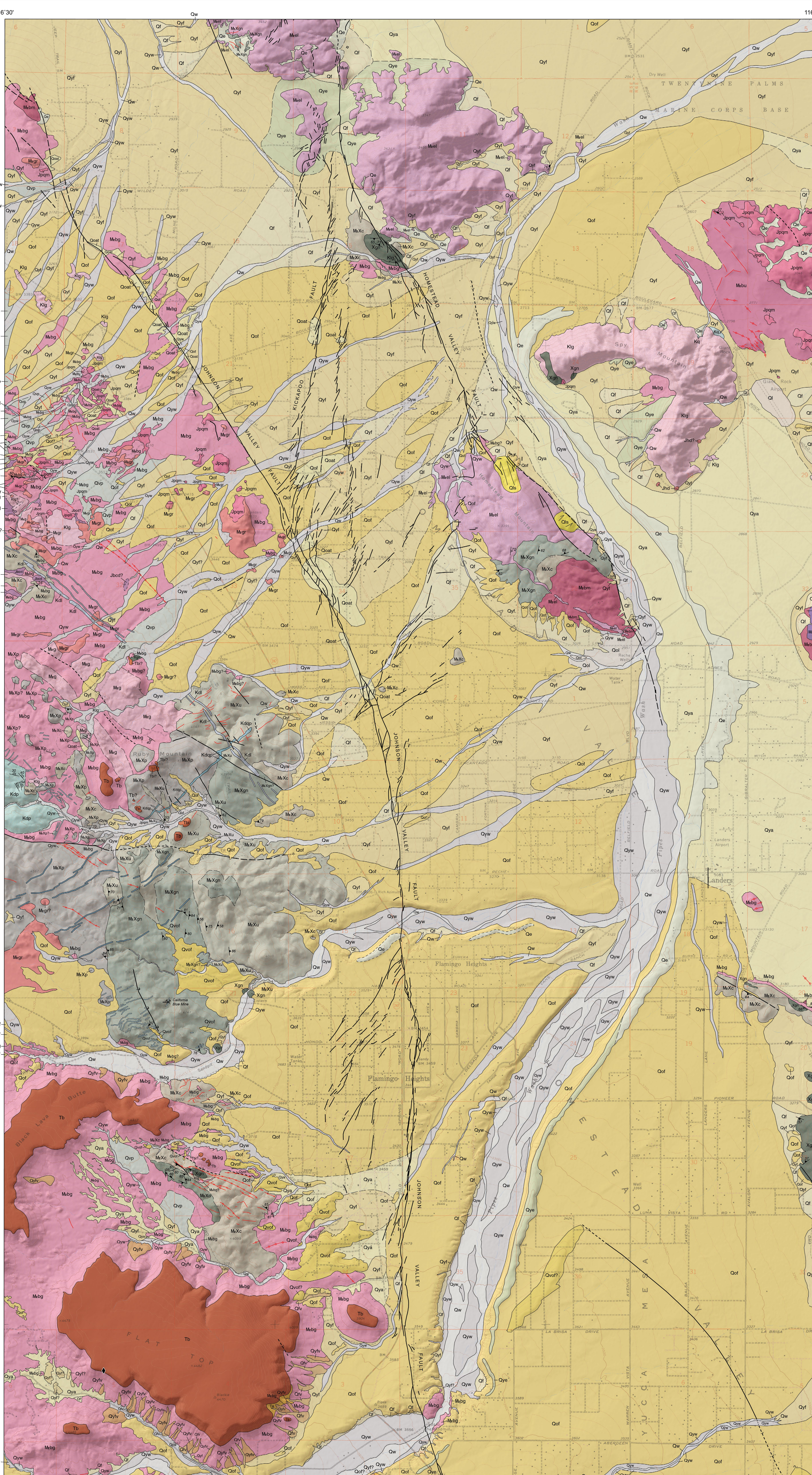

Coordinate System:
Universal Transverse Mercator, Zone 11N
North American Datum 1927

Topographic base from U.S. Geological Survey
Landers 7.5-minute quadrangle, 1972.
Yucca Valley North, 1972, photo revised 1979
Shaded relief image derived from USGS 1/3 arc-second
National Elevation Dataset (NED)*

Scale 1:24,000

Contour Interval 40 Feet
Dotted Lines Represent 20-Foot Contours
Contour Inrerval on River Surface 5 Feet
National Geodetic Vertical Datum of 1929

Approximate Mean Declination, 2022

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Publication Title: "Preliminary Geologic map of the Landers and Yucca Valley North (Northern Half) 7.5′ Quadrangles, San Bernardino County, California: California Geological Survey Preliminary Geologic Map 22-08, scale 1:24,000".

PRELIMINARY GEOLOGIC MAP OF THE LANDERS AND YUCCA VALLEY NORTH (NORTHERN HALF) 7.5' QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA

VERSION 1.0

By
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2022

Preliminary Geologic Maps available from:
https://www.conservation.ca.gov/cgs/maps-data/rgm/preliminary

California Department of Conservation
California Geological Survey

DESCRIPTION OF MAP UNITS

QUATERNARY SURFICIAL DEPOSITS

Qw **Modern wash deposits (late Holocene)**—Unconsolidated sand and gravel deposited in recently active stream channels. Occur as anastomosing to elongate deposits within Pipes Wash and its tributaries. Sediments are generally derived from local bedrock or older Quaternary deposits. Materials subject to localized reworking and new sediment deposition during storm events and only support local, sparse vegetation. Very dark-greyish-brown (10YR 3/2) when damp. Locally contains moderately to well-consolidated, cohesive, silty clay overbank deposits, likely derived from the volcanic units. These overbank deposits are cemented and very micaceous with fissile bedding, and are very dark-brown (10YR 2/2) when damp.

