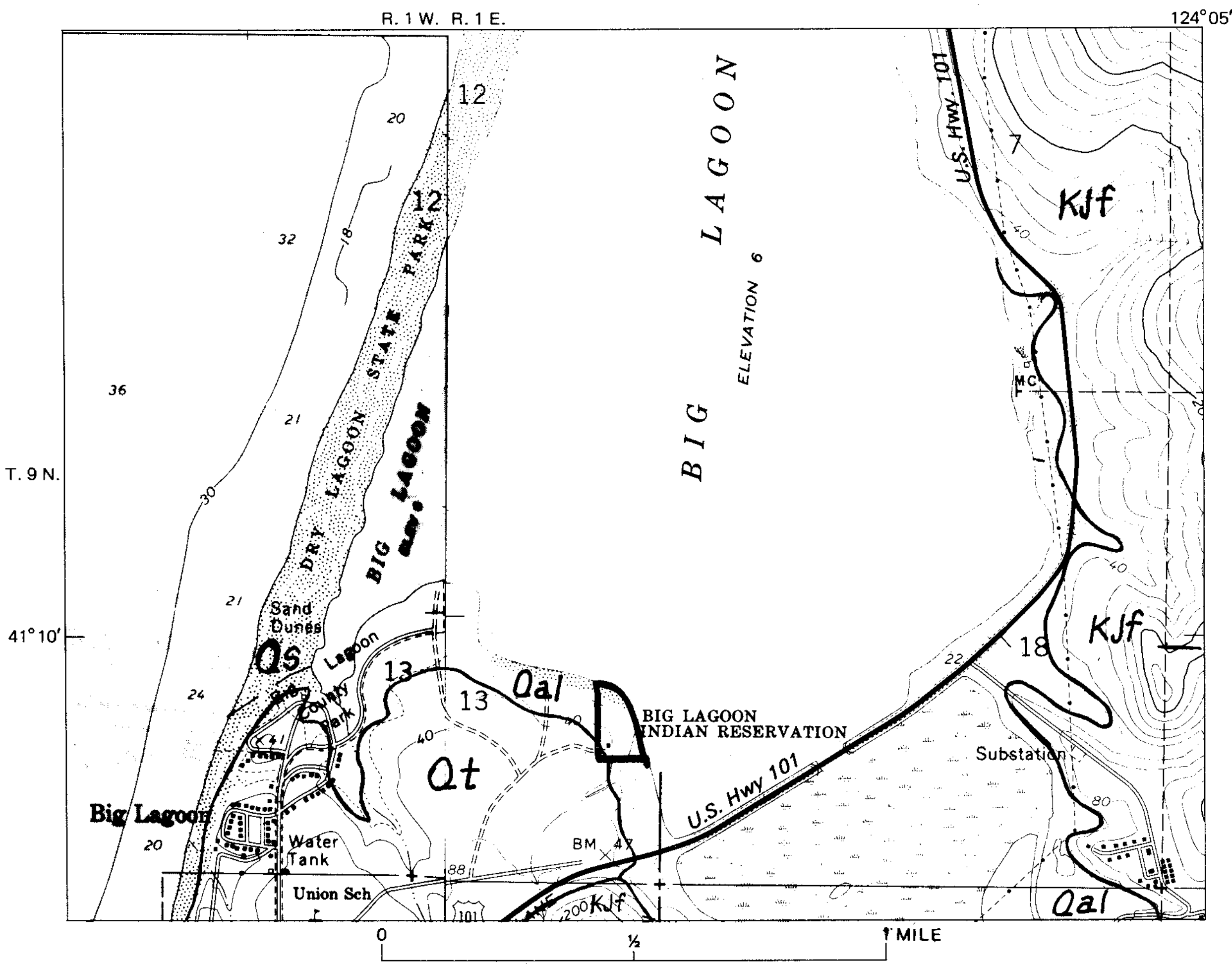

EXPLANATION

Quaternary — Recent	Qs	Dune and beach sand
Quaternary — Recent	Qal	Alluvium and windblown sand
Quaternary	Qt	Sand and gravel in terrace deposit
Upper Jurassic and Cretaceous	KJf	Franciscan Formation; graywacke, shale, mafic volcanic rocks

Figure 13. Geology and mineral occurrences of the Big Lagoon Rancheria area, California.

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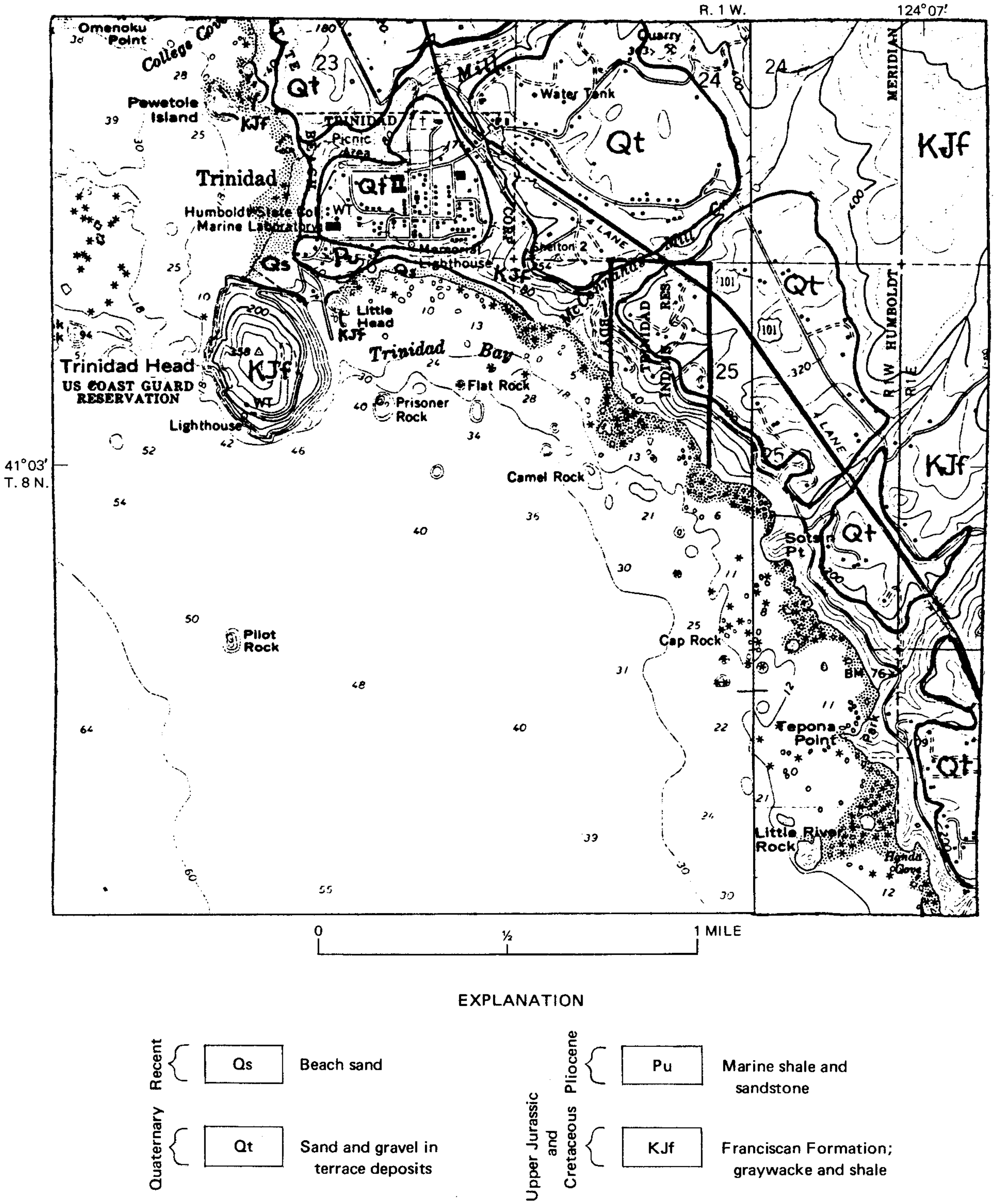

Figure 14. Geology of the Trinidad Rancheria (modified from Strand, 1963).

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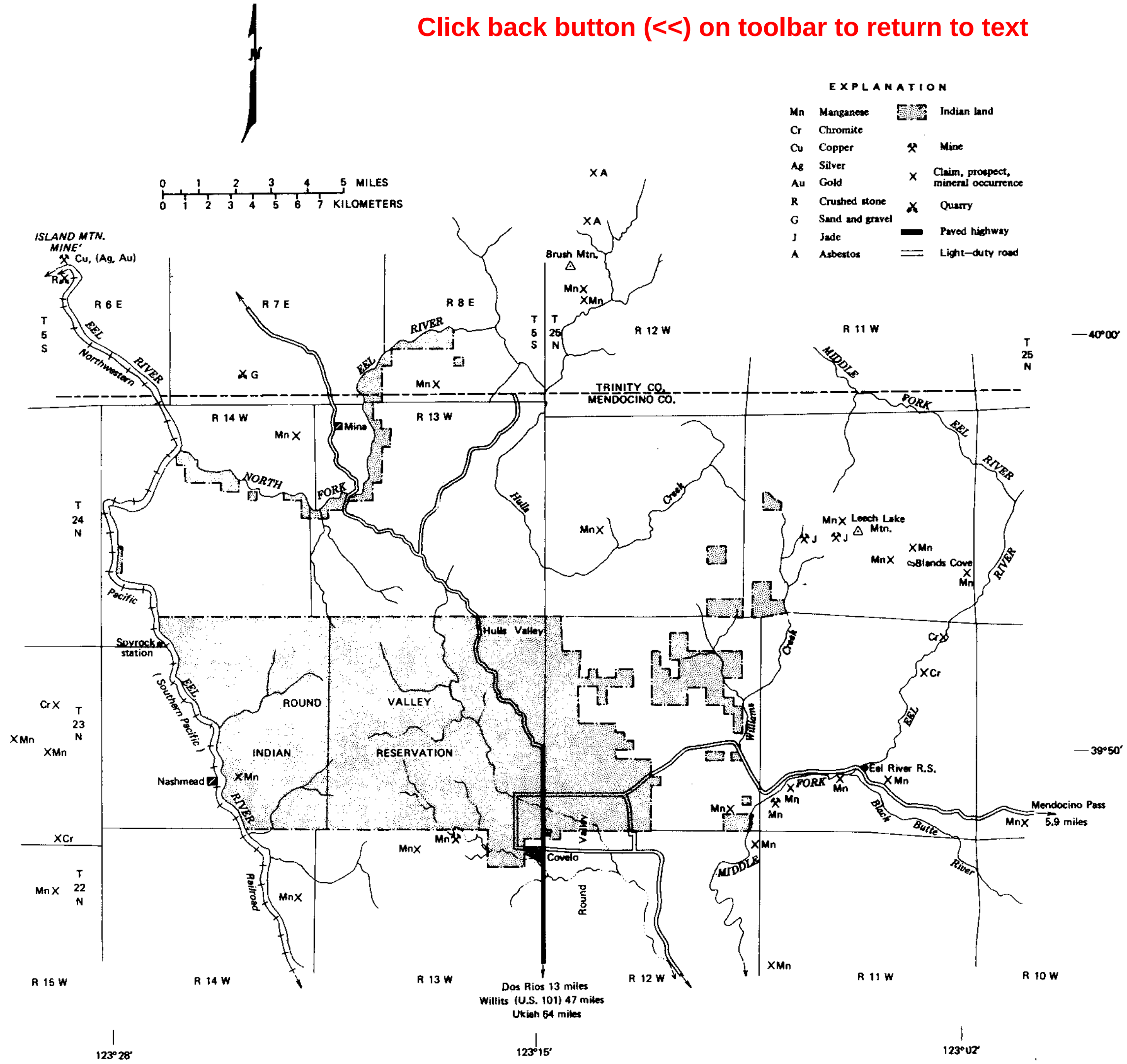

Figure 15. Mineral occurrences of the Round Valley Reservation area, California.

