Geology of the Mitchel Range and Waterman Hills, San Bernardino County, California

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Legend

Quaternary

- Qu — Surficial deposits. Active and older alluvium.
- Qt — Talus. Breccia on steep slopes.
- Qsu — Perched surficial deposits.

Tertiary

- Ta — Intrusive andesite. Brick red to brown, aphyric to prophyritic volcanic rocks.
- Tri — Intrusive rhyolite and dacite (Miocene). Pink to gray, aphyric to prophyritic silicic volcanic rocks found as domes and plugs intruding Pickhandle Formantion. Ar/Ar intercept age of 20.0 Ma. Locally flow-banded.

Pickhandle Formation (early Miocene) Heterogeneous unit comprising intertonguing sandstone, conglomerate, lacustrine siltstone, landslide breccias, volcanogenic mudflows, lithic-rich pyroclastic flow deposits, and pyroclastic fall deposits.

- Tpm — Mudflow member. Heterogeneous unit including volcanogenic mudflows, volcanogenic arkose, lithic-rich pyroclastic fall deposits, pyroclastic fall deposits, and conglomerate. Typically green and sandy.
- Tpl — Lacustrine member. Thin horizons (typically 10 cm to 5m thick) of variegated and locally mudcracked siltstone, typically green to brown. Locally mineralized by barite and silver ores.
- Tpls — Limestone member. Thin bed of limestone; only found in northern klippen of the Mitchel Range.
- Tpb — Megabreccia member. Monolithologic megabreccia composed of biotite diorite and locally hornblende diorite.
- Tpc — Exotic-clast conglomerate member. Conglomerate composed of clasts exotic to the area, including coarse-grained marble, pelitic gneiss, black metachert, green and white calc-silicate rocks, diorite with abundant, large (>5mm) books of biotite, and porphyritic granitoids. Locallly includes mixed horizons of both local volcanic and exotic clasts.
- Tpa — Arkose member. Well-bedded brown to buff arkose and conglomerate of volcanic detritus. Occurs as tongues, principally in Tpm.
- Tpa — Andesite member. Purple to brown K-metasomatized andesite flows found north and south of the Waterman Mine.
- Tr — Rhyolite member. Rhyolite flows and breccias; may locally include Tpa and possibly Tri.

Granite of the Waterman Hills (early Miocene). Gray biotite granite, mylonitic near the Waterman Hills detachment fault. Dated by U/Pb zircon method on four samples at 22-23 Ma; Ar/Ar intercept ages from two samples are 20.9 and 20.1 Ma.

- Tg — Nonmylonitic to protomylonitic phase. Gray nonmylonitic to protomylonitic granite with a weak to stong biotite lineation.

Other Miocene Intrusive rocks

- pd — Porphyritic dacite. Phenocrysts of biotite and plagioclase +/- garnet. Groundmass is brown, yellowish brown or orangish brown.
- Aphanitic felsite. Fresh surfaces are white, tan or light grey.
- ch — Barite-bearing chert that replaces bm unit.

Pre-Tertiary crystalline rocks. Heterogeneous gneiss including dioritic orthogneiss, fledspathic paragneiss and schist, micaceous metaquartzite, impure marble, and calcsilicate rocks. Typically strongly mylonitic and folded on outcrop scale.

- mc — Mafic igneous complex. Contains hornblende gabbro and hornblende-biotite diorite.
- xpm — Nonmylonitic rocks (pre-Tertiary). Undifferentiated.
- xmy — Mylonitic rocks (pre-Tertiary). Undifferentiated.
- ms — Pelitic muscovite schist.
- m — Marble undifferentiatied.
- tm — Tan dolomitic marble.
- bm — Bluish-grey calcite marble with siliceous layers and porphyroclasts. Also seen as white siliceous marble with graphitic layers.
- q — Quartzite.

Lithologic Contacts

- Known
- Approximate
- Inferred

Faults

- Known
- Approximate
- Inferred

Normal Faults

- Known
- Approximate

Shear Gradient

Folds

- Axial trace of upright syncline showing plunge.
- Axial trace of upright anticline showing plunge.
- Axial trace of overturned syncline showing plunge
- Axial trace of overturned anticline showing plunge.

Description of Map Symbols

- Strike and dip of bedding.
- Strike and dip of overturned bedding.
- Set of joints.
- Mylonitic-foliation and stretching lineation for LS-tectonites.
- Mylonitic stretching lineation for L-tectonites.
- Hinge surface, hinge and trace of mesoscopic fold projected onto a horizontal surface.
- Kink-band cleavage or en echelon tension gash arrays.

Topography from United States Geological Survey
Barstow and Nebo 7.5 Minute Quadrangles

0.0 km 0.5 km 1.0 km 2.0 km

34°57'30" 117°2'30"
117° 34°57'30"
116°57'30" 34°57'30"
117° 34°55'
116°57'30" 34°55'