ECONOMIC MINERAL DEPOSITS OF THE CASCADE RANGE, MODOC PLATEAU, AND GREAT BASIN REGION OF NORTHEASTERN CALIFORNIA

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The minerals industry of this region—about 16,500 square miles comprising the northeastern corner of California—is dominated by three factors: (1) A narrow range in variety of rocks, which are predominantly Cenozoic basalt and andesite, with local lake-bed sedimentary rocks; (2) a low population density both in and about the region, creating but minor local market demand, and (3) the lack of known commercial deposits of any mineral commodities except pumice, volcanic cinders, and peat suitable for mining and shipping to more distant population centers. Although transportation routes through the region are not numerous, rail and highway routes are more than adequate to meet the foreseeable demand for hauling mineral products.

The principal mineral commodities of the region, all of which are directly related to its volcanic terrane, are volcanic cinders, pumice and pumicite, and crushed stone—used for railroad ballast, lightweight aggregate, and regular aggregate, respectively. Volcanic products of potential importance are tuffaceous stone, for dimension stone; perlite, for lightweight aggregate; and obsidian, sought by rock collectors for decorative purposes. Numerous areas of hot springs, related to recent volcanic activity in the region, are possible sources of geothermal power, but none has been developed so far.

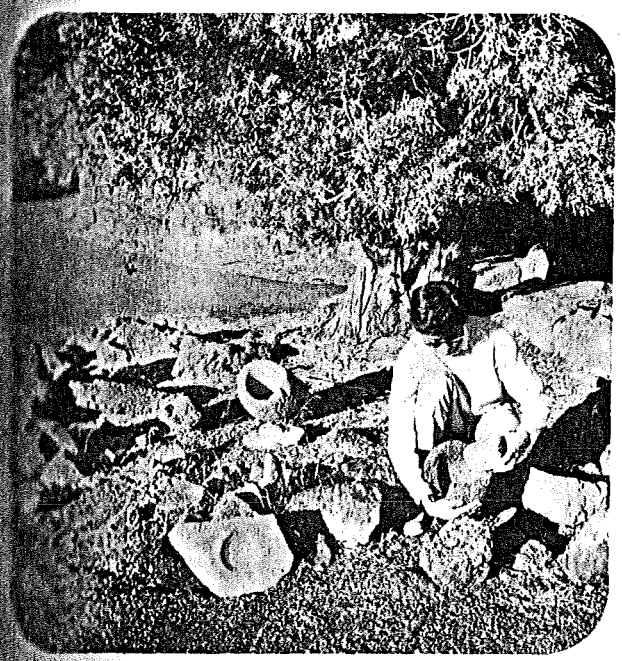


Plate 1. Indian mortars and pestles made from volcanic rock. Modoc Lava Bed Museum. *Photo by Mary Hill.*

Metallic commodities are notably lacking in the region, although three minor gold districts, minor showings of quicksilver, scattered traces of copper, and one small uranium deposit are known.

Lakebed deposits include peat that is being utilized, diatomite as yet unused, and salt which has not been recovered for many years. Stream and flood-plain deposits of sand and gravel are used locally for aggregate, but their chemical reactivity owing to excessive glass creates a problem. Mainly of historical interest are minor showings of low-grade coal; local common clay deposits formerly used for brick; spring-deposited limestone once burned for local use as mortar; and various siliceous materials, such as jasper and petrified wood, sought by rock collectors.

METALLIC MINERAL COMMODITIES

Copper

Colorful showings of secondary copper minerals in local altered zones in andesitic rocks have encouraged minor prospecting at half a dozen localities in the region, but no production has resulted.