Qf **Modern alluvial fan deposits (late Holocene)**—Unconsolidated to weakly consolidated, poorly sorted, gravel, sand, and silt deposits forming active, essentially undissected, alluvial fans. Fan apices commonly occur at or upstream of mountain fronts or wash channel walls. Clasts are derived from up-slope rock sources and reworked from adjacent older fan deposits. Local fan deposits dominated by dark volcanic clasts shed from volcanic buttes are denoted as Qfv .

Qfv **Modern alluvial fan deposits, volcanic clast dominated**—Local fan deposits dominated by dark volcanic clasts. Qfv deposits include debris fans shed from the volcanic buttes within the field area and contain unweathered blocks of vesiculated and non-vesiculated basalt .

Ql **Modern playa deposits (late Holocene)**—Moderately consolidated, stiff, cohesive clayey silt from saline dry lakes that are periodically flooded. Very pale-brown (10YR 7/3) dry and dark-yellowish-brown (10YR 4/4) damp. Forms mud cracks on the surface. In places contains micaceous silt, is generally alkaline, and may locally contain evaporites (Dibblee 1967a).

Qe **Modern eolian deposits (late Holocene)**—Unconsolidated, loose, generally well-sorted wind-blown sand. Fine- to medium-grained. Deposited on and just beyond the crest of the east bank of Pipes Wash and on south and east facing slopes and ravines in bedrock in the northern half of the Landers Quadrangle. Very pale-brown (10YR 6/4) when damp.

Qls **Landslide deposits (Holocene to Pleistocene)**—Previously mapped by Umbarger (1992). Landslide deposits are located on the eastern and northeastern side of Homestead Mountain. The deposit on the eastern side contains poorly sorted, angular clasts in a muddy matrix, and calcium carbonate coatings cover the surface (Umbarger, 1992). The deposit on the northeastern side contains angular to subangular clasts, and failure is likely from pre-existing discontinuities within the bedrock (Umbarger, 1992).

Qyw **Younger wash deposits (middle Holocene to late Pleistocene)**—Weakly consolidated sand, gravel, cobbles and local boulders. Composed of silty sand with small gravel, few cobbles, and rare boulders. Commonly occurs as elongate deposits on the margins of active Qw deposits in Pipes Wash and its tributaries, as well as larger canyons upstream of the mountain front. Sediments are generally derived from bedrock in upstream source areas or older Quaternary deposits. Sediments may be subject to mobilization and redeposition during large storm events. Vegetation may be sparse to moderately dense. Light-olive-brown (2.5Y 5/3) when damp.

Qyf **Younger alluvial fan deposits (middle Holocene to late Pleistocene)**—Unconsolidated to weakly consolidated, silty sand with pebbles and cobbles. Surfaces are undissected to slightly dissected. Locally overlain by thin eolian veneer or interlayered with eolian deposits such as sand sheets. Contains subrounded to subangular quartz, feldspar, and biotite. Locally moderately consolidated with alternating layers of sand, pebbley sand, and thin silt layers. Clasts are locally derived up slope or up wash and reworked from adjacent older fan deposits. Yellowish-brown (10YR 5/4) when damp. No calcite, soil development, nor cementation. Locally includes narrow active Qf/Qw deposits. Local fan deposits dominated by dark volcanic clasts are denoted as Qyfv.

Qyfv **Younger alluvial fan deposits, volcanic clast dominated**—Local fan deposits dominated by dark volcanic clasts shed from volcanic buttes in the western half of the Yucca Valley North Quadrangle.

Qya **Younger alluvium (Holocene to late Pleistocene)**—Unconsolidated silty sand with pebbles. Clasts are subangular to subrounded. Deposited in broad alluvial valleys. Alluvial surfaces are slightly elevated from active channels and support local, brushy vegetation, suggesting they are only inundated during larger, uncommon flood events. Brown (10YR 5/3) when damp. Locally overlain or interlayered with eolian deposits such as sand sheets.

Qvp **Pediment veneer deposits (Holocene to middle Pleistocene)**—Weakly consolidated sand, gravel, and local cobble-sized fragments composed of angular to subangular granitic clasts. Unit forms thin veneer of decomposed granodiorite and sheet wash deposits overlying older, fan-like erosional surfaces developed on Mzbg in the Landers Quadrangle; includes local areas of low bedrock outcrops.

Qye **Eolian deposits (middle Holocene to late Pleistocene)**—Unconsolidated to moderately consolidated, undissected to slightly dissected wind-blown sands including sand sheets and topographically controlled sand ramps. Very pale-brown to yellowish-red (10YR 7/4 to 5YR 5/6), clean fine- to medium-grained sand with subangular to subrounded grains. Deposited on the east bank of Pipes Wash and on north and west facing slopes northern half of the Landers Quadrangle. Abundant vegetation observed on these deposits.

