DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

GEOLOGIC MAP OF THE LAVIC QUADRANGLE SAN BERNARDINO COUNTY, CALIFORNIA

By

T. W. Dibblee, Jr.

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-472

PUBLISHED BY THE U. S. GEOLOGICAL SURVEY
WASHINGTON, D. C.
1966

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TO ACCOMPANY MAP I-472

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DESCRIPTION OF THE MAP UNITS*

CENOZOIC SEDIMENTARY AND VOLCANIC ROCKS

Surficial sediments

Unconsolidated sediments of undissected fill in valley areas and flood plains of canyons. In large valley areas, fill about 100 feet thick, presumably grades downward into older alluvium or older valley sediments; elsewhere thinner and unconformable on older formations. Age, very late Pleistocene and Recent. Composed of following facies units:

Windblown sand.--Loose fine sand deposited as thin cover on alluvium by prevailing westerly winds.

Fan gravel.--Coarse gravel of unsorted subangular to subrounded fragments as large as 3 feet in diameter in coarse sandy matrix. Derived from adjacent mountains and deposited as alluvial fans. Top surface slopes 300 feet per mile or more; grades downslope into alluvium.

Alluvium.--Detrital sediments ranging in size from cobble gravel through pebbly coarse sand to sand and silt in lower parts of valley areas; top surface slopes generally less than 300 feet per mile.

Clay.--Light-gray alkaline clay of Galway and Lavic Lakes (usually dry); top surface practically level.

Basalt of Pisgah flow and Pisgah Crater

One or more basalt flows that erupted from Pisgah Crater onto alluvium and partly onto clay of northern part of Lavic Lake. Age, very late Pleistocene or Recent. Composed of the following units:

Basalt lava.--Vesicular, black, hard, fresh microcrystalline to vitreous basalt composed of gray calcic plagioclase and basaltic glass and small amounts of pyroxene, olivine, and magnetite; commonly contains green phenocrysts of olivine. Rock somewhat porous with minute interstitial vugs. Vesicles generally alined and flattened parallel to top and base of flows. Basalt composed of several(?) lava flows that total about 50 feet or more thick around Pisgah Crater, but which taper outward to a single thin flow only a few feet thick at margin. Top surface of flow buckled into numerous broken folds by hardening of upper surface while molten lava continued to flow.

Basalt pumice.--Fragments and lapilli of brownish-black scoriaceous basaltic glass or pumice that forms Pisgah Crater.

*Potassic and sodic-calcic (plagioclase) feldspar content of igneous rocks determined by chemical staining of sawed surface by M. B. Norman

Older alluvium

Mostly massive to crudely bedded fanglomerate and gravel of unsorted fragments derived from adjacent mountains. Dissected where elevated. As thick as 200 feet at north base of Bullion Mountains; light-gray where derived from andesitic or granitic rocks, black where derived from basalt of Lava Bed Mountains. Similar to older fanglomerate and gravel unit, but undeformed and fragments generally smaller; unconformable on older valley sediments and on basalt of Sunshine flow as well as on Tertiary rocks. Age, presumably Pleistocene.

Basalt of Sunshine flow and craters

Basalt lava erupted from at least three small craters northeast of Sunshine Peak; unconformable on Tertiary and Mesozoic rocks. Age, presumably Pleistocene. Composed of units as follows:

Basalt lava.--Vesicular, hard, black microcrystalline to vitreous basalt composed of gray plagioclase and basaltic glass, and small amounts of pyroxene, olivine, and magnetite; commonly contains green phenocrysts of olivine. Rock somewhat porous with minute interstitial vugs. Vesicles somewhat alined and flattened parallel to top and base of flows. Basalt forms several flows that may total 100 feet, thinning outward to margins. At surface, basalt is buckled into numerous minute folds and broken into angular blocks.

Basalt pumice.--Brownish-black scoriaceous basalt composed of basaltic glass; forms three small craters.