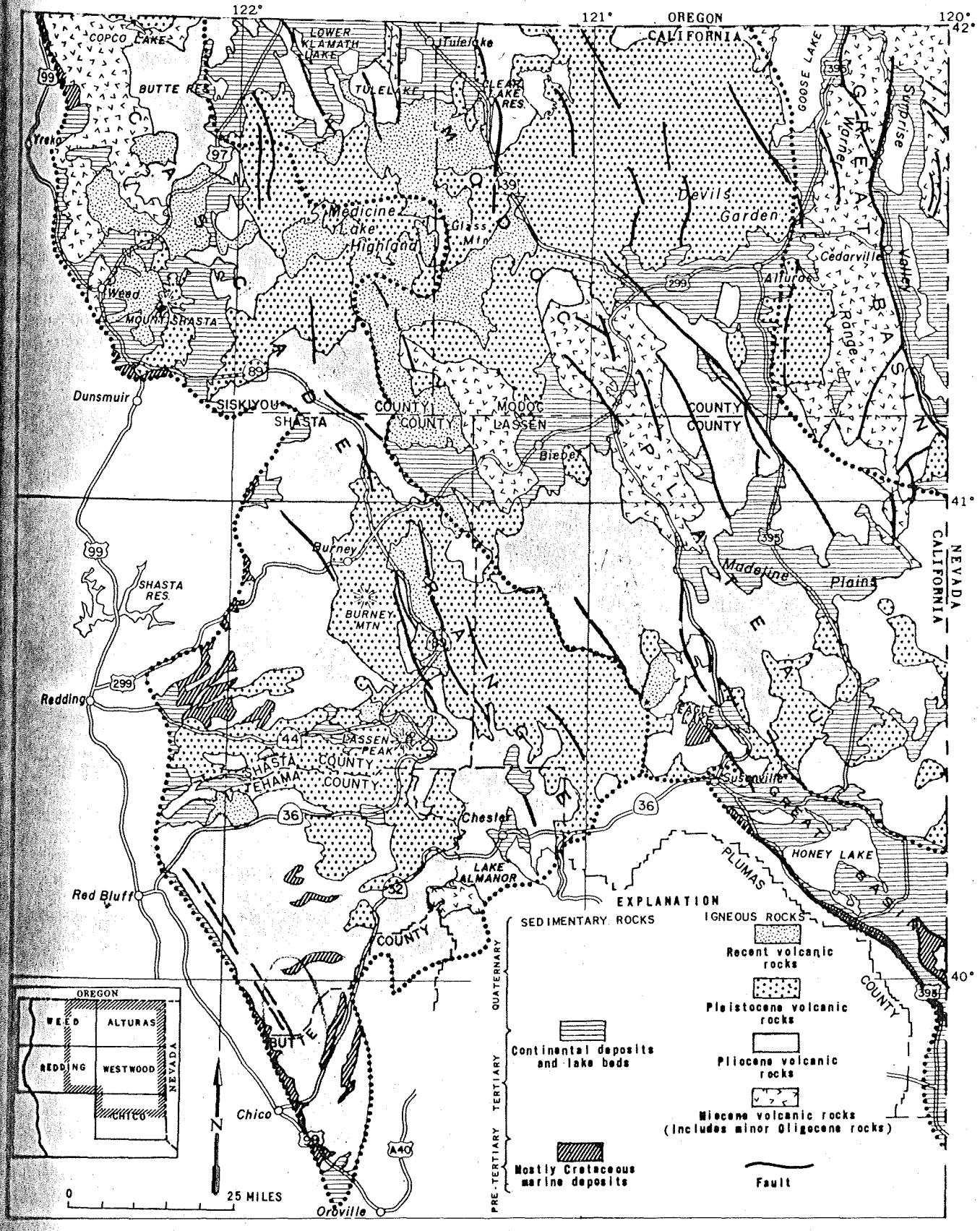
Gold

The Hayden Hill gold-mining district in Lassen County and the High Grade and Winters districts in Modoc County have yielded about $3,500,000 in gold and silver, mostly in the early 1900's; however, all have long been inactive.