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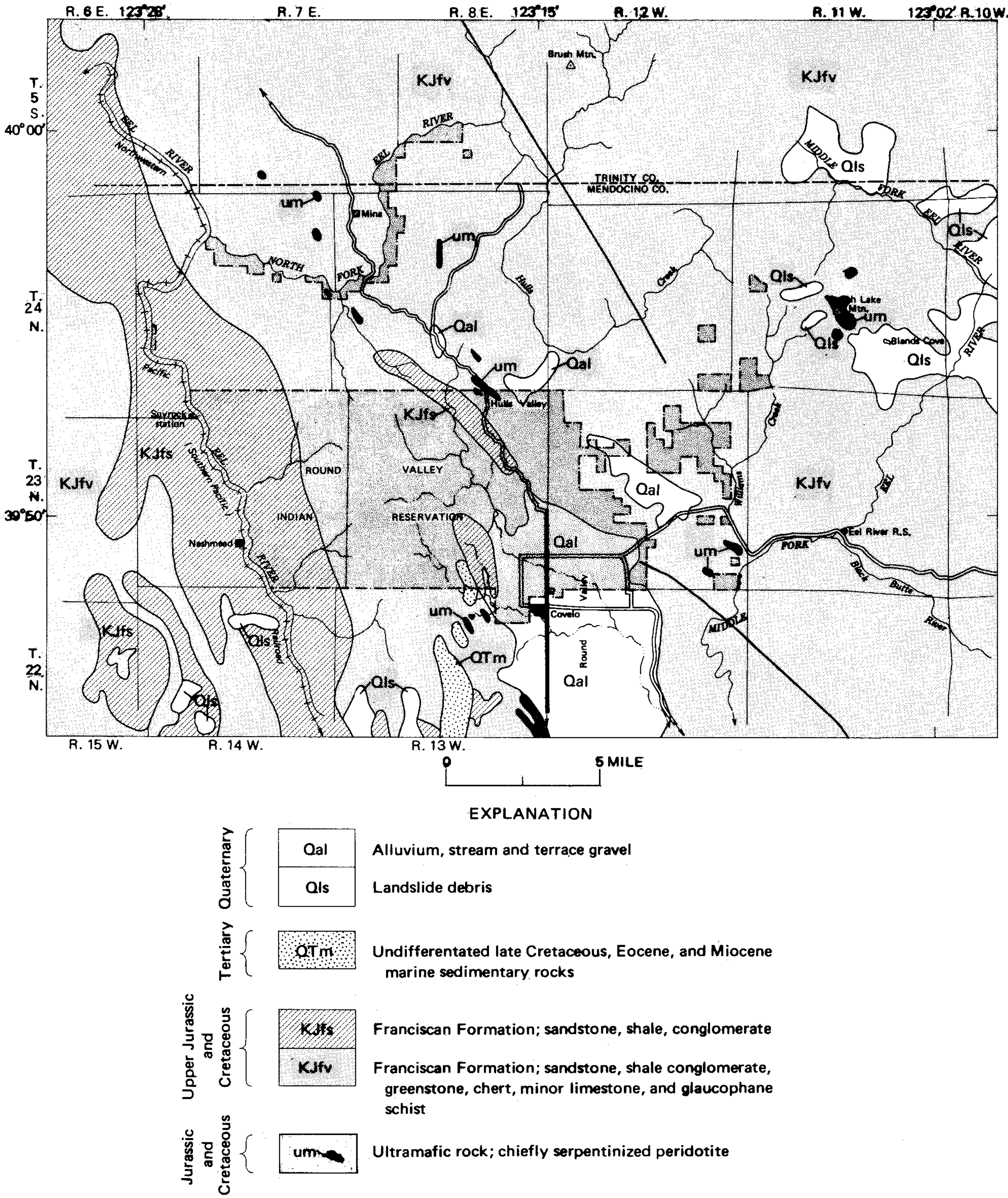

Figure 16. Geology of Round Valley Reservation (from Irwin, 1960).

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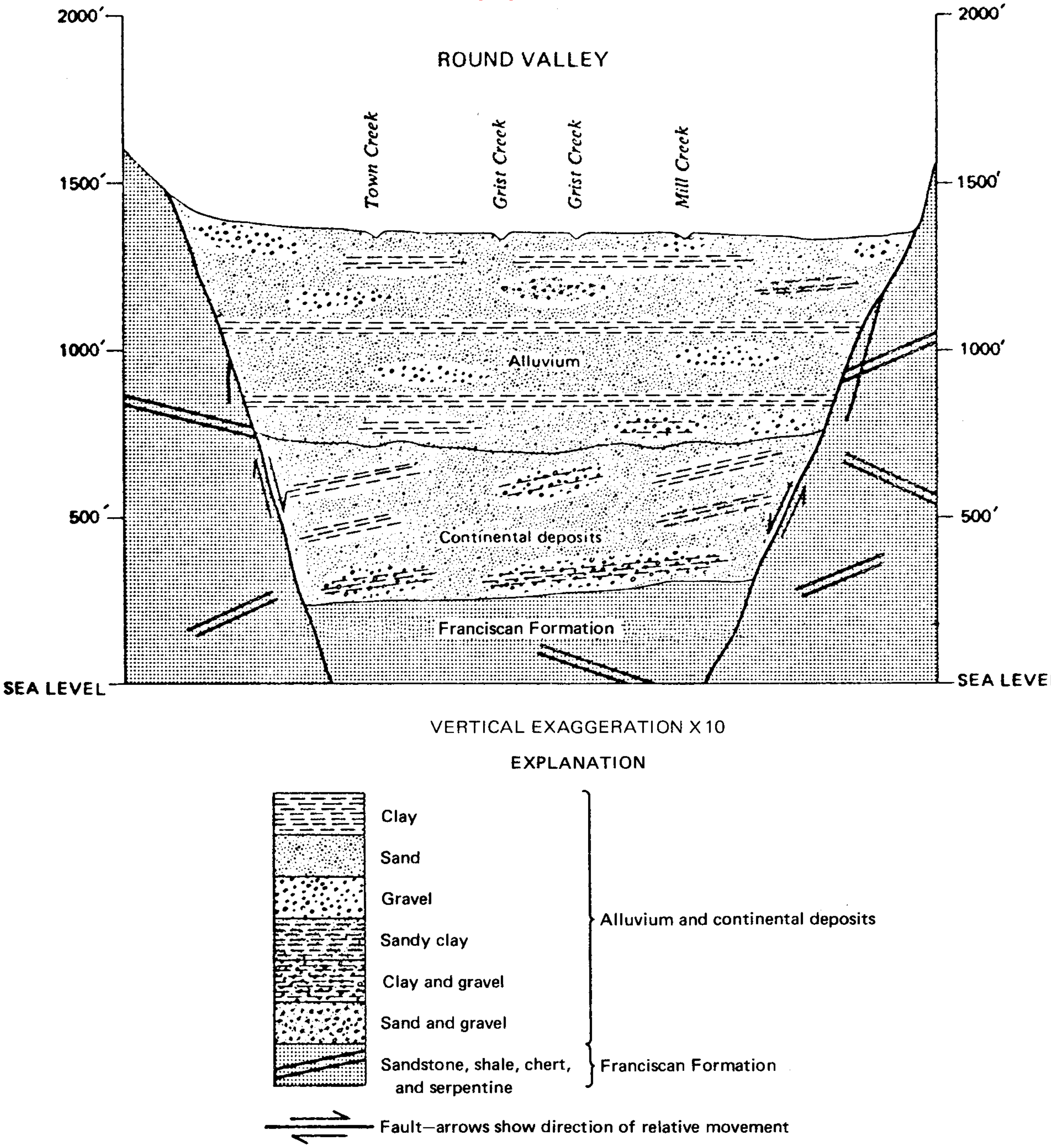

Figure 17. Generalized geologic section through Round Valley (from Muir and Webster, 1977).

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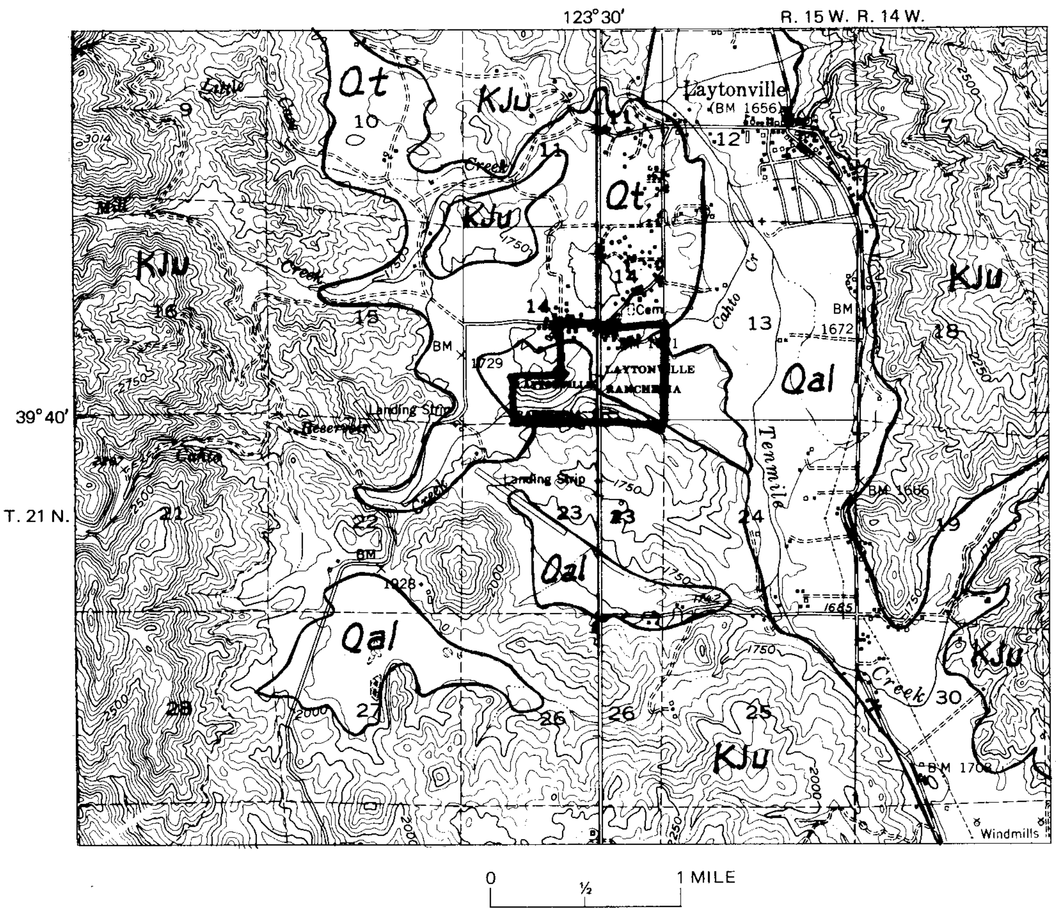

EXPLANATION

Recent	Qal	Alluvium; unconsolidated clay, silt, sand, and gravel
Pleistocene	Qt	Terrace deposits; unconsolidated gravel, sandy clay, and silt with local sand and gravel lenses
Jurassic–Cretaceous	KJu	Franciscan Formation; consolidated sandstone (graywacke), shale, limestone, and chert with minor greenstone, serpentine, and schist

Figure 18. Geology of the Laytonville Rancheria (from Cardwell, 1965).