Qoat **Older alluvium, tufa dominated (late to middle Pleistocene)**—Unconsolidated to moderately consolidated, fluvial pebbly fine- to coarse-grained sand and silt interlayered with tufa deposits and eroded tufa predominantly associated with spring discharge along faults. Unit is prominent along the Johnson Valley Fault, other unnamed faults, and elsewhere in the west side of the Landers Quadrangle. Locally surrounds small outcrops of biotite granodiorite (Mzbg) and porphyritic biotite granodiorite (Jpqm) that are too small to map separately at map scale.

Qof **Older fan deposits (late to middle Pleistocene)**—Slightly to moderately consolidated silty sand with gravel. Interbedded with cobble-rich layers with boulders up to 3/4 m diameter and capped by thin sheet wash. Yellowish-brown (10YR 5/4) damp. Local moderately consolidated paleosols with carbonate. Brown (7.5 YR 4/4) when damp where the source is predominately gneissic. Paleosols are composed of sandy silt held together with clay and are poorly sorted with minor gravel. Dark-yellowish-brown (10YR 4/4) when damp. Surfaces are commonly moderately dissected. Typically capped with younger sheet-wash on large fan surfaces adjacent to Pipes Wash. Locally includes thin sand deposits. Surface is modified by erosion in the eastern Yucca Valley North Quadrangle. Surfaces are generally elevated at least several meters above active channel grade and not subject to historic flood inundation. This unit includes debris flow deposits on the northeastern edge of Homestead Mountain. The debris flow deposits are well-indurated, poorly sorted, and consists of a reddish-brown aplite-rich sand with coarse gravels in a carbonate-cemented, clayey sand (Umbarger, 1992). The debris flow is faulted against a landslide deposit along the Homestead Valley Fault.

Qol **Lacustrine deposits (late to middle Pleistocene)**—Moderately to strongly cemented, undissected to moderately dissected fine-grained sand, silt, clay, and mud from lake or playa deposits. Few phenocrysts, 7% subangular to rounded in a fine clay matrix. 5% plagioclase, 2% hornblende and chlorite. Fresh surface is pinkish-tan. Previously mapped by Umbarger (1992). Possibly old lakebed deposits from a pond or marshy area that drained into Pipes Wash during the Pleistocene that were subsequently uplifted due to activity on the Homestead Valley Fault (Umbarger, 1992).

Qvof **Very old fan deposits (early Pleistocene)**—Moderately to well-consolidated silt, sand, gravel, cobbles, and boulders locally exceeding 1 m in diameter and forming deposits up to 15 m thick; some clasts are exotic to local source areas.. Moderately consolidated reddish-yellow (7.5 YR 6/6) alternating 1-4 cm-thick beds of gravelly sand and 4 cm beds of silty sand capped with volcanic clast rich layer. Carbonate-rich soil horizons are also present. Sediment is granitic derived with undersides of few clasts coated in carbonate. Lenses of cobbles and boulders composed mostly of volcanic clasts. Local moderately to well-consolidated brown (7.5YR 5/4) developed soils.

TERTIARY VOLCANIC AND SEDIMENTARY UNITS

Tb **Basalt flows and scoria (Miocene)**—Olivine-bearing massive basalt with scoria, previously mapped by Dibblee (1967b). Occurs on Flat Top Butte and Black Butte as well as smaller, scattered, butte-forming outcrops. Local basalt plugs (Tbi) indicate the basalt is near-vented. Basalt flows overlap a thin reddish arkose onto saprolitic granitic basement rock. Forms resistant dark gray basalt flows with a layer of dark-brownish-red and dark-gray scoria on the tops of the buttes. The basalt is vitrified and phenocryst poor. Vesicles range in size from <1 mm to 6 cm and increase in abundance up section to 40%. Vesicles are commonly filled with calcite. Phenocryst abundance is around 20% with plagioclase, olivine, and orthopyroxene making up the major mineral assemblage. The olivine is almost entirely altered to iddingsite. Phenocryst size averages 1 mm. Basalt near the contact with the underlying arkosic sandstone (Ta) is more vitric, and vesicles here are commonly filled with calcite. At this contact, alteration such as oxide staining, epidote, and limonite, as well as calcite veins, is present. On top of the buttes is a lapilli tuff with large scoria (up to 15 cm) and lapilli within an ashy matrix. Vesicles within the scoria vary in concentration from 10-50% with an average vesicle size of 3 mm. New 40Ar/39Ar dating at one locality on Flat Top Butte (see map) yielded a Miocene age of 8.63 ± 0.06 Ma. Analyses were conducted at the New Mexico Geochronology Research Laboratory

Tbi **Intrusive basalt (Miocene)**—Vitric, aphanitic, basalt plugs with inclusions of obsidian (2-3 mm). Dark gray with no distinguishable phenocrysts in hand sample. Olivine and plagioclase present in the groundmass. Contains mantle xenoliths. Intrudes pre-Tertiary units. Previously mapped by Dibblee (1967b).

Ta **Arkosic sandstone (Miocene)**—Unconsolidated to consolidated sedimentary deposits beneath basalt flows (Tb), previously mapped by Dibblee as the "Old Woman(?) Sandstone" (1967b). This unit is variable thickness and crops out in segments underneath the basalts, probably due to paleotopography. The first ~3 m below the basalt are anomalously reddish with abundant calcite veins in the upper meter. Deposits range from unconsolidated, subangular, arkosic sand and pebbles to consolidated, bedded silty sand with subrounded pebbles and cobbles up to 15 cm. Sediments are derived from underlying granitic units and contain plagioclase, potassium feldspar, quartz, biotite, and muscovite. Consolidated sections contain carbonate layers as frequent as 8 cm apart. Tufa is deposited within the unit in several areas just below the basalt at Flat Top Butte, probably due to spring discharge. This unit is extensive but only mappable on the east side of Flat Top Butte where it is relatively thick and exposed by erosion.