At Hayden Hill, steeply dipping veins, 1 to 25 ft wide, cut Tertiary rhyolitic tuff and breccia. Free gold, valued up to $14 per ounce (1915), occurs in iron-stained and manganese-rich gouge and ochre seams. Workings, as long as 4,500 ft on the level, and as deep as 835 ft, followed veins containing oreshoots which were reported to be enriched by concentration by descending waters. An estimated total of about $2,500,000 in gold, with minor silver, was recovered from 1880 to 1911, and about $50,000 was won during the latest period of activity, 1924 to 1934.

Photo 2. Air photo of Medicine Lake Highland area, showing lava flows.

Figure 1 (opposite). Geologic map of portions of Cascade Range, Modoc Plateau, and G
provinces in northeastern California. Modified from Weed (1964), Alturas (1958), Redding (19
wood (1960), and Chico (1962) sheets of Geologic Map of California.



Great Basin
1962), West

At High Grade, in the northern Warner Range, rich but discontinuous oreshoots were found within a hundred feet of the surface. Gold occurred mainly in narrow stringers in quartz-filled, steeply dipping silicified breccia zones and veins in Tertiary rhyolite. Despite enthusiastic promotion of the camp in 1909–11, its productivity was about $75,000 from 1910 to 1919, and perhaps $10,000 from 1931 to 1934. Since 1934 it has been essentially inactive.

The Winters district, near Adin Summit, comprises only the Lost Cabin mine, which in the early 1900's yielded about $10,000 from oxidized gold-bearing ore occurring in sheared calcite- and quartz-filled brecciated zones in Tertiary andesite.

Quicksilver

At several localities along the east side of Goose Lake, Modoc County, traces of cinnabar occur with chalcedonic silica as vein and seam fillings in brecciated, iron-stained, Tertiary rhyolite and interbedded tuff. Despite furnaces (now ruins) built in the 1940's and earlier at three localities, and local reports of "several flasks" of quicksilver produced from small rich pockets reached by shallow workings, no production is recorded. Exploration, though sporadic in recent years, was underway in mid-1965.

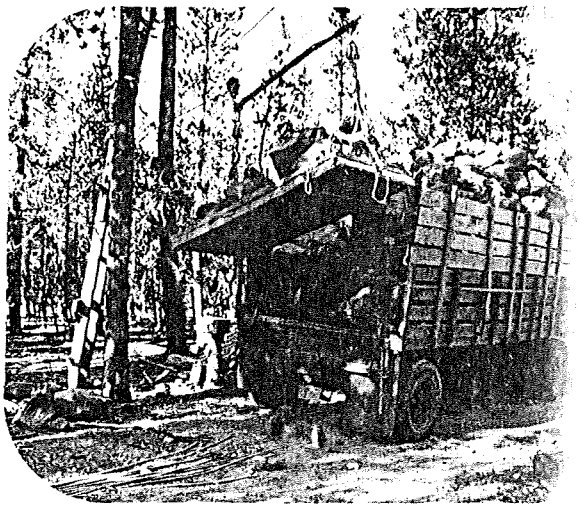
Uranium

On the Nevada line, northeast of Hallelujah Junction, Lassen County, autunite and other secondary uranium minerals occur in tuffaceous to sandy Tertiary lakebeds that overlap granitic basement. The uranium minerals occur disseminated and in seams, but are concentrated in and near woody and leafy organic material that is scattered in the lakebeds. In the late 1950's, open pit mining yielded a number of carloads of ore, averaging about 0.5 percent U_2O_3, shipped from Nevada to Salt Lake City, Utah. Exploration has been active in 1964 and 1965, but production, if any, is undetermined.

NONMETALLIC MINERAL COMMODITIES

Calcite (optical)

On the lower east slopes of the Warner Ra Modoc County, calcite pods and veins as muc 2 ft thick yield clear optical-grade calcite, sui for making polarizing prisms and other precision cal equipment. The calcite occurs in Miocene a sitic tuff-breccia of the Cedarville Series in two lo ties, just west of Cedarville, and 2 miles nort Eagleville. About 1,000 ounces of optical calcite f the more southerly location were sold in 1920 1921. This shipment included usable crystals as l as 12 inches. An additional undetermined quantity recovered from this deposit during World War I use in gunsights. In the late 1940's about 1,000 po of chemically pure calcite from the same deposit sold as a standardizing agent for testing acids, bu subsequent production is known.