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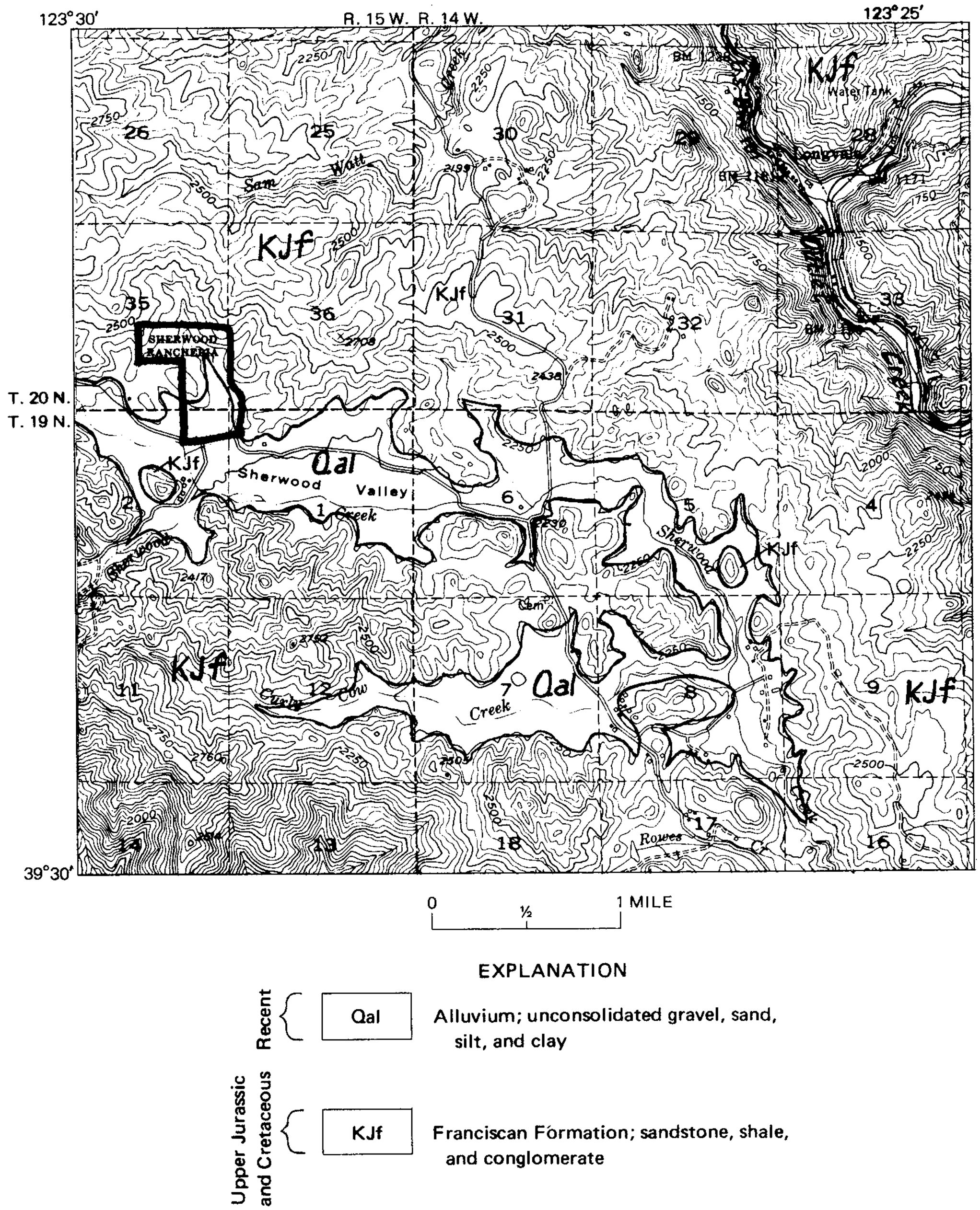

Figure 19. Geology of the Sherwood Valley Rancheria area, California.

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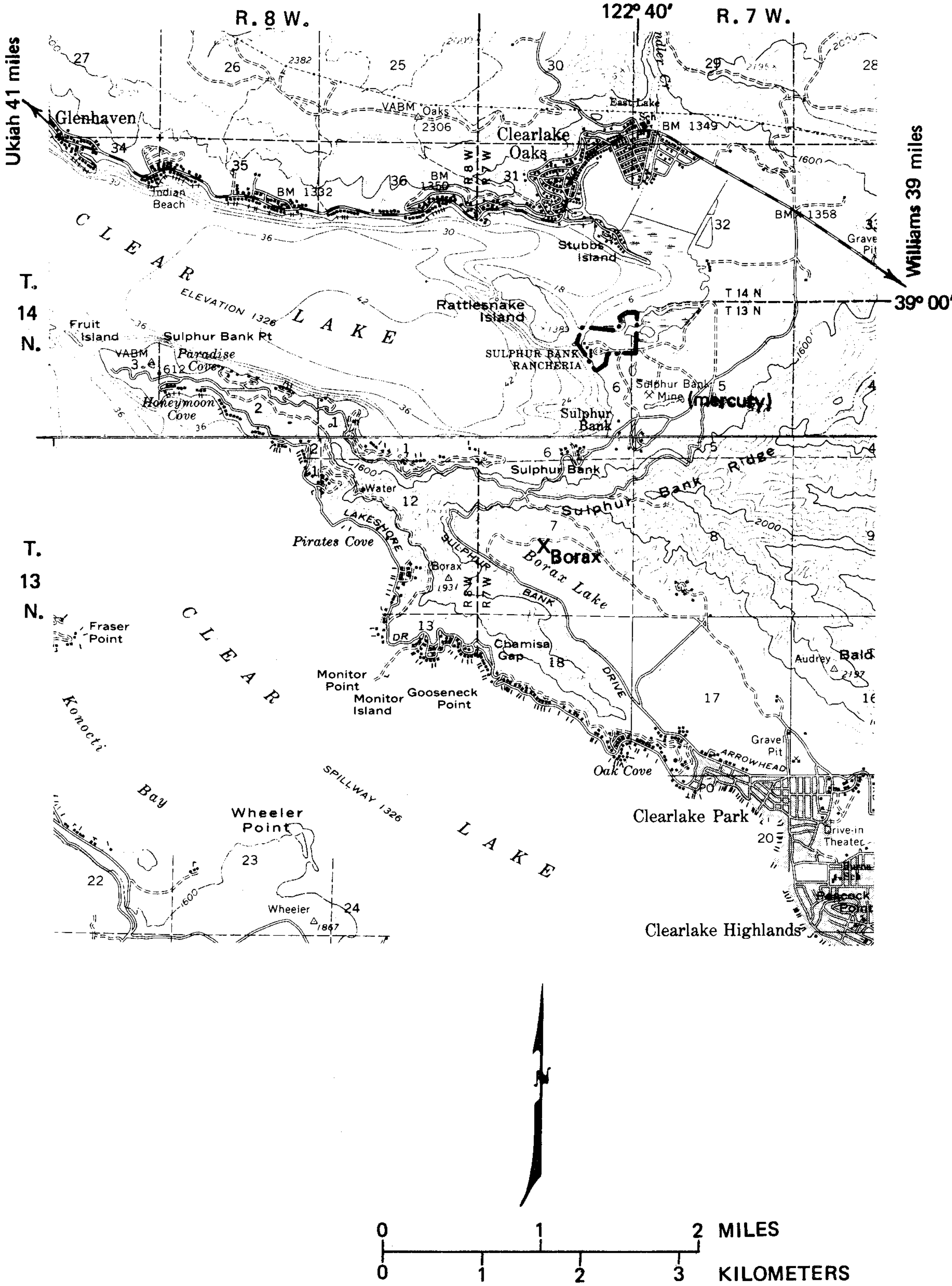

Figure 20. Index map and mineral occurrences of the Sulphur Bank Rancheria area, California.

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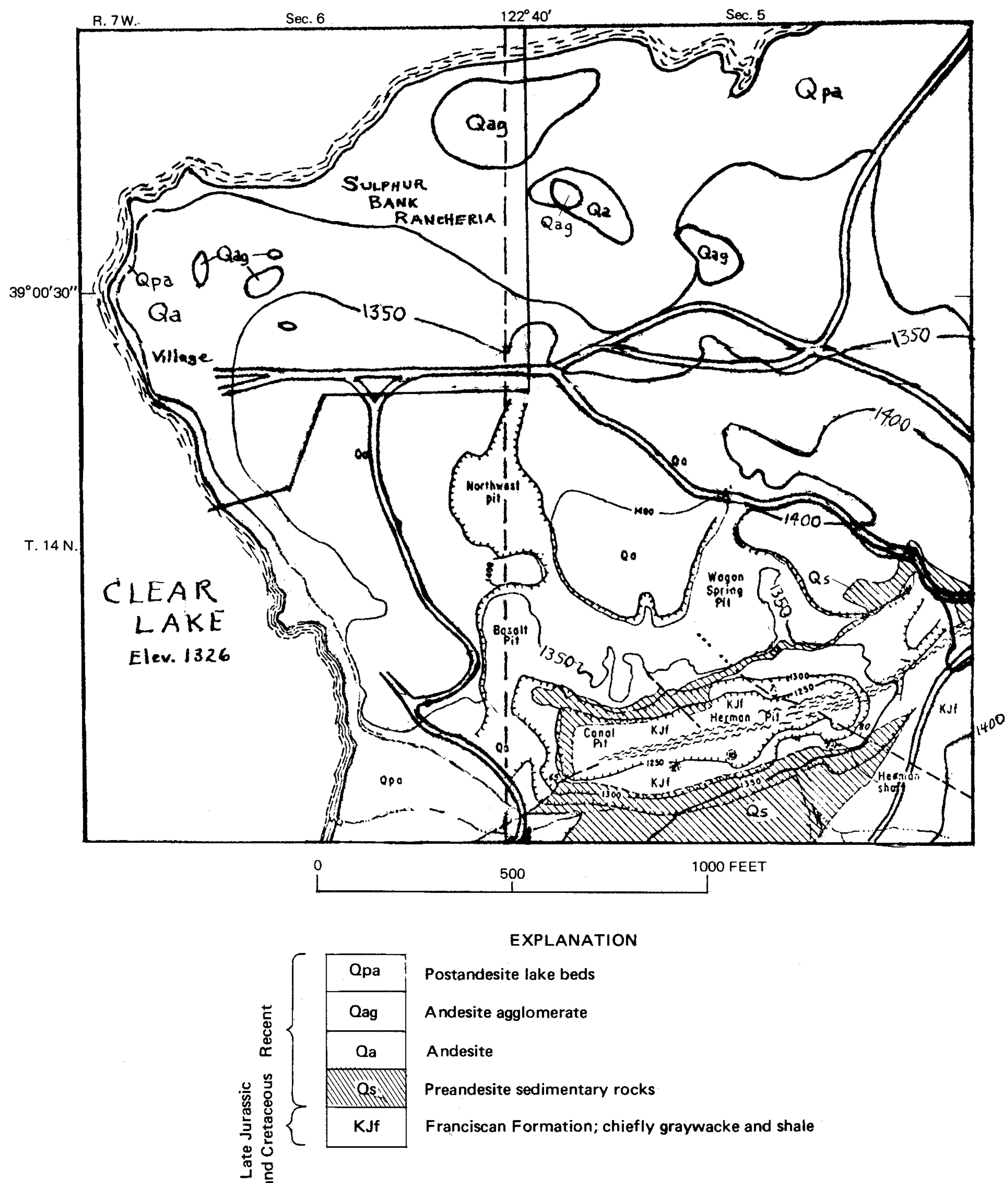

Figure 21. Geology of the Sulphur Bank Rancheria (modified from Everhart, 1943).

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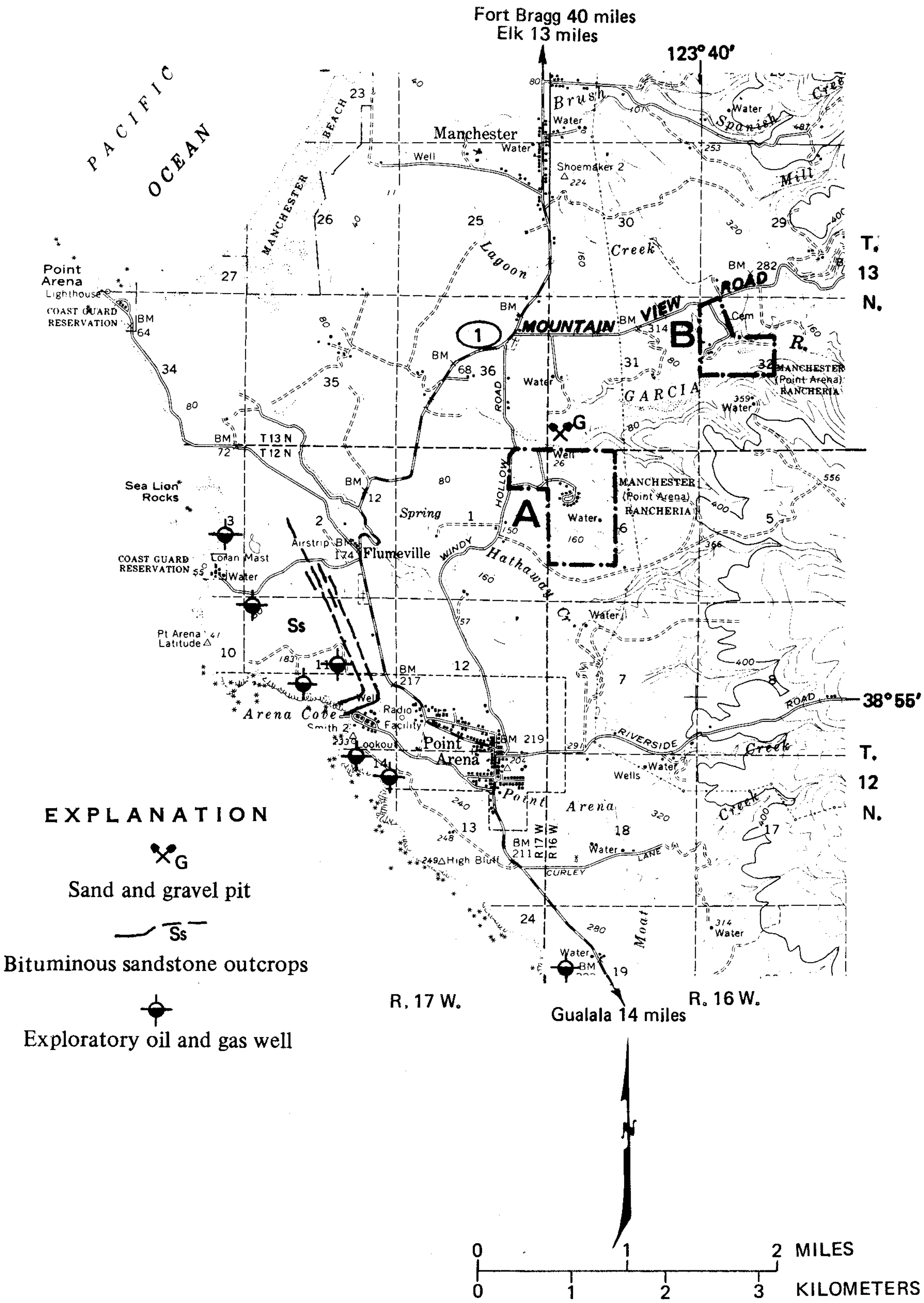

Figure 22. Mineral occurrences of the Manchester (Point Arena) Rancheria area, California.