INTRUSIVE AND METAMORPHIC UNITS – MESOZOIC AND/OR OLDER

Kdl **Latite dikes (Cretaceous)**—Localized to the western Landers Quadrangle and trend northwest. Vary texturally depending on thickness of the dikes. Thin latite dikes are light-tan, very fine-grained to fine-grained, and felsitic. Thinner latite dikes commonly grade from microcrystalline exteriors to equigranular fine-grained interiors. Where these dikes are thicker, up to 30 meters thick, they are composed of numerous phenocrysts of quartz, potassium feldspar, sodic plagioclase, and plates of biotite in a microcrystalline light-gray groundmass (Dibblee, 1967a). Phenocrysts, as large as 3 mm, make up as much as 60% of the rock mass, with the groundmass composed of the same minerals as those that occur as phenocrysts as well as iron oxides (Dibblee, 1967a). Exteriors of the thicker dikes resemble the thinner latite dikes and are brittle and felsitic. Age is presumably Cretaceous or younger (Dibblee, 1967a, Moxham and others, 1955). Dikes intrude metamorphic units MzXc and MzXu, and Mesozoic igneous units, Mzbg and Mzgr. Shown as dike symbols where too narrow to map as polygons. Where these dikes are thicker, dike exterior chemical compositions are diorite whereas interiors are granite in composition. Thinner dikes are granite in composition.

Kdqp **Quartz porphyry dikes (Cretaceous)**—Massive light-gray dikes trending northeast in the eastern half of the Landers Quadrangle. Weathers tan. Intrudes units MzXp, MzXgn, and MzXu. Presumably Cretaceous in age and may be associated with Mesozoic igneous units (Moxham and others, 1955). 45-50% phenocrysts of quartz, potassium feldspar, plagioclase, and biotite in a light-gray groundmass composed of the same mineralogy. Color index is 3-4% as mostly biotite, which is 2 mm across on average. Quartz forms distinct, ovoid, smokey gray, anhedral phenocrysts, about 10%, 3 mm average. Samples are 15% potassium felspar sub- to euhedral, tabular, up to 1.4 cm long, but on average, 4 mm long, and include 20% euhedral plagioclase phenocrysts, average 4 mm wide. Dikes intrude metamorphic units MzXp, MzXu, MzXg. Sericite alteration present. Granite in composition.

Kdp **Pegmatite dikes (Cretaceous)**—Thick, resistant pegmatite dikes up to 2-3 meters thick intruding igneous and metamorphic units, concentrated in the western half of the Landers Quadrangle. Crop out as dike swarms and as individual dikes. Pegmatite dikes are on average about a meter thick composed of predominantly potassium feldspar and quartz in equal proportions. Quartz and felspar crystals are up to 15 cm long with an average grain size of 6 cm. Quartz and potassium feldspar are commonly intergrown, but more commonly form individual crystals. Accessory minerals of pegmatites across the field are include muscovite, biotite, and garnet. Pegmatite dikes commonly grade into aplite exteriors, or dikes are layered with pegmatite and aplite bands. The aplite portions and aplite dikes elsewhere in the field are very fine-grained, and predominantly composed of quartz, plagioclase, and alkali feldspar in equal proportions with less than 1% mafic minerals including chlorite, biotite, and oxides. Pegmatite and aplite dikes intrude igneous unit Mzbg and metamorphic units MzXgn and MzXp. The pegmatite dikes are offset by faults near and at the California Blue Mine. At the California Blue Mine, a pegmatite dike intrudes Paleoproterozoic gneiss. Here, beryl has been mined out of mialoritic pockets within the pegmatite dike, and minerals including plagioclase, topaz, cleavelandite, fluorite, and minor zircon, apatite, monazite, allanite, titanite, columbite, and schorl have been documented (Pauly, 2019). No critical minerals or miarolitic pockets have been observed in any other pegmatite dikes in the map area. Only one large pegmatite dike swarm on the western edge of the Landers Quadrangle and other large pegmatite dikes have been mapped, but these dikes are pervasive throughout metamorphic units and Mzbg in the entire. western half Landers Quadrangle. Within the large dike swarm, pegmatite dikes are closely spaced together and intrude Mzbg.

INTRUSIVE AND METAMORPHIC UNITS – MESOZOIC AND/OR OLDER (CONTINUED)

Kq **Quartz pods (Cretaceous)**—Massive, fractured, milky white quartz forms local pods and veins around Spy Mountain that Intrude unit Klg. Varies compositionally and texturally from massive, fractured quartz to pegmatite veins with potassium feldspar and quartz in roughly equal abundance. Veins have chilled margins at the contact of Klg.