Older valley sediments

Mostly coarse detrital sediments deposited as alluvial fans by torrential downpours in former valley areas; unconformable on older formations; much dissected in areas where elevated and deformed; maximum exposed thickness about 2,000 feet in southern Lava Bed Mountains; presumably underlies surficial sediments in most of larger valley areas. Age, presumably Pleistocene, possibly in part very late Tertiary. Exposure northwest of Lavic Lake possibly Tertiary. Composed of the following units:

Fanglomerate and gravel.--Light-gray, weakly consolidated, alluvial sediments. Mostly unstratified fanglomerate of unsorted cobbles and boulders in coarse sandy matrix, but includes some crudely bedded cobble-pebble gravel and bedded gravelly sand and silt. In Lava Bed Mountains, detritus mostly

of Mesozoic igneous rocks (mostly biotite quartz monzonite and dike rocks), and Tertiary volcanic rocks (including basalt of Lava Bed Mountains); lower part of sequence contains intercalated gray to orange-gray soft arkosic sandstone and siltstone. In northeastern part of quadrangle, mostly unstratified fanglomerate of detritus derived from nearby Tertiary volcanic rocks. In sec. 7, T. 7 N., R. 5 E., in northwestern part of quadrangle, unit is greenish- to brownish-gray coarse sand and gravel derived mostly from Tertiary volcanic rocks.

Tuff.--Gray-white to buff, massive medium- to coarse-grained tuff composed of glass shards and small fragments of pink to gray rhyolitic to andesitic felsite. Forms a stratum as thick as 12 feet, present locally in lower part of fanglomerate and gravel in Lava Bed Mountains.

Red conglomerate.--Red to brown, hard, massive to bedded conglomerate of subrounded fragments as large as 2 feet in diameter, mostly of biotite quartz monzonite, in matrix of hard, gritty arkosic sandstone cemented by hematite; largest fragments at base, decrease in size upward. Forms hard consolidated facies in lowest part of section; grades laterally westward and upward into light-gray fanglomerate and gravel unit described above.

Boulder gravel.--Gray gravel or conglomerate of subrounded boulders (as large as 4 feet in diameter) of biotite quartz monzonite in loose fragmental granitic matrix. Forms lens as thick as 150 feet at base of older valley sediments at south border of quadrangle.

Basalt of Lava Bed Mountains

Black, massive, hard, slightly to moderately vesicular basalt, breaks into large angular blocks; microcrystalline, composed of calcic plagioclase (usually as laths), pyroxene, and finely divided iron oxides (magnetite?); usually contains a few phenocrysts of olivine (largely altered to greenish-yellow iddingsite). Forms lava flows that total as much as 200 feet; unconformable on Tertiary tuff-breccia, in places with angular discordance, especially in area east of Lavic Lake; unconformably(?) overlain by Pleistocene fanglomerate and gravel unit. Age, probably late Tertiary or early Quaternary on basis of stratigraphic position. Referred to the Black Mountain Basalt, Pliocene(?) and Pleistocene, by Gardner (1940, p. 284-286, pl. II).

Basalt dikes

Black nonvesicular microcrystalline basalt similar in composition to basalt of Lava Bed Mountains where it forms feeder dikes as thick as 30 feet.

Rhyolitic felsite

Light-brown-gray, brown-weathering, massive, hard, fine-grained felsite or silicified tuff; contains a few small phenocrysts of sodic plagioclase and some of iridescent sanidine, a few of quartz, and minute flakes of biotite; lies unconformably on Tertiary volcanic and sedimentary rocks in northern Bullion Mountains. Age, presumably late Tertiary or early Quaternary.

Sedimentary rocks

Stream-laid sedimentary rocks exposed only in SW 1/4 sec. 18, T. 7 N., R. 5 E.; form basal part of a sedimentary section as thick as 3,000 feet to west in Rodman Mountain quadrangle; probable unconformity at base. Age, presumably Tertiary, most probably Miocene. Composed of the following units:

Fanglomerate.--Gray, unstratified, composed of unsorted subrounded boulders, cobbles, and pebbles derived mostly from Mesozoic porphyry complex, biotite quartz monzonite, and hornblende-diorite exposed west of quadrangle.

Granitic breccia.--Gray breccia of biotite quartz monzonite rubble.