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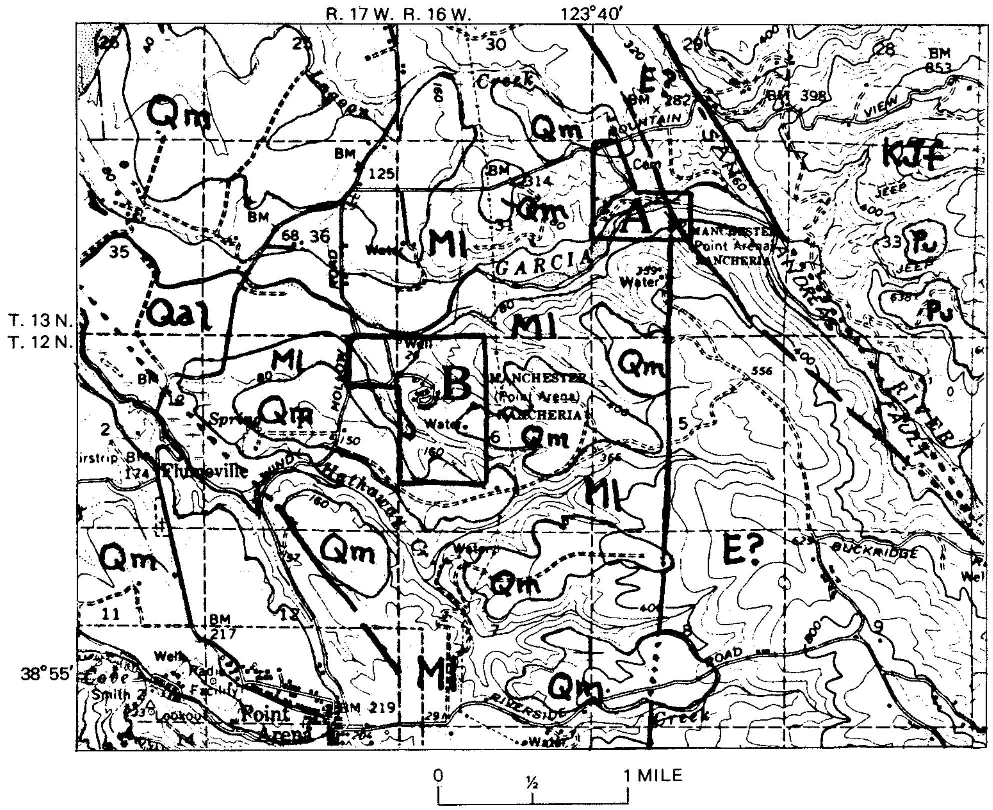

EXPLANATION

Quaternary	Recent	Qal	Alluvium
	Pleistocene	Qm	Millerton Formation; Pleistocene marine and marine terrace deposits composed of fossiliferous sands, clays, and gravels
Tertiary	Pliocene	Pu	Marine sandstone, siltstone, silty clay, and interbedded gravels of the Merced Formation and the Ohlson Ranch Formation.
	Miocene	Ml	Composed of sandy shales, mudstones, and sandstones of the Gallaway Beds and foraminiferal clay shales, bituminous sandstone, and cherty shale of the Point Arena Bed
	Eocene	E?	Marine sandstone, sandy shale, clay shale, and conglomerate of the Markley Formation, Domengine Formation, and Nortonville shale
Cretaceous	Late Cretaceous	KJf	Franciscan Formation; graywacke, shale, and minor conglomerate

Figure 23. Geology of the Manchester Rancheria (from Koenig, 1963, generalized).

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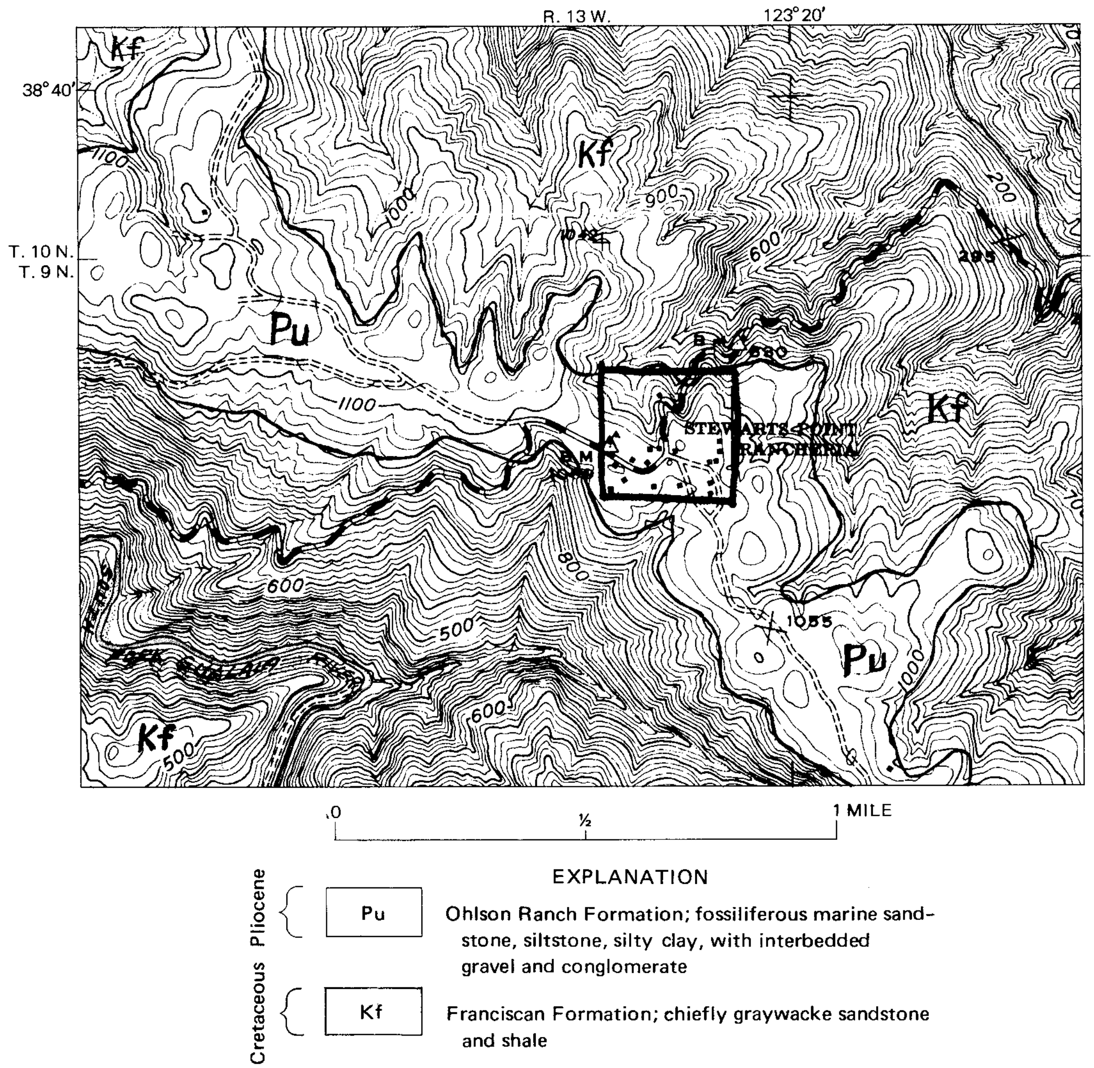

Figure 24. Geology of the Stewarts Point Rancheria (generalized from Higgins, 1960).

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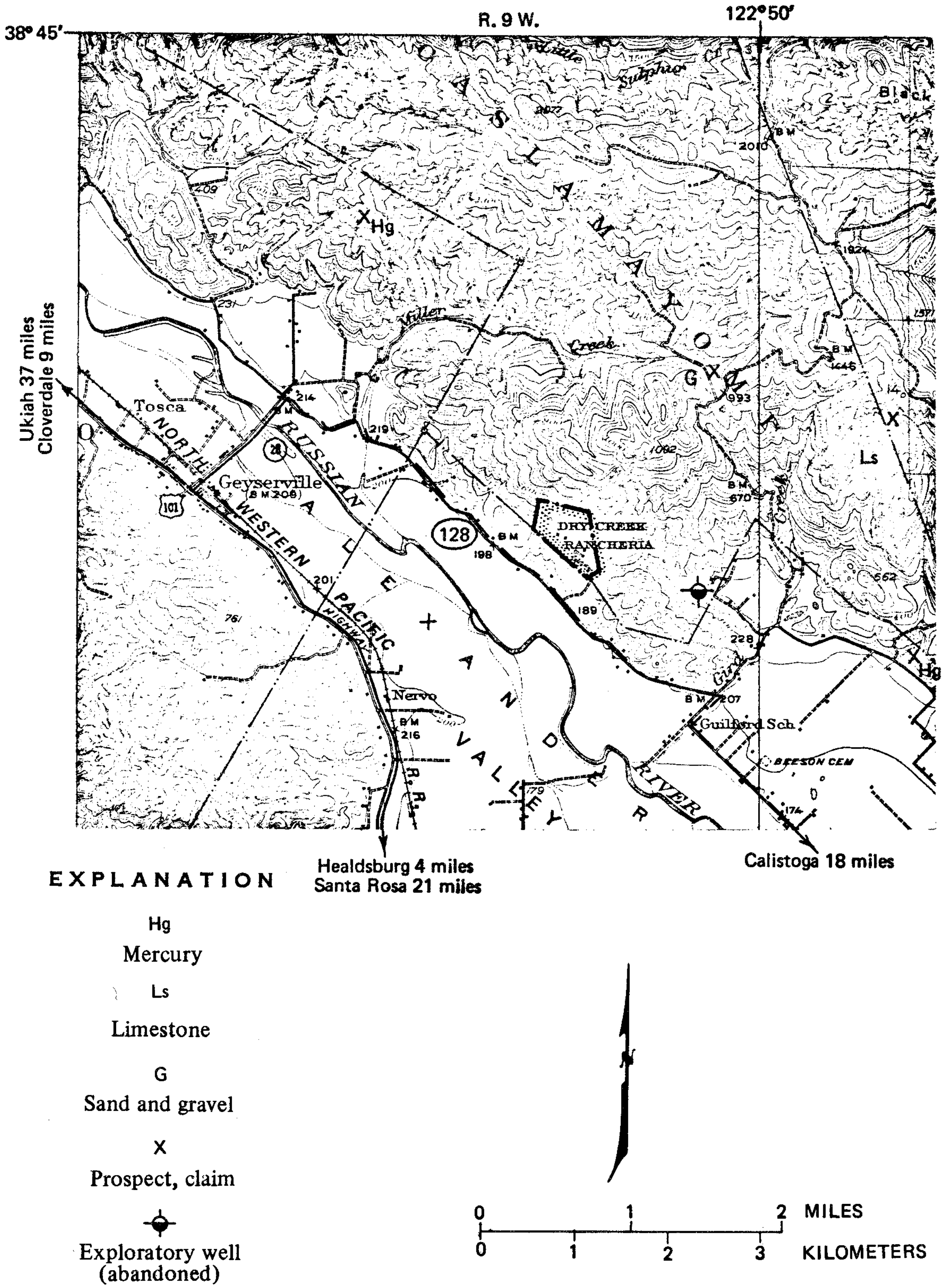

Figure 25. Mineral occurrences of the Dry Creek Rancheria area, California.