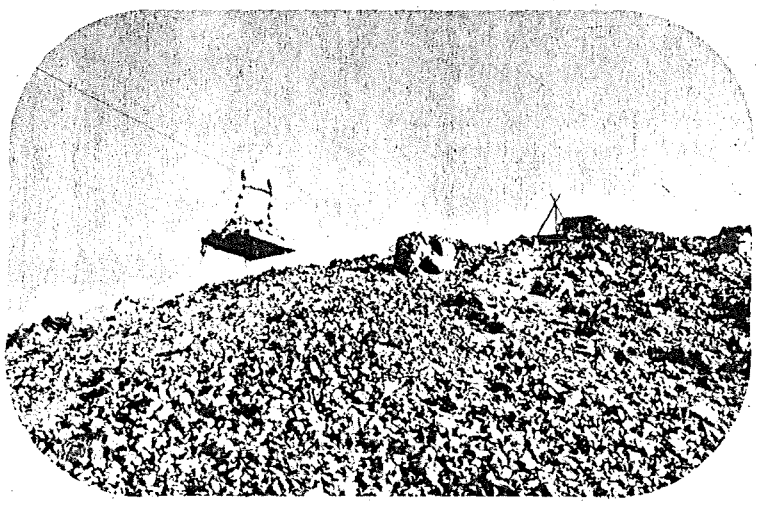


Photo 3 (left) and 4 (above). Mining volcanic rock for garden stone from the Little Glass Mountain area. *Photo by Mary Hill.*

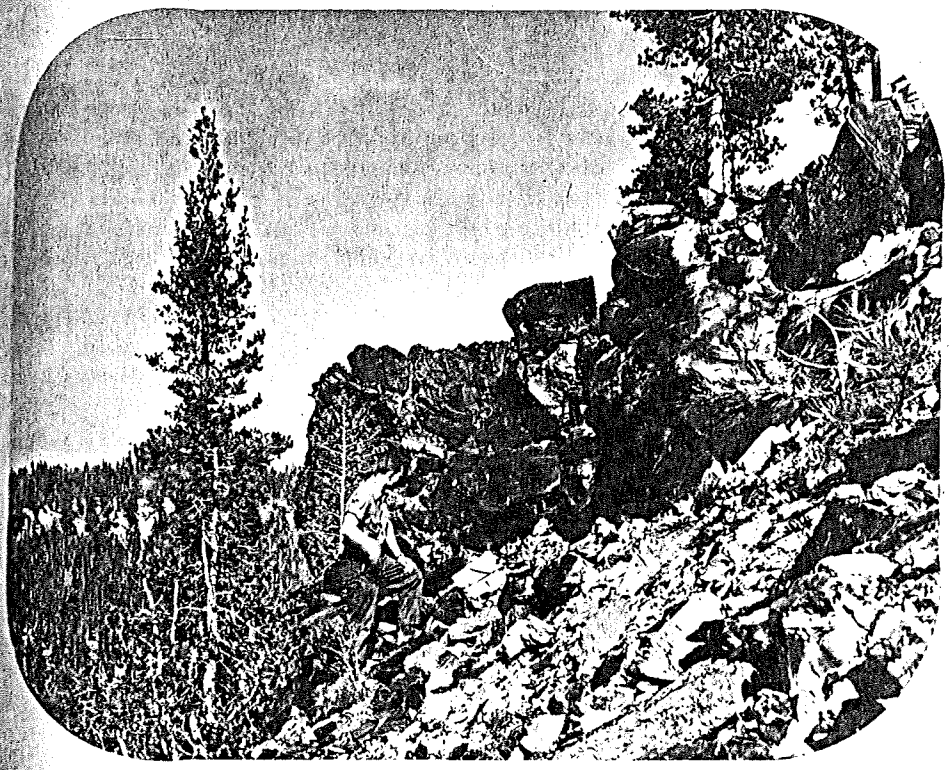


Photo 5. Face of an obsidian flow, Siskiyou County. *Photo by Charles W. Chesterman.*

Clay

Common clay, mostly alluvial soil, was quarried in the late 1800's, from several localities near the early towns of the region; it was burned in field kilns to make bricks for local buildings.