Klg **Leucocratic granite (Cretaceous)**—Massive tan to light-gray leucocratic granite. Has variable grain size but is typically medium- to coarse-grained with equigranular texture. Composed of plagioclase, alkali feldspar, and quartz in generally equal proportions with slight variability. Mafic minerals consistently make up less than 5% of the phenocrysts as biotite and muscovite. Accessory minerals include titanite, zircon, (Dibblee, 1967a), iron oxides, and chlorite. Alkali feldspar, plagioclase, and quartz are all equant, with plagioclase and alkali feldspar presenting as euhedral crystals and quartz as sub- to anhedral. Feldspars and quartz have myrmekitic growths in thin section. The average grain size is 3-4 mm, with mafic minerals less than 1 mm. Lacks mafic xenoliths. This unit has also been referred to as the Cactus granite (Vaughan, 1922; Moxham and others, 1955), the White Tank Monzonite (Miller, 1938), the White Tank Quartz Monzonite (Rogers, 1958; 1961), and quartz monzonite (Dibblee, 1967a; 1967b; 1967d). Dated in the adjacent Quadrangle at 89 +/- 10 Ma at the Pomona Tile quarry (Dibblee 1967c) as Dibblee's quartz monzonite unit. This age could correspond to the biotite granodiorite (Mzbg) described herein. Chemistry on 6 samples mapped as Klg indicates that this unit is granite in composition.

Mzg **Biotite granite (Mesozoic)**—Massive, pervasively jointed granite. Weathers purplish-gray. Of intermediate composition between Klg and Mzbg, located in the western half of the Landers Quadrangle. Coarse-grained and equigranular similar to Klg. Mafic content and xenolith abundance is between Klg and Mzbg. Color index is between 5-10% and mafic xenoliths are rare but present. Chemistry indicates that this unit is granite in composition.

Mzel **Quartz monzonite of Emerson Lake (Mesozoic)**—Localized to the northern half of the Landers Quadrangle. Massive, light-gray, hard, resistant quartz monzonite and granite. Weathers dark-purplish-gray. Fine-grained with phenocrysts primarily of quartz, alkali feldspar, and plagioclase in equal parts and 2% biotite and hornblende up to 1 mm. Samples are mostly aphanitic and slightly porphyritic with larger phenocrysts of potassium feldspar up to 2-3 cm making up about 5% of the bulk rock. Displays myrmekitic texture in thin section. Contains muscovite, titanite (Dibblee, 1967a), chlorite, and iron oxides as accessory minerals. In places previously mapped to the north by Dibblee, this unit intrudes or is in gradational contact with the biotite granodiorite (Mzbg) (Dibblee, 1967a). Chemistry in this unit varies slightly from quartz monzonite to granite.

Mzld **Leucocratic quartz diorite (Mesozoic)**—Localized to Goat Mountain. Nearly white, fine-grained intrusive rock. Weathers with a dark-brown varnish. Very resistant and fractures in blocks. Rockfall-producing unit with angular boulders up to 1.5 meters. Intrudes the biotite granodiorite (Mzbg) and biotite diorite (Mzbm). Composed of quartz and plagioclase with around 10% of a fine dark-green mineral in hand specimen. Average grain size is less than 1 mm. Minor sericite alteration is present. Less than 1% apatite that appears as yellowish-green. Chemistry shows that this unit is depleted in potassium and indicates that this unit is a granodiorite in composition. However, because of only one geochemical sample and for consistency with prior mapping, the name of this unit has been retained as leucocratic quartz diorite (Dibblee, 1967a).

Mzbu **Biotite granodiorite and quartz monzonite; undifferentiated (Mesozoic)**—Includes biotite granodiorite (Mzbg) and porphyritic biotite granodiorite (Jpqm). The units are closely associated within the field area, and the porphyritic biotite granodiorite (Jpqm) forms small, resistant outcrops within the biotite granodiorite that are too small to map at this scale. This unit is intruded by felsic dikes in the northeastern Landers Quadrangle. Felsic dikes are granite in composition.

Mzbg **Biotite granodiorite (Mesozoic)**—Massive medium- to coarse-grained granodiorite. Most commonly medium-grained but occasionally coarse-grained. This unit varies in hardness and forms both resistant and low-lying grussy outcrops. Weathers light-tan to medium-pinkish-tan. Fresh outcrops are light-tannish-gray to light-purplish-gray. Color index varies from 8-25% as mostly biotite and minor clinopyroxene. Biotite forms individual phenocrysts up to 3 mm and also forms glomerocrysts up to 8 mm. The rest of the mineral assemblage is composed of potassium feldspar (10-15%), quartz (30%), and plagioclase (35-40%). Average grain size for felsic minerals is 3-4 mm. Accessory minerals include muscovite, titanite, and zircon. This unit is commonly porphyritic, with potassium feldspar phenocrysts up to 6 mm. Contains common mafic xenoliths averaging 10 cm wide. Locally, xenoliths are dense. Locally weakly foliated. This unit looks similar to the leucocratic granite (Klg) but distinguishable by its higher color index, presence of mafic xenoliths, local porphyritic texture, and darker appearance. Observed in direct contact with Jbcd, where mafic xenolith abundance can be upwards of 70-80%. This unit commonly has a ductile, fine-grained, gray, porphyritic facies of granodiorite composition containing exotic xenoliths at the contact with metamorphic units on the west side of the Landers Quadrangle. This unit is intruded by latite dikes (Kdl), pegmatite dikes (Kdp), mafic dikes, felsic dikes, and undifferentiated dikes. Mafic dikes vary in composition from monzogabbro to gabbro. Chemistry on one sample of Mzbg indicates that this unit is a granodiorite, but close to granite in composition.