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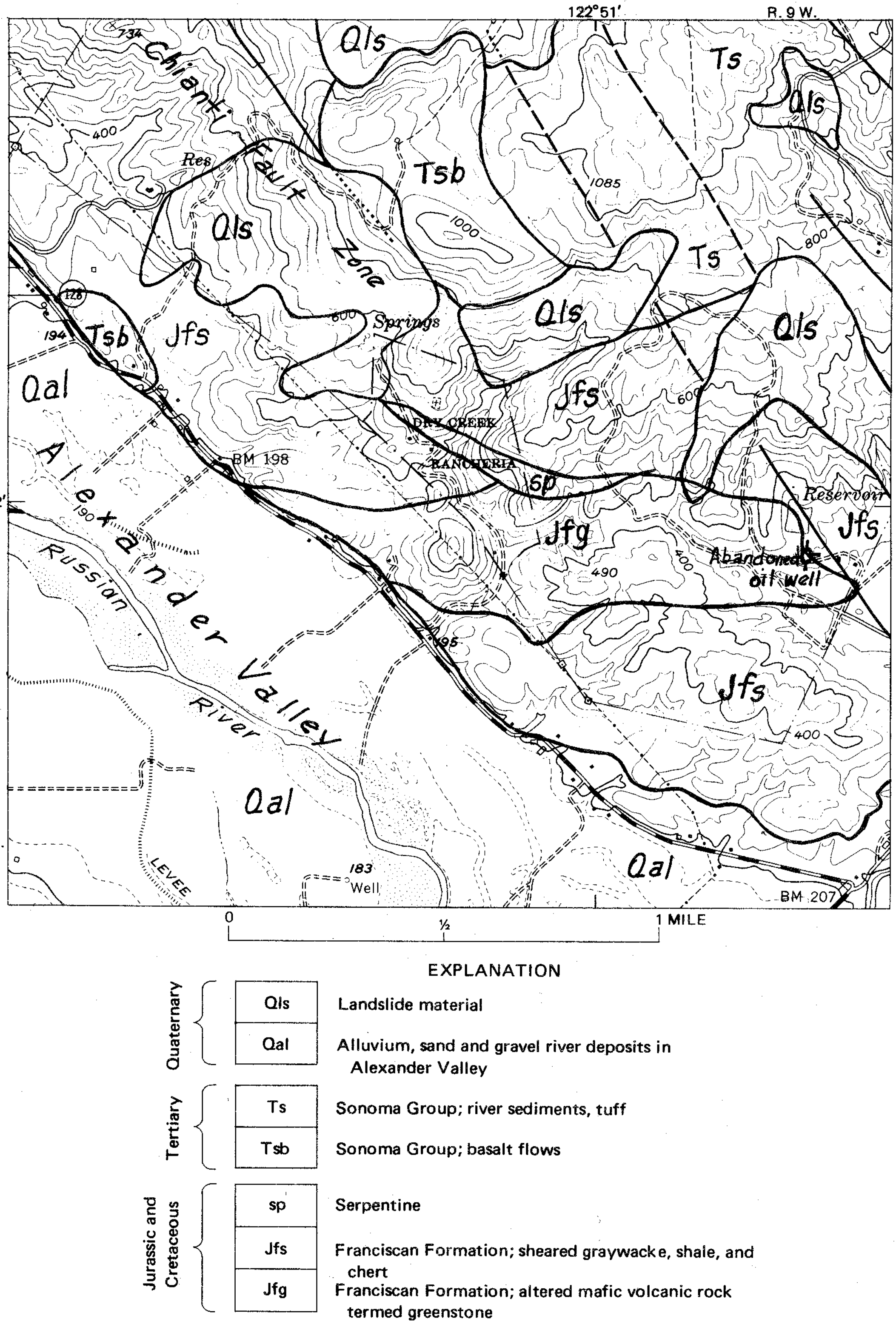

Figure 26. Geology of the Dry Creek Rancheria.

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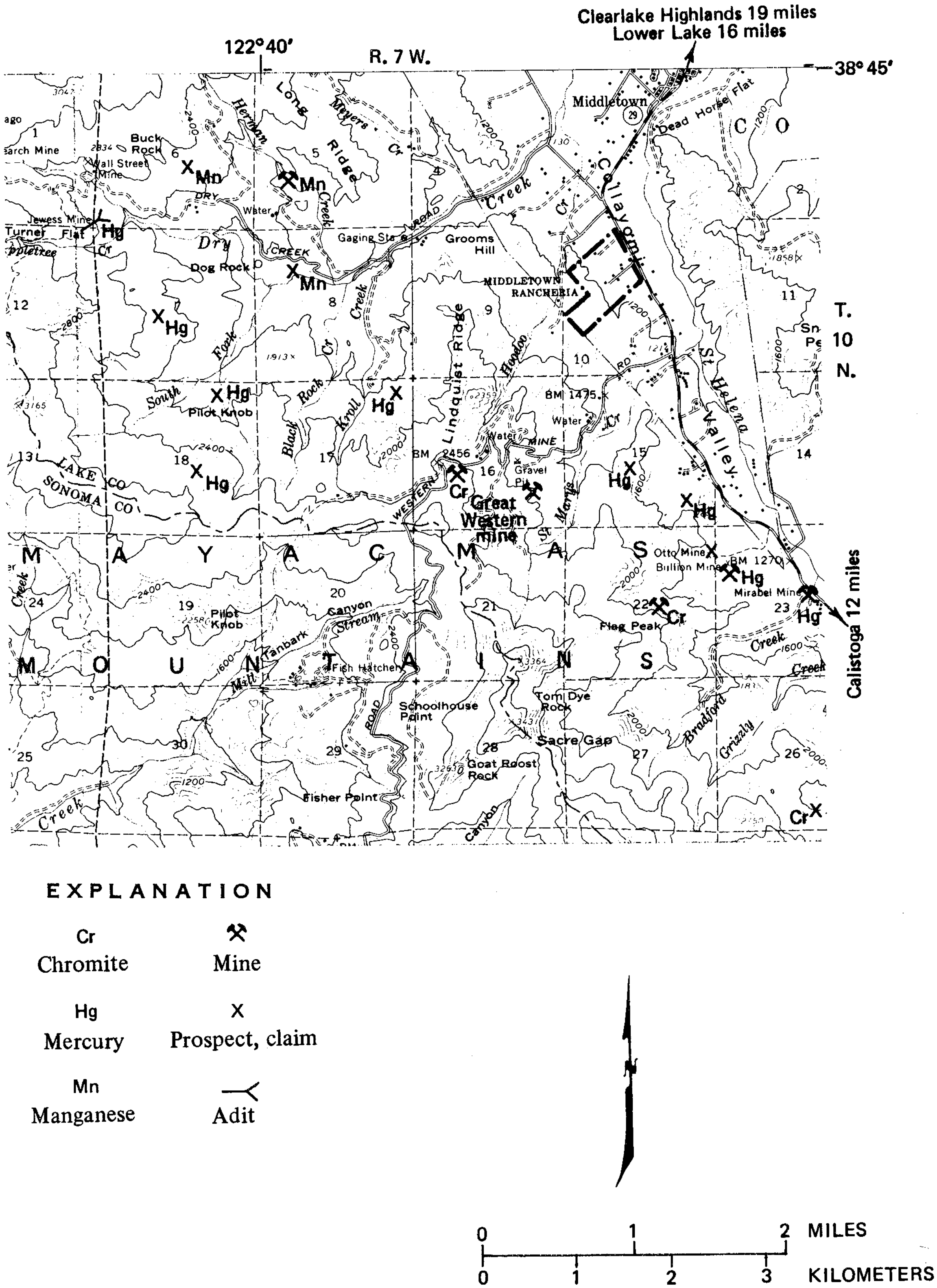

Figure 27. Mineral occurrences of the Middletown Rancheria area, California.

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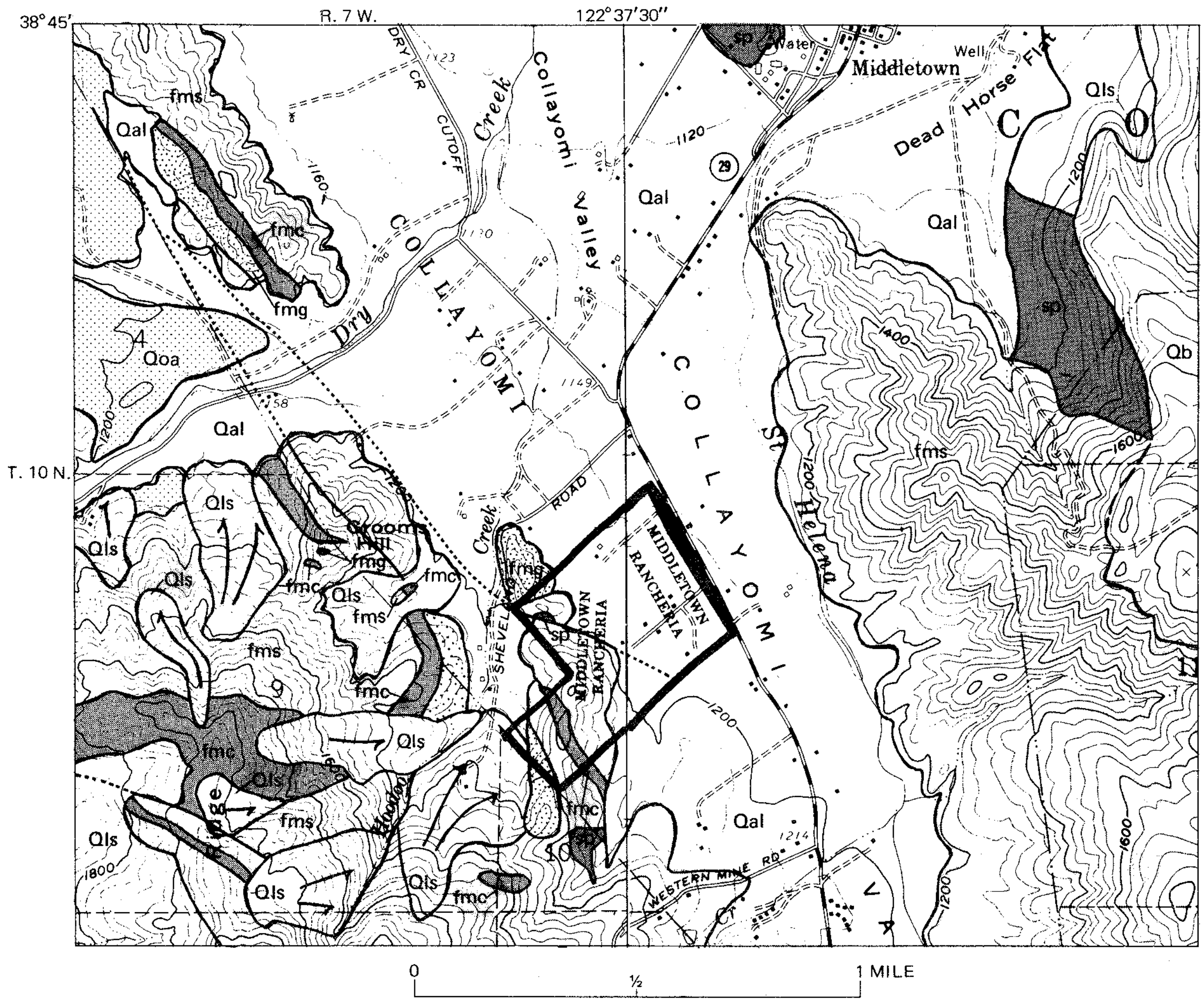

EXPLANATION

Recent	Qal	Alluvium; stream deposits of Collayomi Valley
	Qls	Landslide material
Quaternary	Qoa	Older alluvium; sand and gravel in raised fans and terraces
	Qb	Quartz-bearing basalt
Jurassic and Cretaceous	sp	Serpentinized ultramafic rock
	fms	Franciscan Formation; sandstone and shale, mildly metamorphosed
	fmc	Franciscan Formation; chert and metachert
	fmg	Franciscan Formation; mafic volcanic rock, greenstone, and some schist.

Figure 28. Geology of the Middletown Rancheria.

