

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

**GEOLOGIC MAP OF THE LUDLOW QUADRANGLE
SAN BERNARDINO COUNTY, CALIFORNIA**

By
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MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-477



PUBLISHED BY THE U. S. GEOLOGICAL SURVEY
WASHINGTON, D. C.
1967

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DESCRIPTION OF MAP UNITS*

CENOZOIC SEDIMENTARY AND VOLCANIC ROCKS

Surficial sediments

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

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

Alluvium.--Detrital sediments ranging from cobble-pebble gravel to fine silty sand; mostly pebbly sand.

Fan gravel.--Coarse gravel of unsorted boulders, cobbles and pebbles in coarse sandy matrix, deposited as alluvial fans by runoff from torrential downpours. Grades downslope into alluvium.

Basalt flow

Erupted from craters south of quadrangle; at southeast corner of quadrangle forms one or more flows possibly as much as 100 feet in total thickness; farther north forms a flow only a few feet thick which is conformable on older alluvium; much dissected. Unconformable on Tertiary formations south of quadrangle. Basalt, black, massive, slightly vesicular, vitreous to microcrystalline. Composed mainly of basaltic glass, calcic plagioclase, and pyroxene, and small amounts of olivine and iron oxides. Age, presumably late Pleistocene.

Older alluvium

Crudely bedded brown gravel and sand, deposited as alluvial fans by runoff from torrential downpours, dissected where elevated; undeformed. Presumably as thick as 150 feet. Unconformable on older formations, including the older valley sediments, but in northeastern parts of quadrangle may be in part equivalent to the older fanglomerate and gravel. Age, presumably Pleistocene.

Older valley sediments

Alluvial and some lacustrine sedimentary deposits of former valley areas, as thick as 600 feet, unconformable on Tertiary formations; slightly deformed locally; much dissected where elevated. Age, presumably Pleistocene. Composed of the following units:

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

Older fanglomerate and gravel.--Crudely bedded to nonbedded grayish-brown fanglomerate and gravel, deposited by runoff from torrential downpours as alluvial fans. Composed of poorly sorted boulders, cobbles, and pebbles of Tertiary volcanic detritus in coarse sandy matrix.

Older clay.--Tan to light-gray poorly bedded clay and silt, and some interbeds of buff fine sand. Deposited in playa lakes. Forms lenses as thick as 150 feet in the older fanglomerate and gravel.

Basalt of Ash Hill

Basalt exposed mostly in vicinity of Ash Hill; black, hard, massive, slightly to moderately vesicular, breaks into large angular blocks, subvitreous to microcrystalline, composed of basaltic glass, calcic plagioclase (commonly as laths), pyroxene, and finely divided iron oxides (magnetite?); commonly contains a few phenocrysts of olivine. Occurs mainly as extrusive flows that may total as much as 150 feet thick in Ash Hill area; unconformable on the Tertiary volcanic and sedimentary rocks; unconformably overlain by the older valley sediments and older alluvium. Age, presumably late Pliocene or early Pleistocene, on the basis of stratigraphic position. The following units were mapped:

Basalt flows.--As described above.

Basalt dikes.--Four parallel ridges of basalt near Ash Hill believed to be dikes of basalt that fill fissures through which basalt flows erupted.

Rhyolitic tuff

Light-gray to lavender-gray, weathers to light-brownish-gray, hard but porous, surface is silicified and extremely hard; massive. Rock composed of abundant small phenocrysts of clear iridescent potassic feldspar (sanidine), others of plagioclase (albite-oligoclase), and few of biotite and hornblende, in fine-grained groundmass (of minute shards?) mostly of potassic feldspar and plagioclase containing quartz. At Pacific Mesa, 2-1/2 miles south of Stedman, forms capping as thick as 75 feet, contains fragments of volcanic rock and pumice, according to Bassett and Kupfer (1964, p. 19-20), and overlies sedimentary rocks of Pacific Mesa. On hill 3 miles southeast of Ludlow, as thick as 50 feet, and overlies basalt of Ash Hill, overlain by fanglomerate and gravel. At point 1-1/2 miles south of Ludlow, about 10 feet thick, unconformable on volcanic and sedimentary rocks. Age, presumably late Pliocene or early Pleistocene.