Coal

Thin seams of low-grade coal, and many weathered-out fragments, occur in Tertiary lakebeds and volcanic sedimentary rocks in various parts of the region, but not in commercial quantity or quality.

Decorative Stone

Various decorative limy spring deposits and siliceous rocks such as jasper, chalcedony, and petrified wood, are hunted by mineral collectors ("rockhounds") in the region. Obsidian also is sought, but it is discussed separately in this article as it has another use. Favorite collecting localities are in the eastern desertlike areas, especially near hot springs, in the Warner Range, and in parts of the terrain underlain by the Tuscan Formation.

Diatomite

Some of the lakebed deposits scattered throughout the region, and ranging in age from Early Tertiary to Recent, contain potentially commercial deposits of diatomaceous earth. These deposits are from a few feet to several hundred feet thick, and some are exposed over tens of square miles. Varying amounts of volcanic ash are present in many of the localities, but portions of most of the deposits are relatively pure diatomite and potentially usable. Some deposits are partly covered by thin basalt flows.

These diatomite deposits have not been completely surveyed or analyzed for potential usefulness, and no diatomite from this region has been sold commercially, although freshwater lakebed diatomite has been quarried in Oregon and in Nevada.

The principal diatomite deposits of the region are the Pliocene beds around Lake Britton, northeast Shasta County, and in Willow Creek Valley, northeast Siskiyou County. Less extensive exposures occur near Alturas, Modoc County; near Day, southwest Modoc County; near Karlo and Long Valley, Lassen County; and adjacent to Copco and Lower Klamath Lakes, Siskiyou County.

Hot Springs

A large number of hot springs found throughout the region apparently are related to the recency of volcanic eruptive activity and the abundance of faulting. The 28 hot springs shown on figure 2 are all described by Waring (1915, p. 115–144) as hotter than 90°F. In 1963 sources of geothermal power were sought by exploratory drilling about 2 miles north of Lake City, in Surprise Valley, about half a mile west of the area of recently active mud volcanos described by White (1955), but no development resulted.

Limestone

Small vein and spring deposits of limestone, of variable purity, were quarried and burned to make lime