Sandstone.--Red, pink to light-gray, bedded, medium- to coarse-grained, arkosic; contains some granitic pebbles.

Intrusive volcanic rocks

Volcanic rocks occurring as plugs, pods, and dikes, intrusive into pre-Tertiary rocks and Tertiary volcanic and sedimentary rocks; probably fill vents and fissures through which the Tertiary volcanic rocks erupted. Age, Tertiary, most likely Oligocene or Miocene. Composed of the following units:

Intrusive basalt.--Similar to basalt of volcanic and sedimentary rocks described below, but diabasic, nonvesicular; occurs as intrusive pods.

Andesite porphyry.--Light-greenish-, pinkish-, or brownish-gray, massive to faintly flow-laminated andesitic rock; large masses highly porphyritic, with phenocrysts making up from 20 to 50 percent of rock mass; dikes somewhat darker and less porphyritic, with phenocrysts making up less than 20 percent of rock mass. Most phenocrysts are white plagioclase (andesine?); others are biotite flakes, rarely clear quartz or basaltic hornblende needles; groundmass microcrystalline to subvitreous, composed mostly of plagioclase, little or no potassic feldspar, and specks of iron oxides. Large mass in secs. 29, 31, and 32, T. 7 N., R. 5 E., is greenish gray and contains abundant biotite phenocrysts.

Felsite.--Reddish-brown, light-pinkish-gray, tan, less commonly light-greenish-gray andesitic to dacitic felsite composed mostly of sodic plagioclase, a small percentage of potassic feldspar, in places a small percentage of quartz and specks of iron oxides; commonly contains a few small phenocrysts of sodic plagioclase and minute flakes of biotite; rock aphanitic (microcrystalline) to subvitreous, commonly slightly porous with minute vugs, massive to faintly flow-laminated, commonly fractures into platy slabs. Occurs as intrusive pods or plugs.

Volcanic and sedimentary rocks

Assemblage is mostly volcanic and pyroclastic rocks and a few sedimentary rocks. Unconformable on Mesozoic granitic rocks. In northwest part of quadrangle, only uppermost 1,500 feet of section is exposed. In Lava Bed Mountains, section is as thick as 4,000 feet. In Bullion Mountains, about 4,000 feet is exposed, top is eroded, base is exposed southeast of quadrangle.

Unfossiliferous. Age, Tertiary, probably correlative with assemblages of similar rocks of Oligocene to early or middle Miocene age outside of quadrangle. Composed of the following lithologic types that form lenticular or intertonguing units:

Basalt.--Dark-gray to black, massive to thickly layered flows, finely crystalline, composed of microlitic calcic plagioclase and pyroxene, with finer interstitial grains of plagioclase, magnetite, and greenish-yellow iddingsite (after olivine?); in places contains pseudophenocrysts of iddingsite after olivine; commonly semiporous with interstitial vugs; rock friable where weathered. Commonly vesicular, with vesicles and fractures filled with calcite, opal, chalcedony, and (or) quartz.

Andesite.--Massive pinkish-, purplish-, brownish- to greenish-gray porphyritic andesite. Contains phenocrysts (as large as 4 mm) which make up from 20 to 50 percent of rock mass, in microcrystalline to subvitreous groundmass. Most phenocrysts are white plagioclase (andesine?), but some are small plates of biotite and, in a few places, needles of basaltic hornblende; quartz phenocrysts are rare. Groundmass mostly plagioclase, with little or no potassic feldspar, and specks of iron oxides. Andesite forms extrusive masses, but in places may be in part intrusive.

Andesite breccia.--Similar to andesite but rock brecciated or fragmental, probably a flow breccia, composed of unsorted angular fragments of andesite in andesite matrix; massive to very crudely bedded, light-pinkish to very dark reddish-brown.

Latite felsite.--Gray, pink to pinkish-brown, massive to flow-laminated, microcrystalline to subvitreous, composed of plagioclase and potassic feldspar, with plagioclase predominant, possibly some quartz, and traces of iron oxides; contains a few small phenocrysts of sodic plagioclase and minute flakes of biotite. Apparently a flow, but possibly a sill-like intrusion.