Mzbm **Biotite monzodiorite (Mesozoic)**—Dark-greenish-gray biotite diorite. In places such as Goat Mountain, this unit is very friable and forms low, rounded outcrops. Has a high color index up to 50%. Composed mostly of biotite and plagioclase with minor quartz, hornblende, chlorite, and iron oxides (Dibblee, 1967a). Biotite forms as both individual phenocrysts up to 8 mm wide as well as glomerocrysts of smaller biotite. Contains mafic xenoliths varying in size from 10-60 cm, similar in composition to those found in the biotite granodiorite (Mzbg) and the porphyritic granodiorite (Jpqm). Chemistry ranges in composition from monzonite to monzodiorite.

Jhd **Hornblende diorite (Jurassic?)**—Massive, dark-gray to black, ranging from monzodiorite to gabbro (Dibble, 1967a). Fresh surface is medium-gray, but weathers dark-blackish-gray due to varnish. Color index is around 30-35%, with equal hornblende, biotite, and chlorite, up to 4 mm long. The rest of the phenocrysts are mostly plagioclase (45-55%) and quartz (10-20%) up to 3 mm. Average grain size is 1-2 mm for all mineral phases. Contains minor muscovite, potassium feldspar, oxides, apatite (?), and tourmaline (?). This unit contains small mafic xenoliths up to 6 cm long as well as quartz and epidote veins about 2 centimeters wide. Locally contains coarse mafic pegmatite composed of potassium feldspar, hornblende, and epidote, with average phenocryst size greater than 2 cm. This unit yields a potassium argon age of 78.4 +/- 2.4 Ma for biotite and an age of 109 +/- 6.5 Ma for hornblende (Miller and Morton, 1980). The emplacement age is estimated to be between 160-200 Ma (Miller and Morton, 1980). Chemistry on two samples indicate this unit is diorite in composition.

Mzgr **Granite (Mesozoic)**—Massive, reddish-tan resistant granite. Fine-grained with average grain size less than 1 mm and a color index around 7%. Major minerals include plagioclase, quartz, potassium feldspar, and biotite in decreasing abundance. Biotite is evenly distributed throughout as individual, fine crystals, but also forms clusters up to 2 mm long. Quartz is often yellowish tinged and smoky. Intrudes or mixes with Jpqm and intrudes Mzbg. Mapped in some areas where it appears with Jpqm and/or Mzbg and the individual units cannot be differentiated at map scale. Chemistry indicates that this unit is granite in composition.

Jpqm **Porphyritic biotite quartz monzonite (Jurassic?)**—Massive purplish-gray resistant porphyritic granodiorite. Weathers dark-gray to tan. Resembles the biotite granodiorite (Mzbg) but is much more porphyritic, up to 40-50%. In hand sample, the mineralogy of the matrix is very similar to the mineralogy of the biotite granodiorite (Mzbg). Phenocrysts are bleached white to purple potassium feldspar, on average 2 cm long. Some feldspar phenocrysts exhibit macroscopic zoning. Color index is 30-40%, and mafic minerals are biotite with lesser hornblende. The rest of the groundmass is made of quartz and plagioclase with lesser orthopyroxene and zircon. This unit also contains mafic xenoliths up to 1 meter wide, but commonly 10-15 cm wide. This unit is intruded by felsic dikes and undifferentiated dikes. This unit is bleached with calcic alteration near the eastern edge of the map boundary in the Landers Quadrangle. Chemistry indicates that this unit is quartz monzonite, but plots close to granodiorite composition.

Jbcd **Biotite clinopyroxene diorite (Jurassic?)**—Massive, dark-gray diorite. Fine-grained with a color index around 35%. Mafic minerals include mostly clinopyroxene (25%) and biotite (10%). The rest of the phenocrysts are mostly plagioclase with minor quartz. Average grain size is less than 1 mm with mafic minerals forming clusters up to 2-3 mm. Muscovite is present as a minor phase (<1%). This unit forms the mafic xenoliths within Jpqm, Mzbm, and Mzbg. Only observed in the western Landers Quadrangle.

MzXc **Mixed metamorphic and igneous complex (Mesozoic to Paleoproterozoic)**—Includes a mixed assemblage of leucocratic granite (Klg), biotite granodiorite (Mzbg), metamorphic porphyry (MzXp), biotite orthogneiss (MzXo), and banded biotite gneiss (Xgn) that are too small to differentiate at the map scale. This unit is intruded by pegmatite dikes (Kdp), mafic dikes, felsic dikes, and undifferentiated dikes.

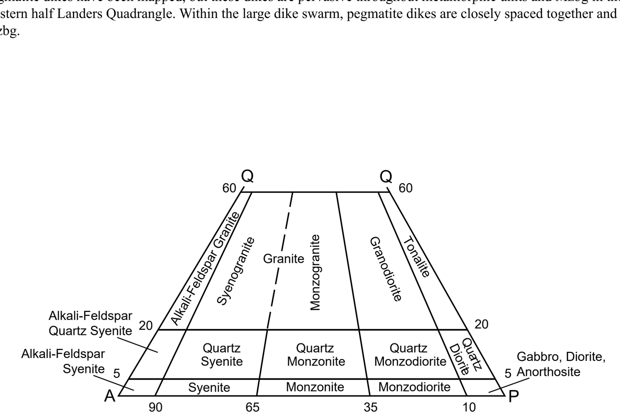
MzXu **Metamorphic rocks; undifferentiated (Mesozoic to Paleoproterozoic)**—Includes a mixed assemblage of metamorphic porphyry (MzXp), biotite orthogneiss (MzXo), and banded biotite gneiss (Xgn) that are too small to differentiate at the map scale. This unit is intruded by latite dikes (Kdl), quartz porphyry dikes (Kdqp), and undifferentiated dikes.