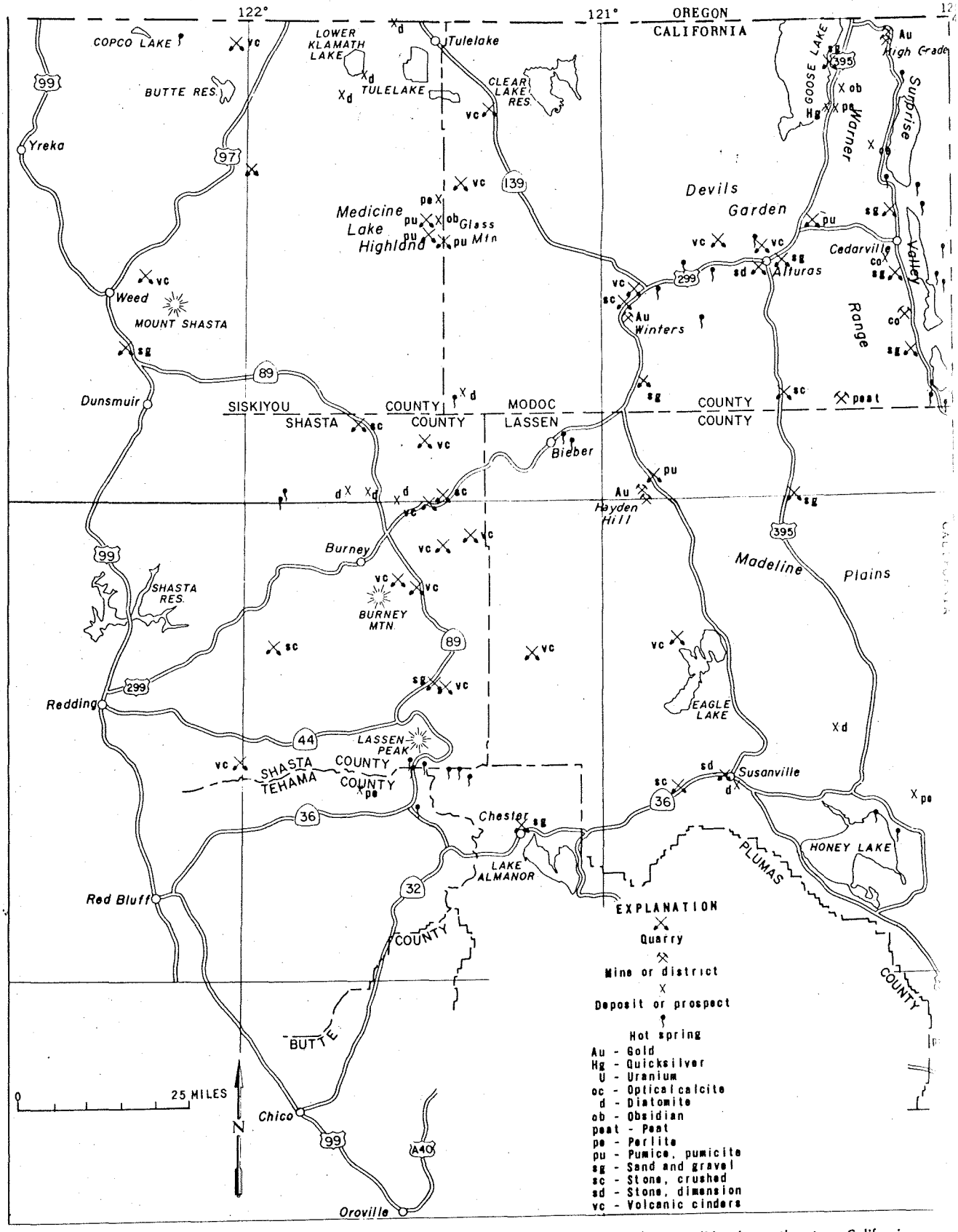
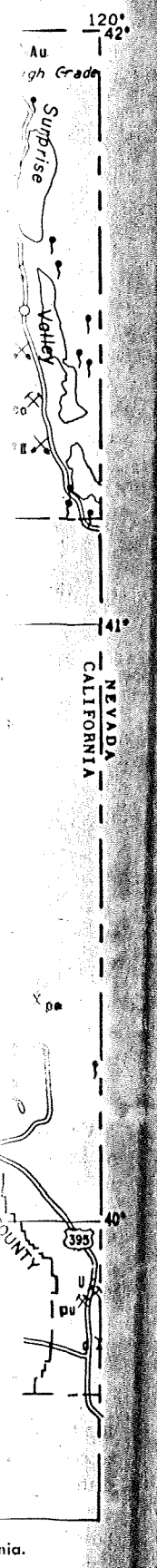


Figure 2. Map showing the location of hot springs and deposits of economic mineral commodities in northeastern California.



mortar for local building in various towns of the region, mainly during the 1800's.

Obsidian

Quaternary obsidian masses in the Medicine Lake Highland and in the Warner Range are sites of avid mineral-collector activity. Chatoyant ("rainbow") obsidian and red-streaked obsidian from the Warner Range are especially prized for cutting and polishing. Apparently, several thousand dollars worth of obsidian from the Warner Range was sold in the 1960's, and a large number of claims were staked covering desirable deposits. An unusual development came in the early 1950's, when several large pieces of clear obsidian from Glass Mountain, Siskiyou County, were cut and polished to make experimental industrial mirrors.