Tuff breccia.--Tan, pinkish-tan, pinkish-gray to gray-white, moderately hard, crudely to moderately stratified; composed of small white fragments of devitried pumice and small to large angular fragments of Tertiary porphyritic to felsitic andesitic rocks in matrix of fine- to coarse-grained tuff. In Lava Bed and Bullion Mountains the unit contains intercalations of tuffaceous sandstone and volcanic conglomerate with cobbles and pebbles of Tertiary andesitic rocks; in Lava Bed Mountains some fragments are of dacite porphyry.

Sandstone and conglomerate.--In secs. 6, 7, and 18, T. 7 N., R. 5 E., buff, gray, whitish- to light-pinkish-gray, thick-bedded, semifriable, fine- to coarse-grained tuffaceous to arkosic sandstone and some conglomerate comprised mostly of granitic cobbles and pebbles.

Fanglomerate of andesitic detritus.--In Bullion Mountains grayish-brown, composed of unsorted subrounded boulders and cobbles of Tertiary volcanic rocks in friable fragmental matrix.

Fanglomerate of granitic detritus.--In sec. 7, T. 7 N., R. 5 E., light-gray, composed of unsorted boulders and cobbles of quartz monzonite in matrix of coarse granitic sand. In sec. 18, T. 7 N., R. 5 E., gray, composed of unsorted, subangular boulders mostly of biotite quartz monzonite in fragmental arkosic matrix.

Dacite porphyry

Gray-white to light-greenish-gray massive porphyry composed of euhedral and subhedral phenocrysts as large as 4 mm that make up 40 to 60 percent of rock mass, in microcrystalline groundmass. Most phenocrysts are white plagioclase (oligoclase-andesine), others are biotite, a few are hornblende, and a few clear subrounded ones are quartz. Groundmass gray-white, composed of plagioclase and potassic feldspar, with plagioclase generally predominant, and traces of iron oxides. At end of spur in sec. 24, T. 7 N., R. 5 E., north of Sunshine Peak, nearly all phenocrysts and groundmass plagioclase altered to potassic feldspar, and dark minerals partly altered to iron oxides. Fracture-coatings of epidote found in a few places. Dacite porphyry forms large intrusive mass of Sunshine Peak area, probably emplaced in part as merging dikes. Described as quartz porphyry, mapped as monzonite porphyry, Late Jurassic(?), by Gardner (1940, p. 274-275, pl. II). Intrusive into Mesozoic (Cretaceous?) quartz monzonite, probably emplaced during early stage of Tertiary volcanic activity. Age, most likely Oligocene or early Miocene, possibly older.

MESOZOIC PLUTONIC AND HYPABYSSAL IGNEOUS ROCKS

Quartz monzonite

Gray-white, massive, medium-grained granitic rock composed of quartz, potassic feldspar, and sodic plagioclase generally in equal proportions, 2 to 5 percent biotite (as scattered small plates), and total less than 2 percent sphene, zircon, and magnetite. West of quadrangle, intrusive into biotite quartz monzonite and Mesozoic dike rocks. Age, Mesozoic, presumably Cretaceous, possibly Late Jurassic.

Dike rocks

Parallel dikes from 1 to 15 feet thick, intrusive into biotite quartz monzonite. All composed of very hard, massive, finely crystalline rocks, with a few very small phenocrysts of plagioclase. Age, Mesozoic, as indicated by relationships outside of quadrangle. Composed of two types as follows:

Mafic (dioritic or andesitic) dikes.--Gray to dark-gray, composed of gray calcic plagioclase, commonly as laths, biotite, hornblende(?), and iron oxides.

Felsitic dikes.--White to pale-gray, composed mostly of sodic plagioclase, possibly some quartz; in a few places small amounts of potassic feldspar.