MzXp **Metamorphic porphyry (Mesozoic or Paleoproterozoic)**—Medium- to dark-gray mesocratic metamorphic rock with feldspar porphyroclasts ranging from less than 1 cm to 5 cm and ranging in abundance from 20-40% in a medium- to coarse-grained groundmass. Feldspar porphyroclasts range in color from light-gray to pink. Locally, hydrothermal alteration is present with epidote and limonite. Metamorphic foliation varies from semi-aligned porphyroclasts to augen gneiss. Feldspar porphyroclasts show primary igneous texture indicating that were developed during initial igneous intrusion and not during metamorphism. Minerals in the groundmass, mostly biotite, plagioclase, and quartz in varying concentrations, typically align in foliation around the porphyroclasts. Contains 4-6 cm pods of primarily biotite in concentrations no less than 60% (Moxham and others, 1955). In places, particularly along New Dixie Mine Road, this unit causes anomalously high counts on a Geiger counter, and preliminary XRF data show anomalously high thorium concentrations. Moxham and others (1955) report several radioactive accessory minerals present in this unit with higher concentrations noted in the biotite-rich inclusions. This unit contains accessory minerals such as magnetite, ilmenite, fluorite, apatite, allanite, zircon, and titanite (Moxham and others, 1955). Mineral compositions vary across the unit. This unit is intruded by quartz porphyry dikes (Kdqp), pegmatite dikes (Kdp), mafic dikes, and undifferentiated dikes.

MzXgn **Gneiss; undifferentiated (Mesozoic or Paleoproterozoic)**—Includes a mixed assemblage of biotite orthogneiss (MzXo) and banded biotite gneiss (Xgn) in areas where these units cannot be distinguished. Any observed migmatite and amphibolite are also mapped as MzXgn. This unit is intruded by latite dikes (Kdl), quartz porphyry dikes (Kdqp), pegmatite dikes (Kdp), mafic dikes, and undifferentiated dikes.

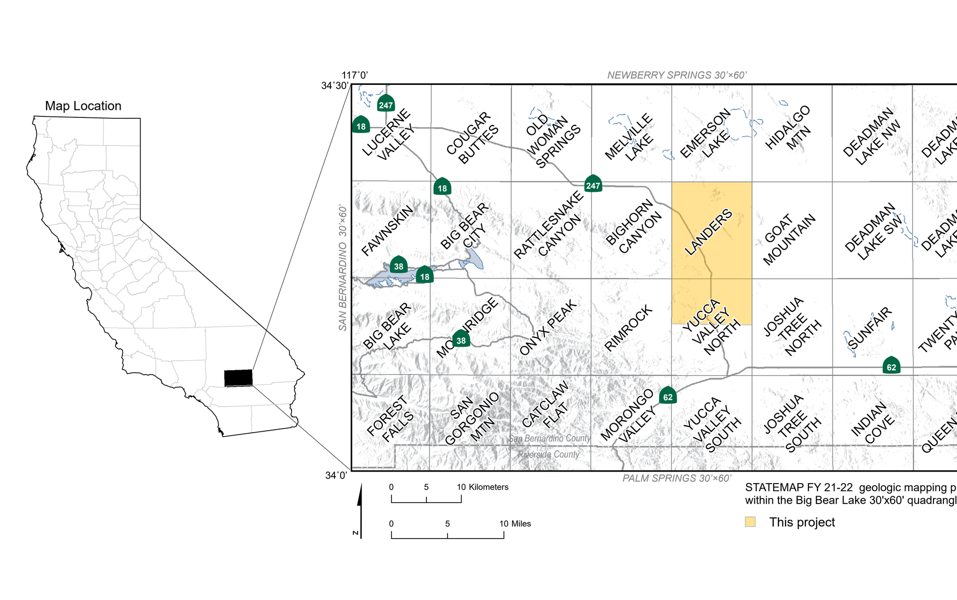
MzXo **Biotite orthogneiss (Mesozoic or Paleoproterozoic)**—Laminated, light-gray medium- to fine-grained granitic gneiss. Weathers tan. Composed mostly of quartz, feldspar, and biotite, with minor muscovite. Nearly homogenous with linear foliation. Varies from slightly porphyritic to nonporphyritic. Faintly to moderately banded with thin, biotite-rich laminae. This unit is intruded by mafic dikes and undifferentiated dikes.

Xgn **Banded biotite gneiss (Paleoproterozoic)**—Coarsely banded to finely laminated gneiss. Medium- to dark-brownish-gray composed of quartz, feldspar, biotite, muscovite and iron oxides, with distinct, alternating light leucocratic bands rich in quartz and feldspar and melanocratic dark bands rich in biotite. In places, the quartz appears yellowish-tan. Bands vary from discrete, centimeter- wide alternating bands, to more diffuse bands with foliation defined by biotite. Where the gneiss exhibits thicker banding, ptygmatic folds are often present and obvious in the leucocratic bands. The alternating felsic and mafic layers suggests a sedimentary protolith. This gneiss may correlate to the Music Valley Gneiss, which is a part of the Pinto Gneiss (Powell, 1981) and the Baldwin Gneiss (Matti and Morton, 2000).