Stream-laid sedimentary sequence as thick as 387 feet, described in detail by Bassett and Kupfer (1964, p. 20); unconformable on the volcanic and sedimentary rocks, overlain unconformably(?) by rhyolitic tuff that forms Pacific Mesa 2-1/2 miles south of Stedman. Unfossiliferous. Age, most likely Miocene or Pliocene. The following units were mapped:

Sandstone.--Light-gray, bedded, friable, fine- to coarse-grained, micaceous, arkosic, and tuffaceous. Contains thin layers of conglomerate with pebbles of andesite porphyry and biotite quartz monzonite, includes one lens as thick as 15 feet of white pumice tuff.

Conglomerate.--Forms two lenses, each as thick as 100 feet, one at base of sequence in northernmost part, and other in upper part of sequence. Light-gray, poorly bedded, composed of poorly sorted small boulders, cobbles, and pebbles mostly of andesite porphyry and biotite quartz monzonite detritus.

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 volcanic rocks of this Tertiary assemblage erupted; age, therefore, Tertiary, most probably Oligocene or Miocene. Composed of the following units:

Intrusive basalt.--Similar to basalt of the volcanic and sedimentary rocks described below, but diabasic, nonvesicular; occurs as dikes, probably feeder dikes to basalt flows.

Andesite porphyry.--Unit ranges from andesite porphyry to dacite porphyry and quartz latite porphyry. Rock greenish, pinkish, to brownish-gray, massive to rarely faintly flow-laminated porphyry with phenocrysts that make up from 20 to 45 percent of rock mass in subvitreous to microcrystalline groundmass. Phenocrysts as large as 5 mm long. Most are plagioclase (oligoclase-andesine), of which some have rims of albite. A few are potassic feldspar, commonly rimmed or replaced by albite. In many places, especially in exposures southeast of Stedman, a few phenocrysts are clear quartz. Biotite plates are common to abundant. Groundmass is mostly glass, plagioclase (albite?), and some potassic feldspar. Rock forms irregular intrusive masses or volcanic piles. In area southeast of Stedman, rock mapped as "monzonite porphyry" by Gardner (1940, pl. 1), and in part as "quartz latite porphyry" by Bassett and Kupfer (1964, pl. 1, p. 18). In small intrusion 1-1/2 miles south of Ash Hill (peak) rock contains no potassic feldspar or quartz.

Andesite porphyry, hydrothermally leached.--Similar to andesite porphyry, but hydrothermally leached to light-buff, softer somewhat porous rock in which feldspars (including phenocrysts), are partly altered to cream-white kaolinite, and iron content (including that of biotite plates) is largely leached out. Rock forms central part of large mass of andesite porphyry of Stedman area.

Intrusive felsite.--Light-gray to tan, massive to locally flow-laminated, subvitreous to microcrystalline felsite composed mostly of glass, plagioclase, and some potassic feldspar. Forms dike as wide as 50 feet about 4 miles southeast of Ludlow.

Assemblage of volcanic flows, pyroclastic rocks, and coarse sedimentary rocks; characterized by extreme lenticularity and intergradation of lithologic units. Maximum exposed thickness of assemblage about 14,000 feet; rests unconformably on uneven surface of Mesozoic granitic rocks and earlier Tertiary volcanic intrusive rocks. Unfossiliferous. Age, Tertiary, most probably Oligocene or early Miocene, on basis of lithologic similarity to volcanic and sedimentary rocks of Oligocene or early Miocene age in Cady Mountains northwest of quadrangle (Dibblee and Bassett, 1966). Composed of the following lithologic units:

Fanglomerate of andesitic detritus.--Grayish-brown to red, crudely bedded, weakly to moderately consolidated fanglomerate of poorly sorted subrounded fragments as large as 2 feet in diameter mostly of Tertiary andesite and andesite porphyry, in matrix of coarse andesitic sandstone.

Fanglomerate of basaltic detritus.--Dark-gray, crudely bedded, weakly to moderately consolidated fanglomerate of poorly sorted subrounded fragments as large as 2 feet in diameter mostly of Tertiary basalt and porphyritic basalt in matrix of coarse basaltic sandstone.