GREAT VALLEY PROVINCE

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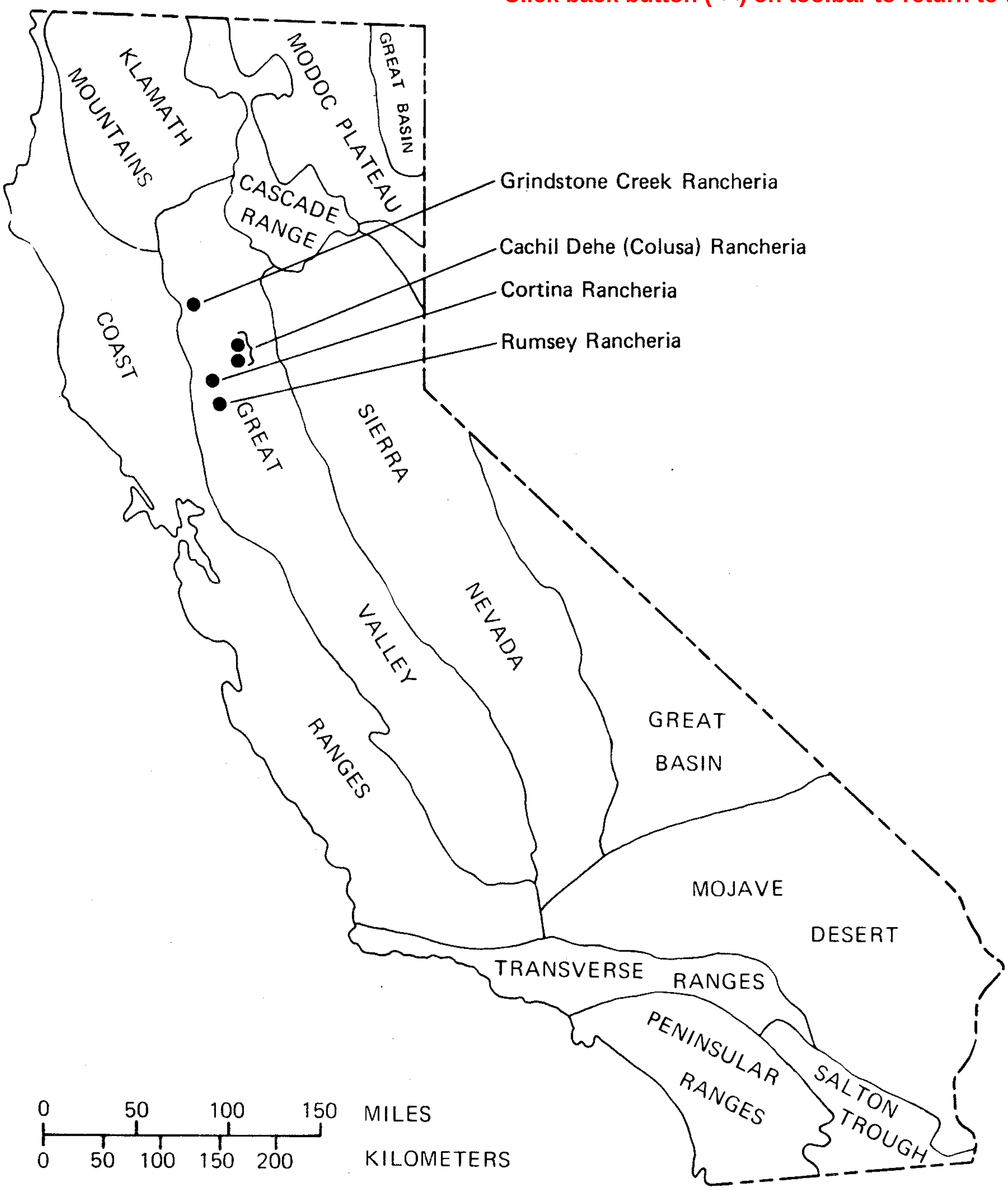

Figure 29. Index map of Indian lands in the Great Valley Province, California.

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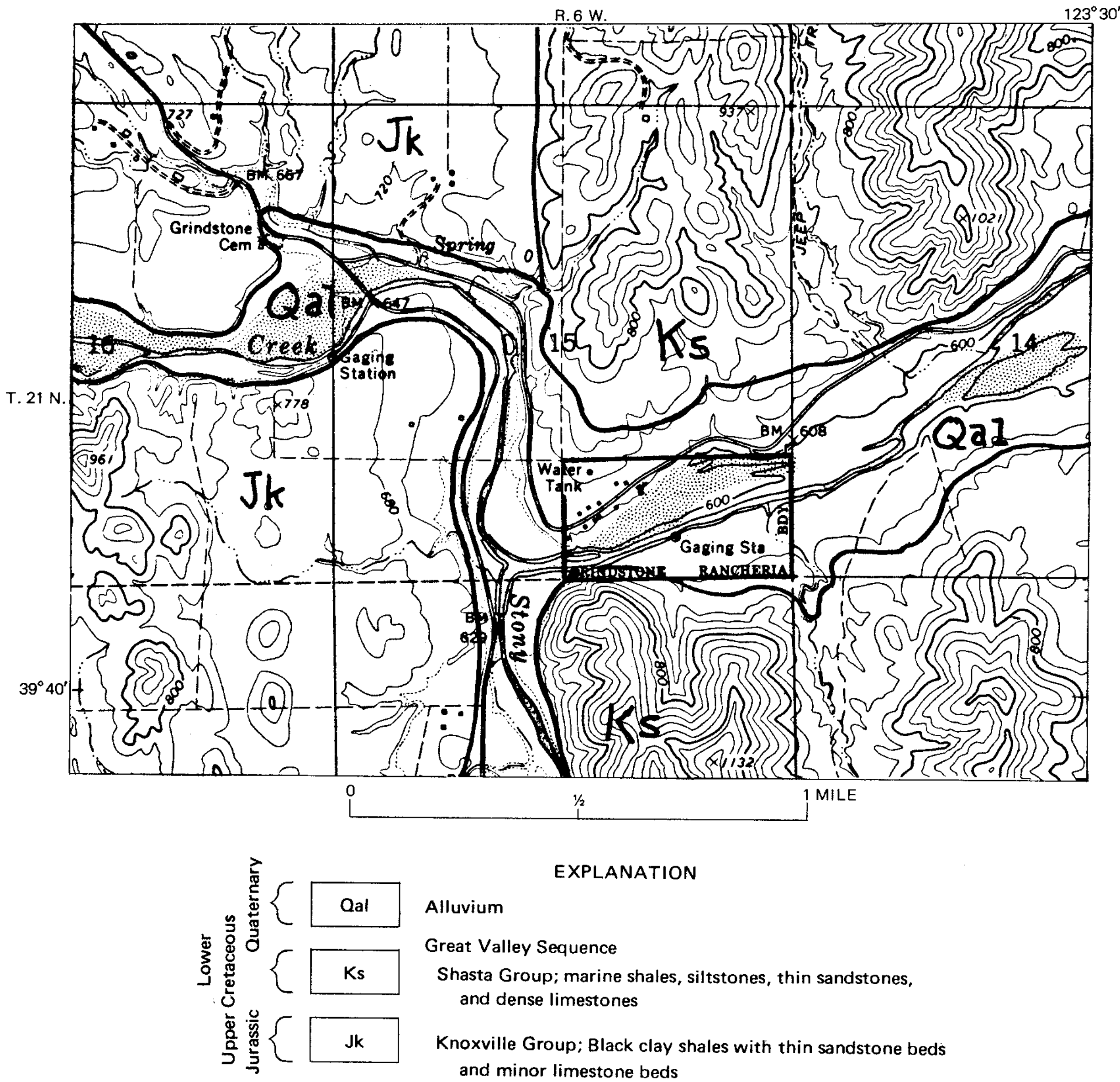

Figure 30. Geology of the Grindstone Creek Rancheria (modified from O'Brien and Braun, 1952).

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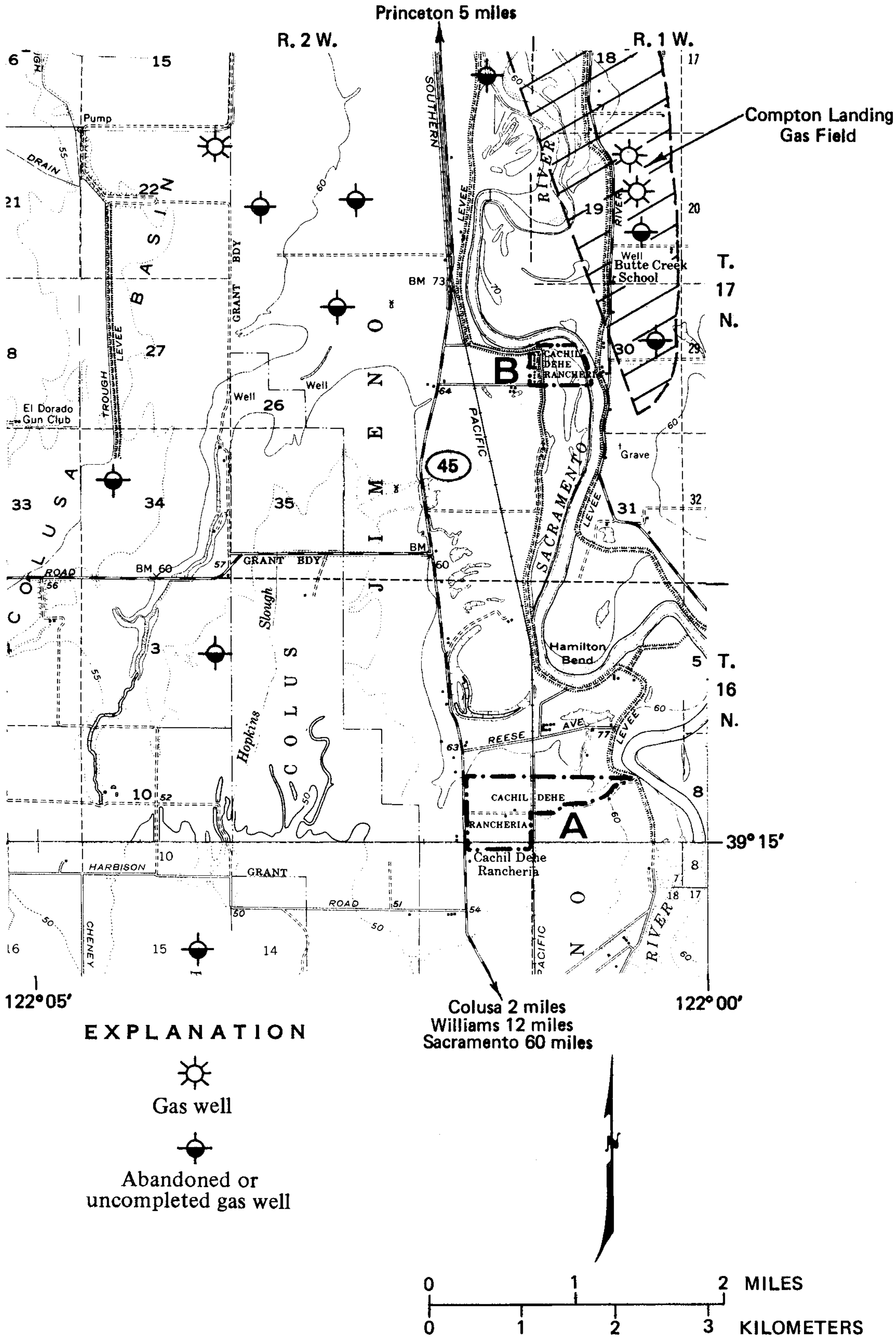

Figure 31. Mineral occurrences of the Cachil Dehe (Colusa) Rancheria area, California.