Classification of plutonic rock types (from Streckeisen, 1973; 1976). A, alkali feldspar; P, plagioclase feldspar; Q, quartz.

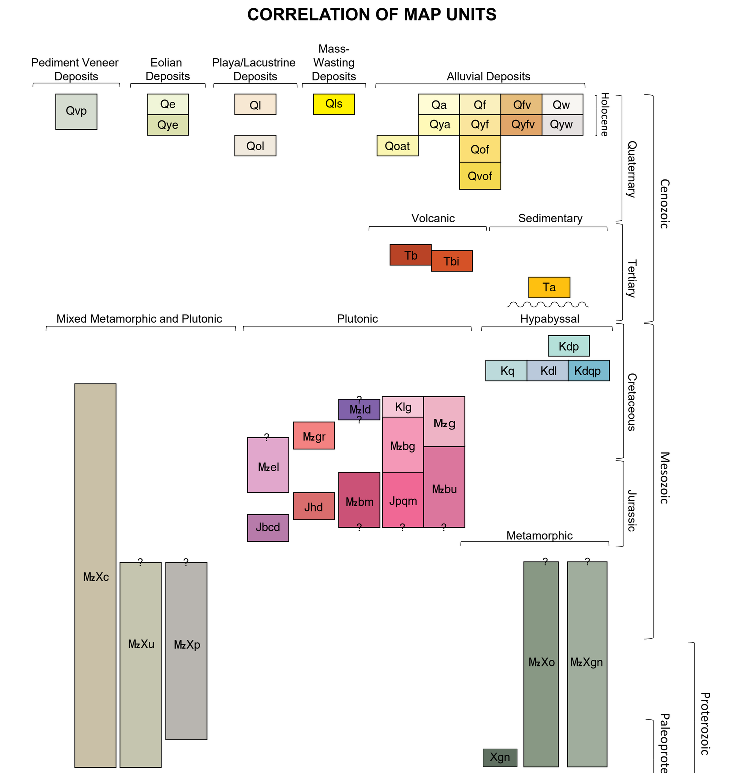
The matrix color of surficial materials and their pedogenic soils is classified according to the Munsell soil-color chart (Munsell Color, 2021).



STATEMAP FY 21-22 geologic mapping projects within the Big Bear Lake 30'x60' quadrangle

This project

CORRELATION OF MAP UNITS



MAP SYMBOLS

Contact between map units—Solid where accurately located; long dash were approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain.

Fault—Solid where accurately located; long dash were approximately located; short dash where inferred; dotted where concealed; queried where identity or existence is uncertain. Arrow and number indicate direction and angle of dip of fault plane.

Dike, undifferentiated

Mafic to intermediate dikes

Felsic dikes

Kdl

Kdp

Kdqp

Landslide—Arrows indicate principal direction of movement

40Ar/39Ar geochronology point (one sample)

California Blue Mine

Strike and dip of geologic structure; number indicates dip angle in degrees.
- Inclined joint
- Metamorphic foliation
- Igneous foliation
- Dike orientation
- Shear

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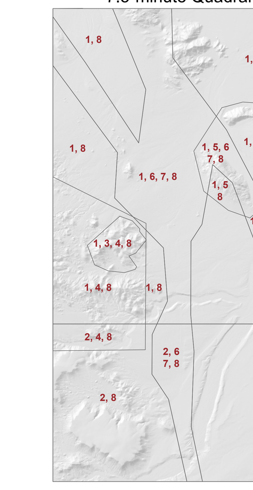
Landers & Yucca Valley North (Northern Half)
7.5-minute Quadrangle



SOURCES OF MAP DATA
1. Dibblee, 1967a
2. Dibblee, 1967b
3. Moxham and others, 1955
4. Matti and others, 1982
5. Umbarger, 1992
6. Qfaults, 2020
7. Bryant, 1992
8. Wesoloski and Marquis, 2022*

*Data source covers entire quadrangle

Suggested citation:
Wesoloski, C. E., and Marquis, G. D., 2022, Preliminary geologic map of the Landers and Yucca Valley North (northern half) 7.5′ quadrangles, San Bernardino County, California: California Geological Survey Preliminary Geologic Map 22-08, scale 1:24,000.

AUTHORSHIP DOCUMENTATION AND PRODUCT LIMITATIONS

PUBLICATION TITLE: Preliminary Geologic Map of the Landers and Yucca Valley North (Northern Half) 7.5’ Quadrangles, San Bernardino County, California Preliminary Geologic Map 22-08

LIMITATIONS: This map is considered preliminary, and the California Department of Conservation makes no warranties as to the suitability of this product for any given purpose. This map should not be considered as an authoritative or comprehensive source for landslide and seismic hazard data. For landslide data, please visit the California Geological Survey Landslides web page at: https://www.conservation.ca.gov/cgs/landslides. For seismic hazards data and Zones of Required Investigation, please visit the California Geological Survey Seismic Hazards Program web page at: https://www.conservation.ca.gov/cgs/sh/program.

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