Biotite quartz monzonite

Gray, massive, medium-grained, commonly porphyritic granitic rock composed of from 10 to 30 percent quartz, 35 to 50 percent plagioclase (andesine); 15 to 30 percent potassic feldspar, in many places with some of potassic feldspar (orthoclase) occurring as rectangular phenocrysts as long as 2 cm; 3 to 20 percent biotite (as clusters of minute flakes, commonly

in part altered to iron oxides); 0 to 5 percent hornblende; and a total of about 1 percent sphene, zircon, and magnetite. Rock locally contains scattered to numerous dark inclusions (as long as 2 cm) of fine-grained biotite and plagioclase. In some places streaks of porphyritic rock, including phenocrysts, bleached white by hydrothermal(?) action, with biotite leached out and potassic feldspars commonly replaced by white albite. At one place in SW 1/4 sec. 34, T. 6 N., R. 5 E., about 30 percent of bleached porphyritic rock is fine grained, but feldspars are chemically unaltered. In a few places rock contains veinlets of epidote. Rock is nonporphyritic in southwest corner of quadrangle (secs. 18, 19, and W 1/2 sec. 20, T. 5 N., R. 5 E.) and in exposures southeast of Sunshine Peak. Age, Mesozoic, on basis of field relations west of quadrangle.

Biotite dorite

Dark-gray, massive, fine-grained dioritic rock composed of gray calcic plagioclase and biotite and small amounts of iron oxides. Probably intruded by biotite quartz monzonite. Age, presumably Mesozoic, possibly older.

MINES, PROSPECTS, AND QUARRIES

Gold, silver, lead, and copper

A. Mowry mine, SE 1/4 sec. 26, T. 7 N., R. 5 E. Gossan, as thick as 7 feet, of iron and manganese oxides and silica reportedly contains copper oxides, galena, cerussite, some silver and gold, along andesitic dike as wide as 30 feet; dike strikes northwest for more than 3,000 feet, dips 80°-90° SW, in dacite porphyry. Workings along about 1,000 feet of gossan include 4 shafts from 100 to 250 feet deep, and 2 adits 105 and 310 feet long, drifted into zone from canyon; worked at intervals from late 1800's to about 1938 (Tucker and Sampson, 1940, p. 245-246; Wright and others, tab. list., p. 81). Only 2 shafts now present on dike, and one on another dike about 500 feet southwest up canyon. All abandoned.

B. Imperial Lode mine, NW 1/4 sec. 36, T. 7 N., R. 5 E. Dark-brownish-gray hard dike, probably altered andesite, with aphanitic mylonitic(?) texture, composed largely of felsitic rock impregnated with oxides of iron and manganese, contains ore shoots of quartz, calcite, and barite that carry pyrite, chalcopyrite, argentite, and silver chloride, ore shoots reportedly as wide as 18 feet, as long as 50 feet; dike from 8 to 20 feet thick, strikes N. 60° W. for nearly 8,000 feet, dips 75°-80° SW, in dacite porphyry. Workings consist of adit driven northwest and another driven southeast into dike from main canyon; shaft (not seen) 100 feet deep with drifts and raises to surface; first worked in 1880's, occasionally until 1938. More than $40,000 in silver ore mined; small shipment in 1951 (Tucker and Sampson, 1940, p. 245; Wright and others, 1953, p. 108). Shallow adits and pits seen in two other dikes about half a mile down canyon.

C. Tiptop prospect, E 1/2 sec. 35, T. 7 N., R. 5 E. Iron oxide gossan, possibly contains silver and copper, in iron-stained andesite porphyry dike as thick as 5 feet, striking northwest in dacite porphyry. Prospected by adit driven southeast about 10 feet into dike. Long idle, abandoned.

D. Silver Cliffs (Silver Reef) mine, NW 1/4 sec. 18, T. 7 N., R. 5 E. Vein of light-gray coarsely crystalline calcite, reportedly contains oxides of copper, lead, silver (John A. Thiede, oral communication), vein from 3 to 15 feet thick, nearly vertical, strikes about N. 80° W., along fault in Tertiary volcanic and sedimentary rocks. Vein prospected by three shafts from 80 to 360 feet deep, with several hundred feet of appended drifts at various levels (Wright and others, 1953, tab. list., p. 84); dismantled mill and other buildings on property; long idle. Calcite vein said to contain rare earths, including rhenium, ReO (John A. Thiede, Lucerne Valley, oral communication, 1964).