Basalt.--Black, massive, moderately hard, finely crystalline, somewhat porous, with minute interstitial vugs. Basalt composed of basaltic glass, calcic plagioclase (commonly as minute laths), pyroxene, olivine, and finely divided magnetite; in places contains small phenocrysts of olivine (partly serpentinized), less commonly of calcic plagioclase; some flows contain amygdules of calcite, quartz, chalcedony, and opal, and locally contain veinlets of same minerals. Some flows have subplaty fracture generally parallel to top or base of flows. Some flows in northeast part of quadrangle somewhat brecciated.

Andesite.--Dark-reddish- to greenish-brown, aphanitic to porphyritic andesite, massive, hard; composed mostly of glass, plagioclase, and small amounts of potassic feldspar, with or without phenocrysts mostly of plagioclase and some minute plates of biotite. In places a few phenocrysts are potassic feldspar, rarely quartz. Porphyritic rock similar to andesite porphyry but with generally fewer phenocrysts. Forms thick lenticular flows, but may be in part intrusive. In places somewhat brecciated, gradational into andesite breccia.

Andesite breccia.--Same as andesite described above, but much brecciated, unstratified. Forms thick flow-breccias. Gradational into the fanglomerate of andesitic detritus and into the tuff breccia.

Tuffaceous conglomerate.--Light-gray to tan, bedded, moderately consolidated, composed of poorly sorted small boulders, cobbles, and pebbles of andesite and andesite porphyry embedded in matrix of tuffaceous to andesitic sandstone. Gradational into the tuff breccia.

Tuff breccia.--Tan to cream-white, moderately consolidated, massive to bedded pyroclastic rocks; mostly tuff breccia composed of scattered to numerous small to large angular fragments of aphanitic to porphyritic andesite (nearly as large as 1 foot in diameter), embedded in matrix of white to tan tuff, commonly with

biotite flakes. In places some massive tuff contains small subrounded fragments of devitrified pumice. Deposited as volcanic mud flows, ash and cinders.

Rhyolitic felsite. --Light-gray to tan, massive to flow-laminated, in places with subplaty fracture, vitreous to microcrystalline, composed of plagioclase and potassic feldspar, possibly some quartz, and traces of iron oxides; in places contains minute phenocrysts of feldspar and flakes of biotite. Forms short, thick flows or possibly sills.

Dacite porphyry

Unit ranges from dacite porphyry to quartz latite porphyry. Rock light-greenish-gray, massive composed of euhedral to subhedral phenocrysts as long as 5 mm that make up from 40 to 60 percent of rock mass, in microcrystalline (aplitic) groundmass. Most phenocrysts are white plagioclase (oligoclase-andesine), commonly zoned; a few are clear quartz, many are biotite plates, and a few are hornblende. Groundmass fine-grained, composed mostly of minute grains of plagioclase (albite) and interstitial potassic feldspar and a few specks of iron oxides. Forms large intrusive mass southeast of Ludlow. Similar to large intrusion of dacite porphyry in Sunshine Peak area in Lavic quadrangle to west that is intrusive into Mesozoic (Cretaceous?) quartz monzonite and emplaced probably during early stage of Tertiary volcanic activity (Dibble, 1966); age most likely Oligocene or early Miocene or older. Mapped by Gardner (1940, pl. 2, p. 274-5) as monzonite porphyry (described as quartz porphyry), Late Jurassic(?).

MESOZOIC HYPABYSSAL IGNEOUS ROCKS

Diorite dikes

Dikes as thick as 15 feet of dark-gray, fine-grained diorite composed of calcic plagioclase, hornblende, and biotite. Age, presumably Mesozoic.

MESOZOIC PLUTONIC IGNEOUS ROCKS

Granitic rock

Nearly white, massive, hard, medium-grained granitic rock composed of quartz, potassic feldspar, and sodic plagioclase, with potassic feldspar predominant over plagioclase, and about 1 percent biotite and accessories (sphene and zircon). Age, presumably Mesozoic.

Hornblende diorite

Dark-gray, massive, hard, medium- to coarse-grained dioritic rock composed mostly of hornblende and plagioclase, and small amounts of biotite, chlorite, and iron oxides. Age, presumably Mesozoic.