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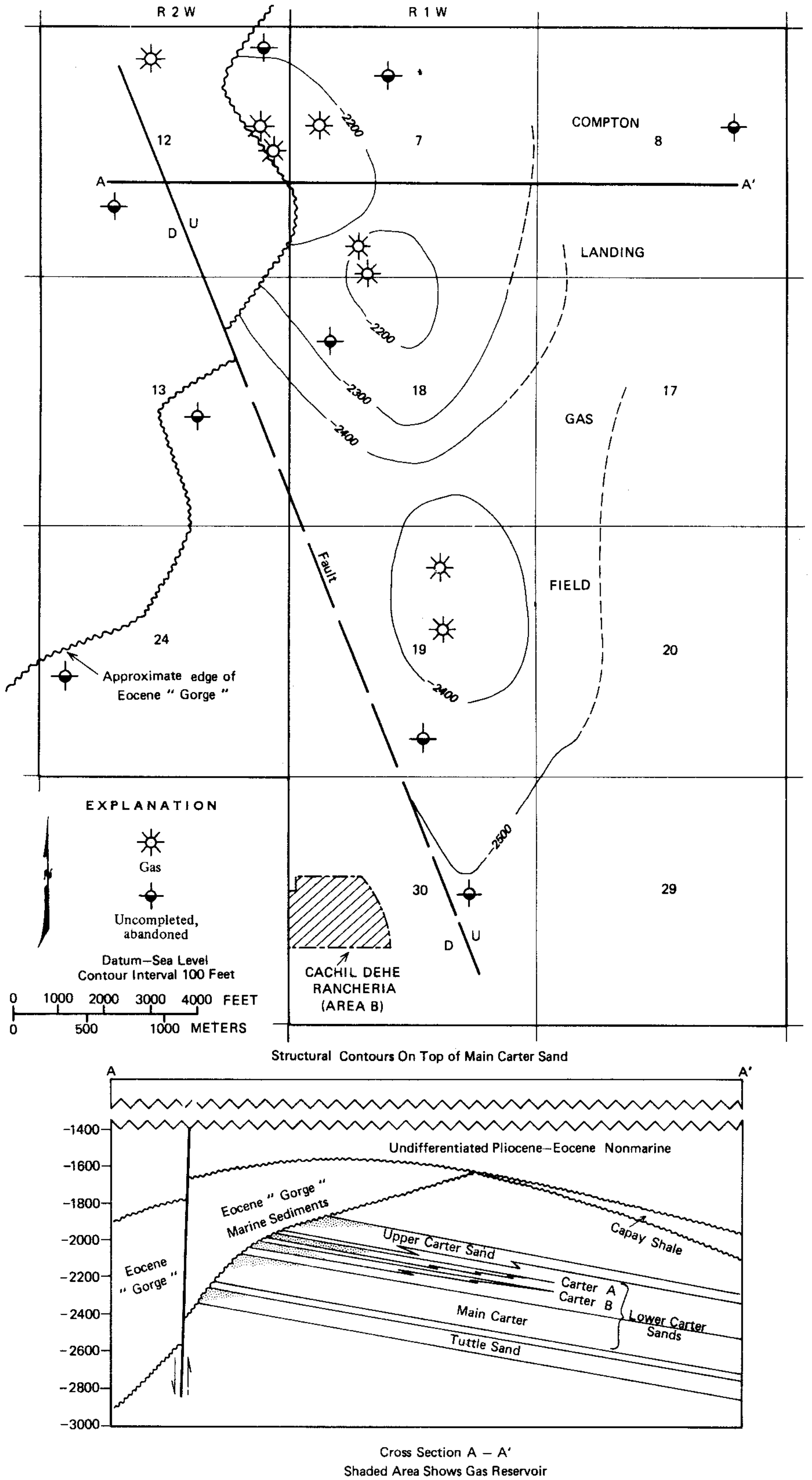

Figure 32. Structure and stratigraphy of the southern part of the Compton Landing gas field, Colusa County, California.

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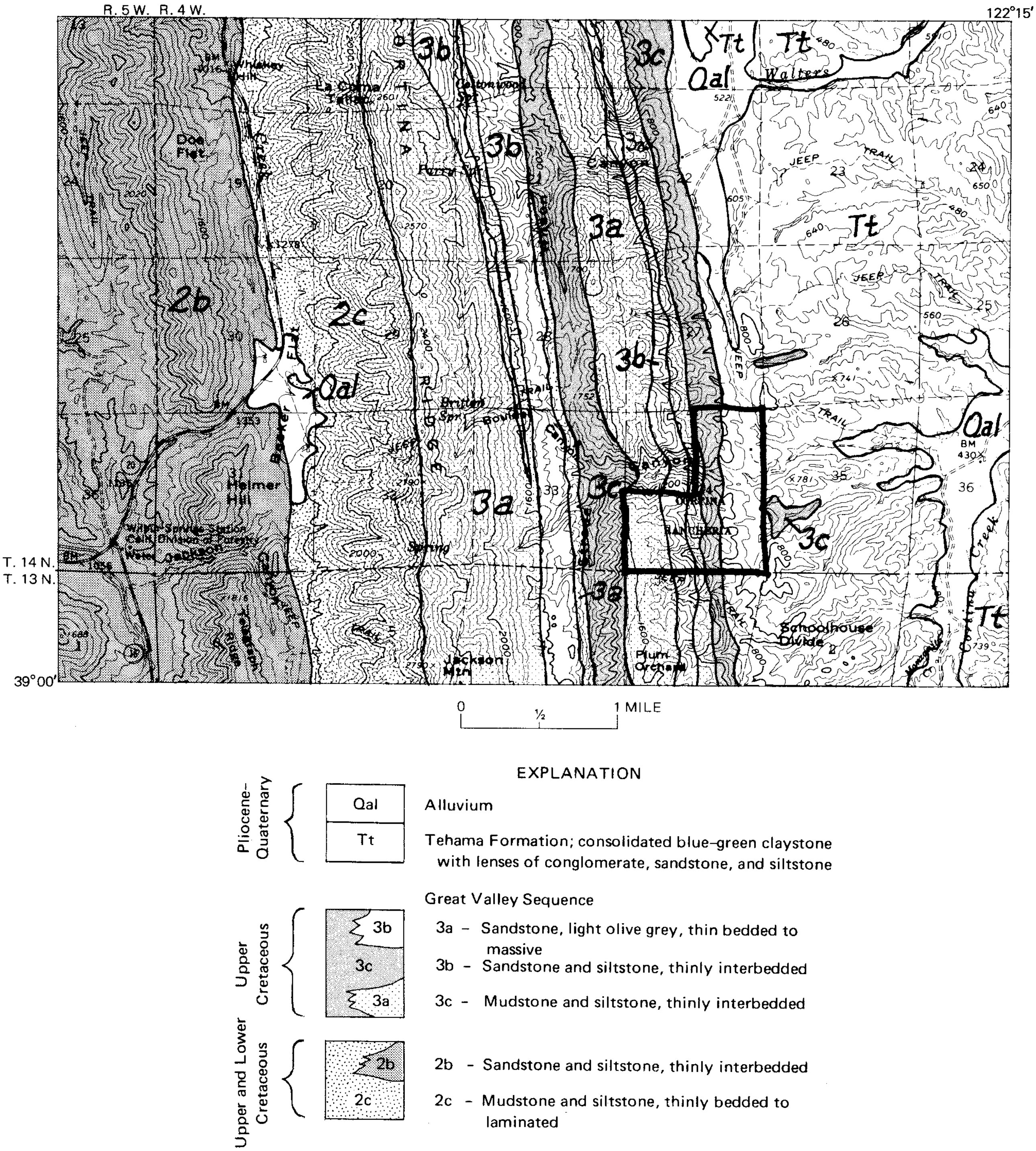

Figure 33. Geology of the Cortina Rancheria.

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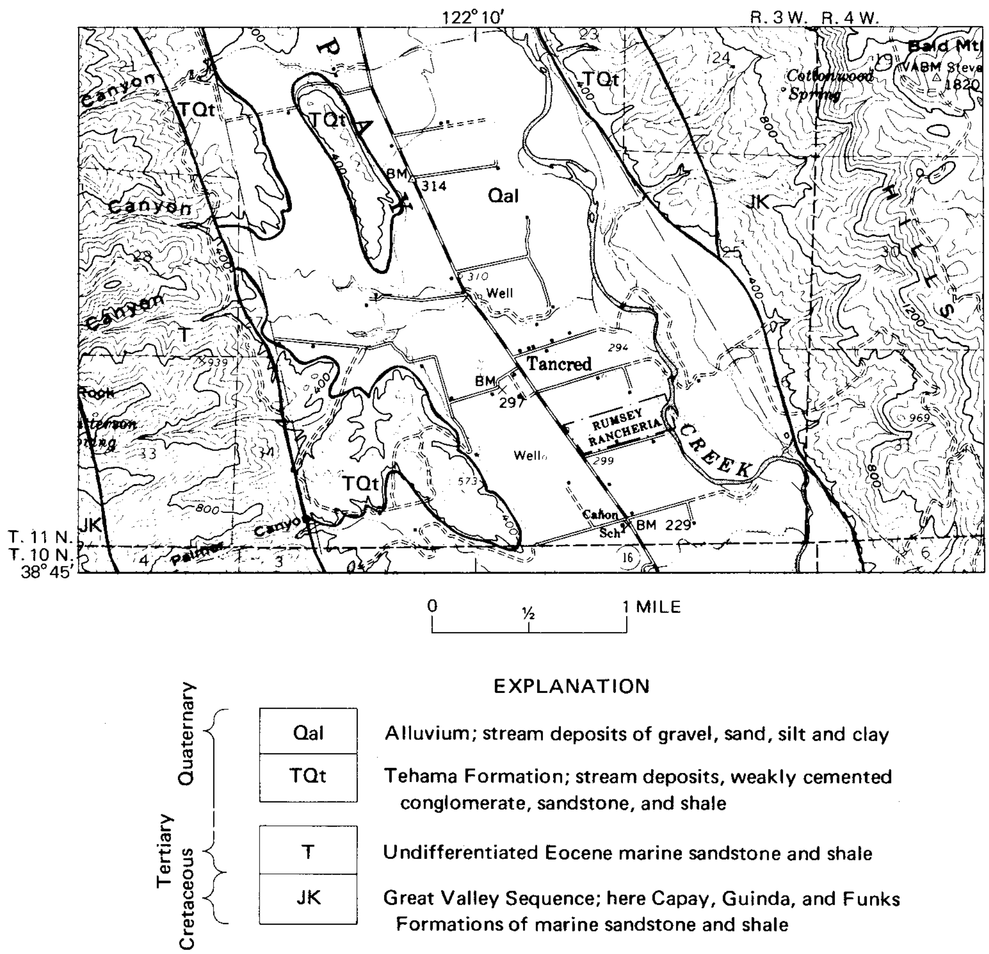

Figure 34. Geology of the Rumsey Rancheria (from Klein and Goldman, 1958).

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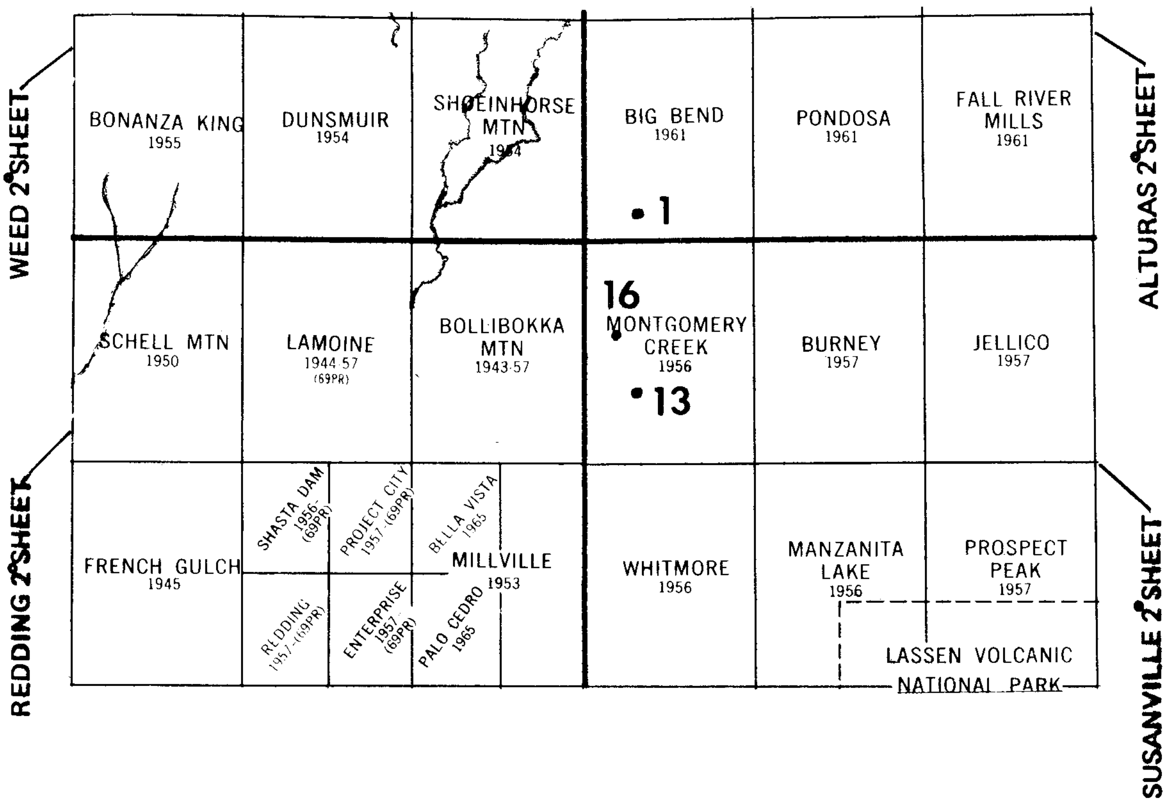

1. Big Bend
2. Big Lagoon
3. Cachil Dehe (Colusa)
4. Cortina
5. Dry Creek
6. Grindstone Creek
7. Hoopa Extension
8. Hoopa Valley
9. Hopland (abandoned)
10. Laytonville
11. Manchester (Point Arena)
12. Middletown
13. Montgomery Creek
14. Orleans Karok
15. Resighini
16. Roaring Creek
17. Round Valley
18. Rumsey
19. Sherwood Valley
20. Stewarts Point
21. Sulphur Bank
22. Trinidad

Figure 35a.