Iron

E. Iron ore prospect, NE 1/4 sec. 32, T. 6 N., R. 5 E. Vein of flaky to massive hematite as thick as 3 feet and as long as 20 feet, and several smaller ones, in biotite quartz monzonite. Prospected from adit driven northwest about 20 feet into largest vein and several shallow pits on other veins. Long idle.

Magnesite(?)

F. Magnesite(?) prospects, SW 1/4 sec. 35, T. 6 N., R. 5 E. Layer of white dolomite with some magnesite, from 1 to 2 feet thick, somewhat nodular, strikes northwest, dips about 30° NE in Tertiary tuffaceous sandstone and green clay. Prospected by shallow pits. Long idle, abandoned.

Clay (bentonite)

G. Bentonite prospect, NE 1/4 sec. 8, T. 6 N., R. 5 E. Massive, white, very fine grained tuff, in part altered to bentonite, much shattered, possibly as thick as 30 feet, strikes north, in brecciated andesite. Prospected by shallow pit. Small tonnage removed. Long idle, abandoned.

South Hector bentonite deposit, S 1/2 sec. 26, N 1/2 sec. 35, T. 8 N., R. 5 E. Hectorite (or saponite), a form of bentonite, but with high magnesia, low alumina content, and up to 1 percent lithia and trace of fluorine, occurs as a waxy white soft nodular layer from 6 to 8 feet thick in sandstone and clay of Tertiary sedimentary rocks; strikes northwest into area north of quadrangle, dips 5° to 10° SW; overlain unconformably by basalt of Pisgah flow. Part within quadrangle worked from the two mines described below (Tucker and Sampson, 1940, p. 250-253; Wright and others, 1953, p. 157, 161; Ames and others, 1958, p. 22-37).

H. Inerto mine. Inclined shaft, with appended drifts and crosscuts to depth of about 70 feet in hectorite layer. About 250 to 300 tons of hectorite mined per year since about 1946. Only high-grade magnesium-rich hectorite taken for specialized uses, such as beverage clarification.

J. "National Lead" (Schundler or Ewrite) mine. (Leased to Baroid Sales Division of National Lead Co.) Vertical shaft 107 feet deep, with drifts in hectorite layer at 40- and 70-foot levels. About 10,000 tons of

hectorite mined from 1947 to 1951, mainly for use in drilling mud, but magnesium-rich beds sorted out for specialized uses. Still producing in 1964.

Pumice

K. Mount Pisgah volcanic cinder quarry, N 1/2 sec. 32, T. 8 N., R. 6 E. Scoriaceous basaltic glass or pumice fragments quarried from west slope of Pisgah Crater for use mostly as test material. Small tonnage quarried at various times since 1948 (Wright and others, 1953, p. 188, 189); quarried since 1960 by Atchison, Topeka, and Sante Fe Railway.

Agate and jasper

Veinlets of banded white agate associated with chalcedony, opal, chert, quartz, and calcite, and some of banded or mottled brown, yellow, red, and green jasper and opal, suitable for cutting and polishing into ornamental stones, present at various places mostly in basalt in Bullion Mountains, T. 5 N., R. 7 E. Material gathered by lapidaries until 1952, when areas became closed to public entry. A few veinlets found in basalt in SW 1/4 sec. 5, T. 7 N., R. 5 E., Lava Bed Mountains.

Fragments of colorful banded, mottled, and mossy jasper and less colorful chert in older fanglomerate and gravel near Lavic gathered for many years by lapidaries.

Gold(?) placer

L. "Maumee" prospect, NW 1/4 sec. 1, T. 5 N., R. 5 E., Lava Bed Mountains. Conglomerate of andesite cobbles and pebbles in tuffaceous matrix in Tertiary tuff breccia. Prospected by shallow pits and trenches, presumably for gold. "Maumee Mine" to southwest near center of east line of sec. 2, T. 5 N., R. 5 E., is a vertical shaft about 70 feet deep, in alluvium.

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