Biotite quartz monzonite

Light-gray, massive, hard, medium- to coarse-grained granitic rock composed of quartz, potassic feldspar and plagioclase (oligoclase-andesine) in proportions from nearly equal to slight predominance of plagioclase, and flakes of biotite (from 2 to 20 percent of rock mass). In a few places rock contains euhedral phenocrysts of orthoclase (in part replaced by albite). In some places rock contains inclusions or small pendants of migmatite or gneiss. In many places rock is iron stained, with biotite partly altered to chlorite and iron oxides.

MINES AND PROSPECTS

Gold, silver, and copper

(All in Stedman mining district)

A. Bagdad-Chase mine. Sec. 8, T. 6 N., R. 8 E. Discovered in 1903, operated from 1904 to 1910 by Bagdad-Chase Gold Mining Co., produced \$4,500,000 in gold from 150,000 tons of ore, treated at Barstow. Operated from 1910 to 1916 by Pacific Mines Corp. of New York, produced \$1,500,000 in gold, silver, and copper from 120,000 tons of ore, treated at Clarksdale, Ariz.; average grade of ore 1.82 percent copper, 0.35 oz in gold, 1.5 oz in silver per ton. Shut down from 1917 to 1938 because of litigation. Operated 1 year in 1938-39 by D'Aix Syndicate of Chicago, Ill., produced average of 0.89 percent copper and \$9.80 in gold, 0.85 in silver, per ton from 850 tons of ore. Operated from 1950 to 1952 by lessees; mined about 74,000 tons of ore for about \$1,000,000 in gold and copper. Idle since 1952, all equipment removed. From 1903 to 1952, about 400,000 tons of ore mined for a total of more than \$7,000,000 in gold, copper, and silver (Wright and others, 1953, p. 71-72, in part).

Ore is in dark, ferruginous and siliceous breccia that contains oxides of copper, mostly chrysocolla, and finely disseminated gold. Breccia is reportedly (Wright and others, 1953, p. 71) fault breccia from 8 to 20 feet wide, dipping gently north between "quartz-monzonite" footwall and "rhyolite" (probably dacite or andesite porphyry) hanging wall. But all dumps show tailings only of an andesite, porphyry, hydrothermally leached andesite porphyry, and breccia with fragments of both of these rocks, none of quartz monzonite.

Workings consist of three shafts a few hundred feet apart in triangular arrangement, a glory hole at south edge of mine, and numerous drifts and crosscuts. Westernmost shaft is vertical and 400 feet deep (Tucker and Sampson, 1940, p. 232-233; Wright and others, 1953, p. 71-72).

A. Old Pete (Yim-Wheelock) mine. NW 1/4 sec. 33, T. 7 N., R. 8 E. Ore containing disseminated gold in zone of brecciated andesite porphyry from 30 to 50 feet wide, about 600 feet long, dipping 30° E., in andesite porphyry. Developed by open cut, and tunnel driven south about 60 feet below open cut. About \$30,000 in gold produced prior to 1939 (Tucker and Sampson, 1940, p. 240).

Undesignated gold mines of Stedman mining district, including Bagtown area. Numerous shafts, adits, pits and trenches dug by many prospectors and miners, mostly between 1904 and 1932, in search for gold. Deepest shaft about 150 feet. Only a few yielded small amounts of gold, but amounts of production not recorded. All now idle or abandoned. Most are along brecciated or shear zones in andesite porphyry, near or along contact with hydrothermally leached andesite porphyry. Several small mines (Gold Standard Group, Bullion Range, Ludlow Belle, Markeson, and Dull Pick mines) described by Tucker and Sampson (1940, p. 232-240), but locations uncertain.

Barite

C. Hansen Barite Deposit. NE 1/4 sec. 36, T. 8 N., R. 7 E. Barite veins in andesite. Main vein from 3 to 14 feet thick, strikes N. 45° W., dips steeply north-

east. Mined from open pit and trench for about 150 feet. Several small parallel veins not worked. About 4,000 tons of barite mined (Tucker and Sampson, 1940, p. 249, in part). Idle.

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