Click back button (<<) on toolbar to return to text

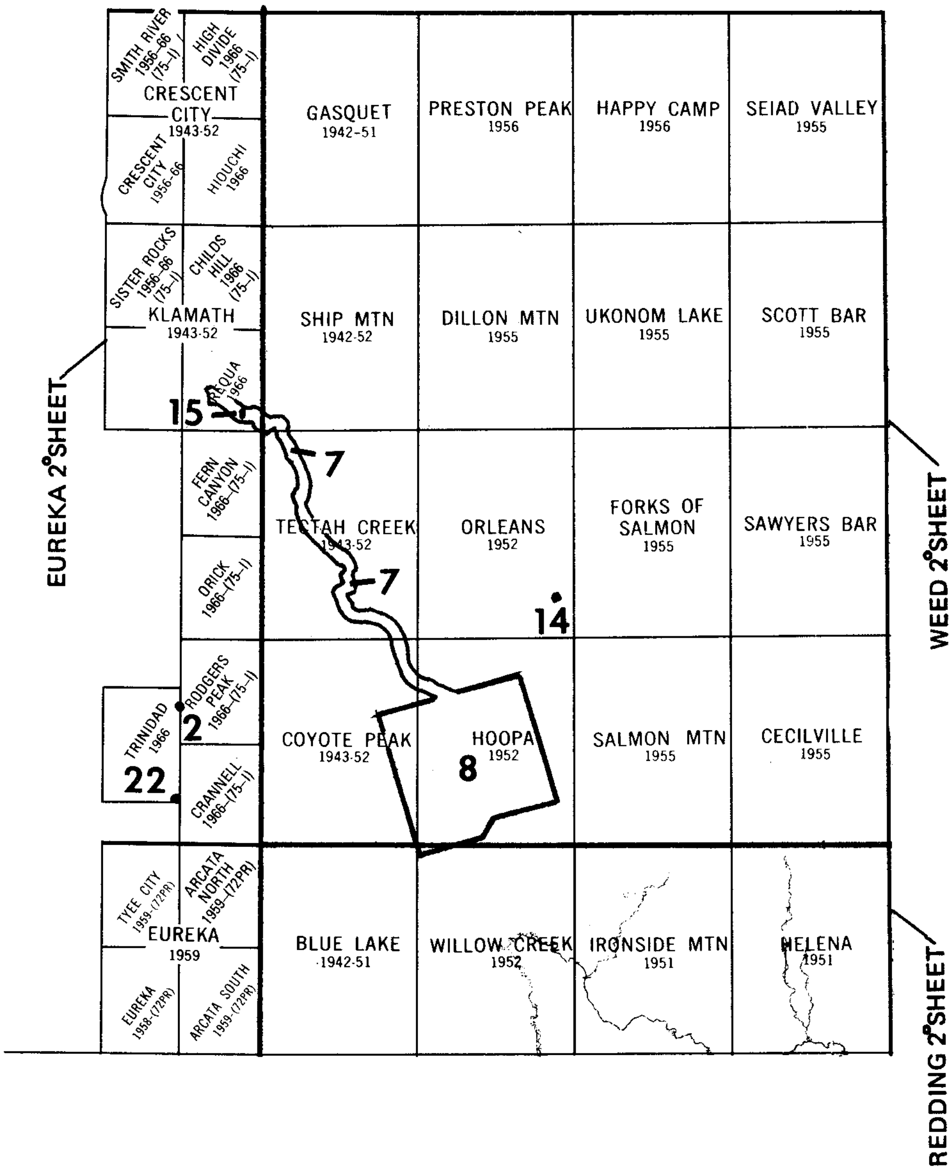

Figure 35b.

Click back button (<<) on toolbar to return to text

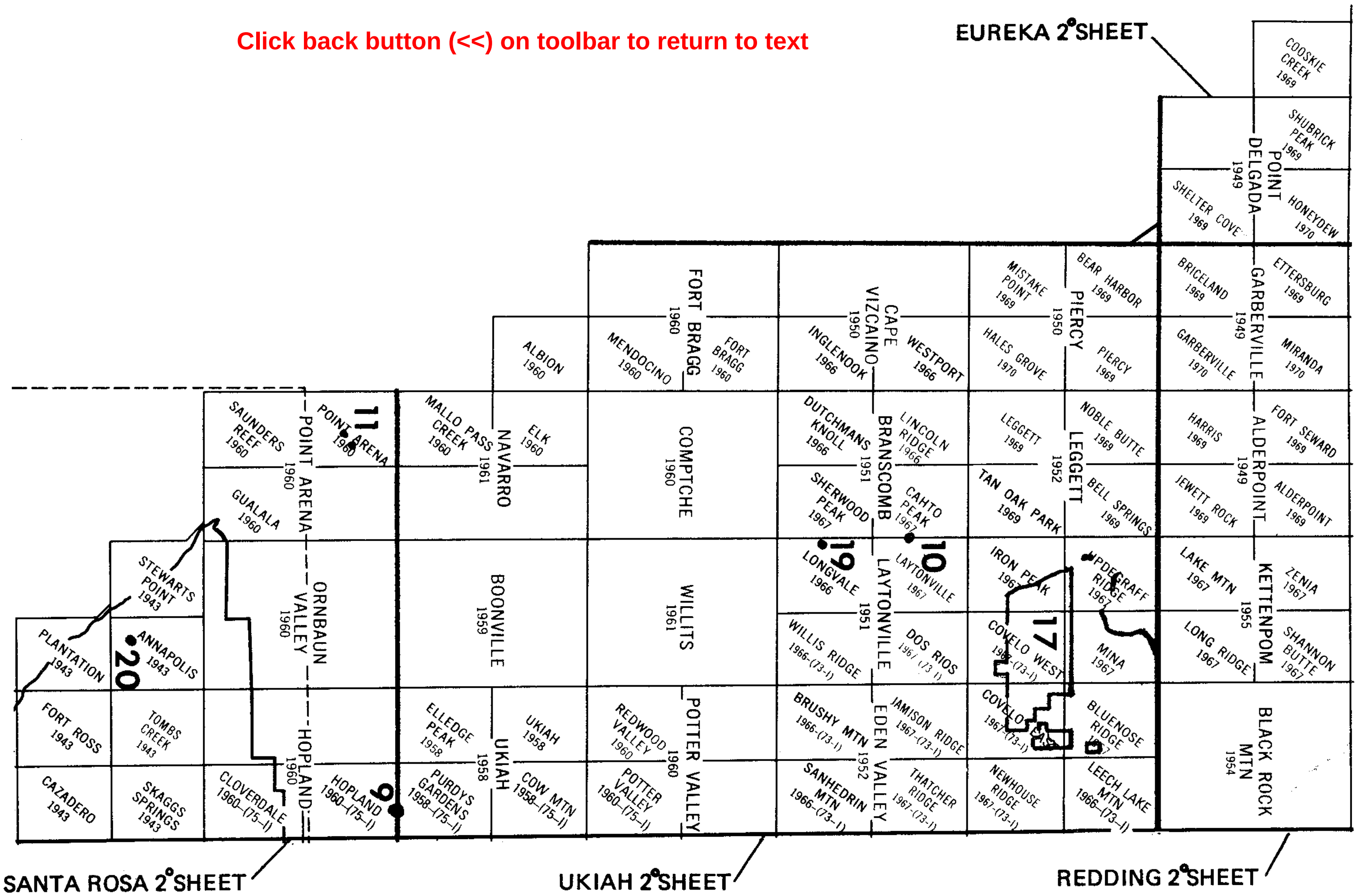

Figure 35c.

Click back button (<<) on toolbar to return to text

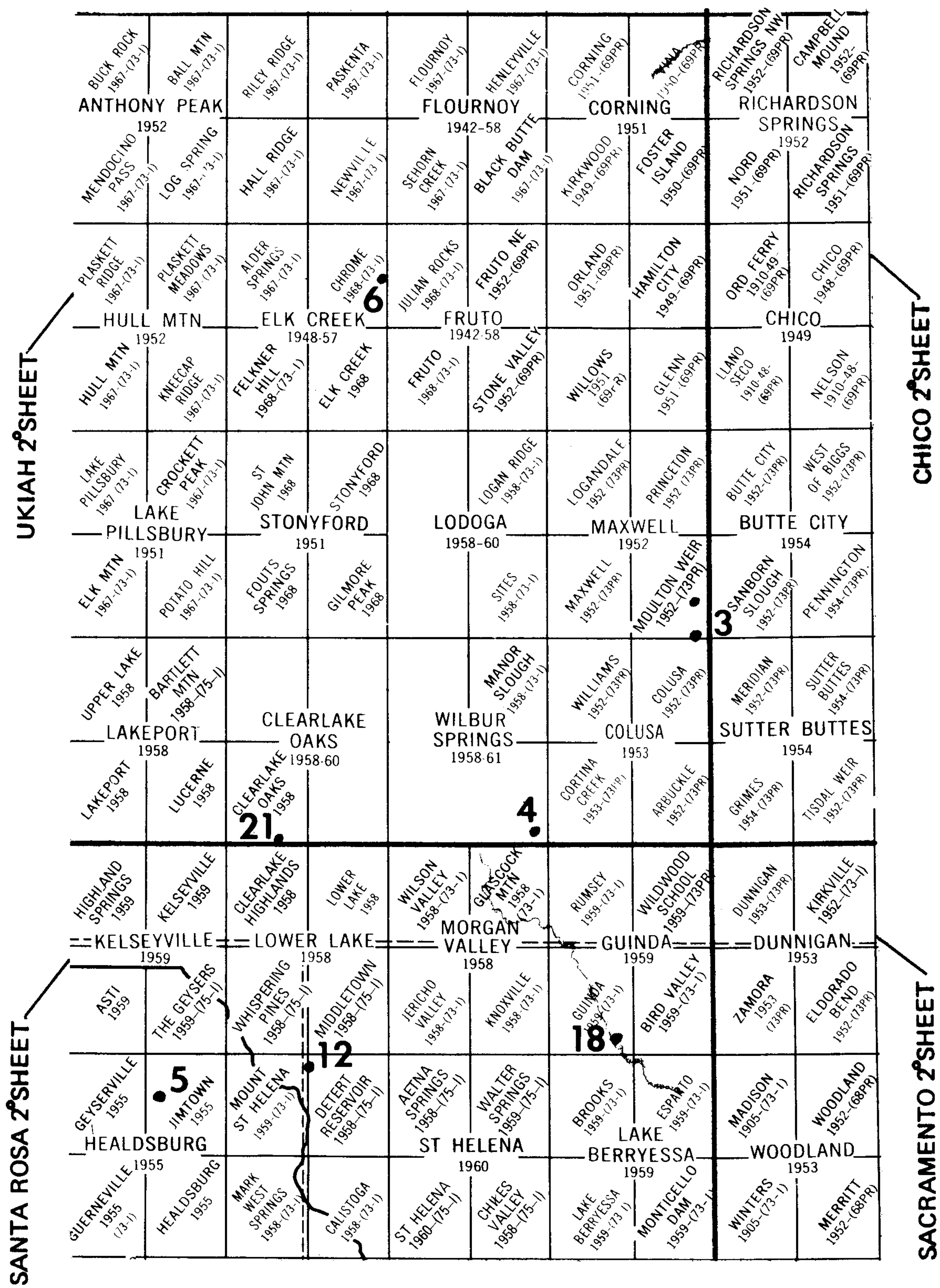

Figure 35d.