Peat

Recent accumulations of hypnum peat moss in the Pleistocene lake basin of Jess Valley, Modoc County, are the only source of peat moss in California. The usable peat layer is about 300 acres in area and about 1½ ft thick, lying beneath a foot of overburden. The deposit, which has been mined since 1939, yields in excess of 10,000 tons of peat moss a year. After the overburden is stripped, the peat is piled to dry for 2 months, then screened, shredded, and bagged in 80-pound bales at Likely for truck and rail shipment. The peat moss is used throughout California and seven western states for soil conditioner.

Perlite

Four deposits of perlite in the region were prospected and tested for lightweight aggregate in the late 1940's, but no production has resulted. These deposits are perlitic phases of Tertiary rhyolitic intrusions and flows, two at Sugar Hill, Modoc County; one at Cougar Butte, northeast Siskiyou County; and one at Hot Springs Peak, north of Honey Lake, Lassen County. A number of other perlite deposits that have not been tested occur with rhyolitic rocks in the region; one of the largest is in Battle Creek Canyon, Tehama County.

The first perlite to be tested for commercial expandability in California was several hundred tons from Sugar Hill, shipped to Campbell, Santa Clara County, for the test in 1947. The availability of good quality perlite in large, uniform deposits much closer to the main centers of use, is mainly responsible for the lack of utilization of these more remote deposits.

Petroleum and Gas

Cretaceous and Early Tertiary units that yield gas in the Great Central Valley Province, also contain gas where they project eastward beneath the Tuscan Formation in the Cascade Province (Safonov, 1952, p. 96). Indicated favorable structures east of Cottonwood, northeast of Red Bluff, and east and northeast of Corning have been drilled in a few places, but no production has resulted.

Pozzolan

The rhyolitic Nomlaki Tuff, and other tuffs in the Tuscan Formation, have been discussed by Faick (1963, p. 714–717) as potential sources of natural pozzolan. Other occurrences of vitric tuffs and siliceous volcanic sediments scattered through the region may also be suitable for use as pozzolan should a market develop.

Pumice and Pumicite

About 30,000 tons of pumice and pumicite (about one-third of California's annual production) are mined each year in this region, with almost all coming from deposits at Glass Mountain, eastern Siskiyou County. The quarrying of pumice and pumicite (particles of pumice smaller than 4 mm) began in this region in the mid 1940's and through 1965 totaled about 500,000 tons. The deposits of the Glass Mountain area consist of loosely consolidated grayish-white rhyolite pumice tuff breccia of Recent age. The tuff breccia occurs in a blanket that ranges in thickness from 1 to 60 feet, and extends over about 10 square miles northeast of Medicine Lake Highland, eastern Siskiyou and western Modoc Counties.

After the overgrowth and thin soil overburden is removed, the pumice is quarried in broad pits by scraper loaders, and trucked about 10 miles to Tionesta for screening and rail shipment, or to pumice block plants near Perez, Modoc County. About 75 percent of the pumice is made into blocks in the area, for shipment throughout northern California and Oregon; about 25 percent is shipped in bulk to the San Francisco area, where it also is used to make lightweight building block. Sized pumice costs about $2.20 per short ton at the railhead.

Several hundred tons of pumice scouring blocks are sawed each year from a pumiceous obsidian crust atop Glass Mountain.

Salt

Brine pumped by windmills from shallow wells and ponds in unconsolidated Recent lake sediments east of Middle Surprise Lake once yielded a small tonnage of crude salt by solar evaporation. The salt was used locally for stock feed in the early 1900's; the salt works has been inactive since 1925, and is almost obliterated.

Sand and Gravel

Most towns throughout the region have local sources of sand and gravel used in small noncommercial quantities for portland cement concrete and asphalt concrete aggregate. Owing to its high content of glassy volcanic rocks, much of the sand and gravel in the region is too reactive for high-specification portland cement concrete, although it is commonly used for less exacting purposes in local road construction. Highway-building contracts commonly specify crushed stone, or require sand and gravel hauled from deposits outside this region—especially for curbs, gutters, and bridges.

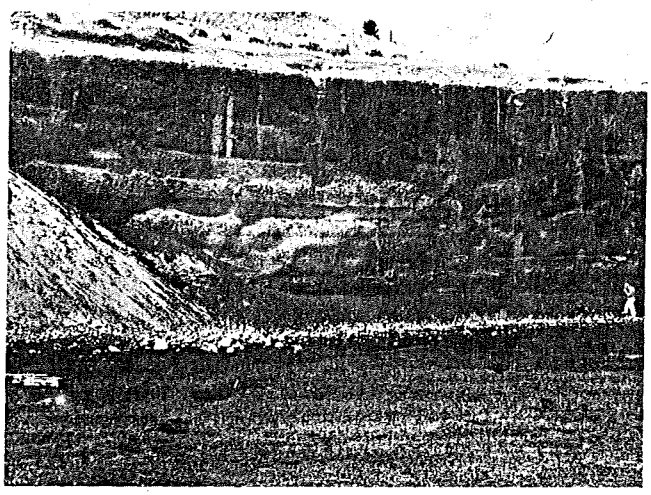


Photo 6. Volcanic cinder quarry on the southeast side of East Sand Butte near Tionesta, Modoc County. Layering represents repeated volcanic outbursts. Solid blocks of rock on quarry floor and in quarry face represent fragments of volcanic bombs. The cinders from this cone are used for railroad construction. Observer faces north. *Photo by Charles W. Chesterman.*

The region's principal sources of sand and gravel are local stream alluvium in various localities; deltaic lake terrace deposits in Goose Lake, Surprise, and Honey Lake Valleys, and in the Madeline Plains; and Quaternary flood-plain gravels near Alturas and Chester.

Stone, Crushed

Like sand and gravel, and volcanic cinders, crushed stone is produced and used throughout the region in undetermined tonnages, with almost all being used for asphalt concrete aggregate and road building material. Various Tertiary and Quaternary basalt and andesite flows are sources of high-specification crushed stone throughout the region; notable quarries are at Canby Bridge and Likely, Modoc County. Decomposed granitic rock is quarried for road and fill purposes in Honey Lake Valley, Lassen County, and elsewhere Tertiary andesitic tuff breccias and vent agglomerates are sources of crushed stone for road building uses.

Stone, Dimension

In the 1800's and early 1900's, small tonnages Tertiary tuffs and tuff breccias near Alturas, Mod County, and Susanville, Lassen County, were quarr for local use in a few public and commercial buildin None of these quarries has been active for seve decades.

Volcanic Cinders

Cinder cones at about 20 localities in northeast Shasta County, eastern Siskiyou County, and west Modoc County, have been sources of about 5 mill tons of volcanic cinders since large-scale quarry began in this area in the early 1930's. Production fr the region has been about 140,000 tons of volca cinders each year for the past decade—about tw thirds to three-fourths of California's annual prod tion.

The cinders at most cones are red, gray, or bl basaltic to andesitic scoria fragments. The cinders layered as they originally fell and are accompan by scattered volcanic bombs. Most of the cones have yielded cinders are Pleistocene, but a few Recent.

Quarrying operations are typically simple: A removal of thin overburden, the loosely consolid cinders are scraped and loaded into trucks for the to market. Sometimes the raw cinders are screened remove bombs and agglutinated clumps. The imm tonnages quarried for railroad ballast at Kegg, S you County, and East Sand Butte, Modoc Cou were loaded directly on railroad cars in the pits.

The main tonnage of volcanic cinders from this gion has been used for railroad ballast, although has been decreasing in the past decade; a lesser growing tonnage, from cones throughout the re is used as road material—fill, asphaltic concrete ag gate, and surfacing material. Smaller tonnages, but notably increasing over the past decade, are use lightweight aggregate in building blocks: the c at Hotlum, near Yreka, Siskiyou County, and P Lake, near Susanville, Lassen County, are the sources of volcanic cinders used for building bl

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