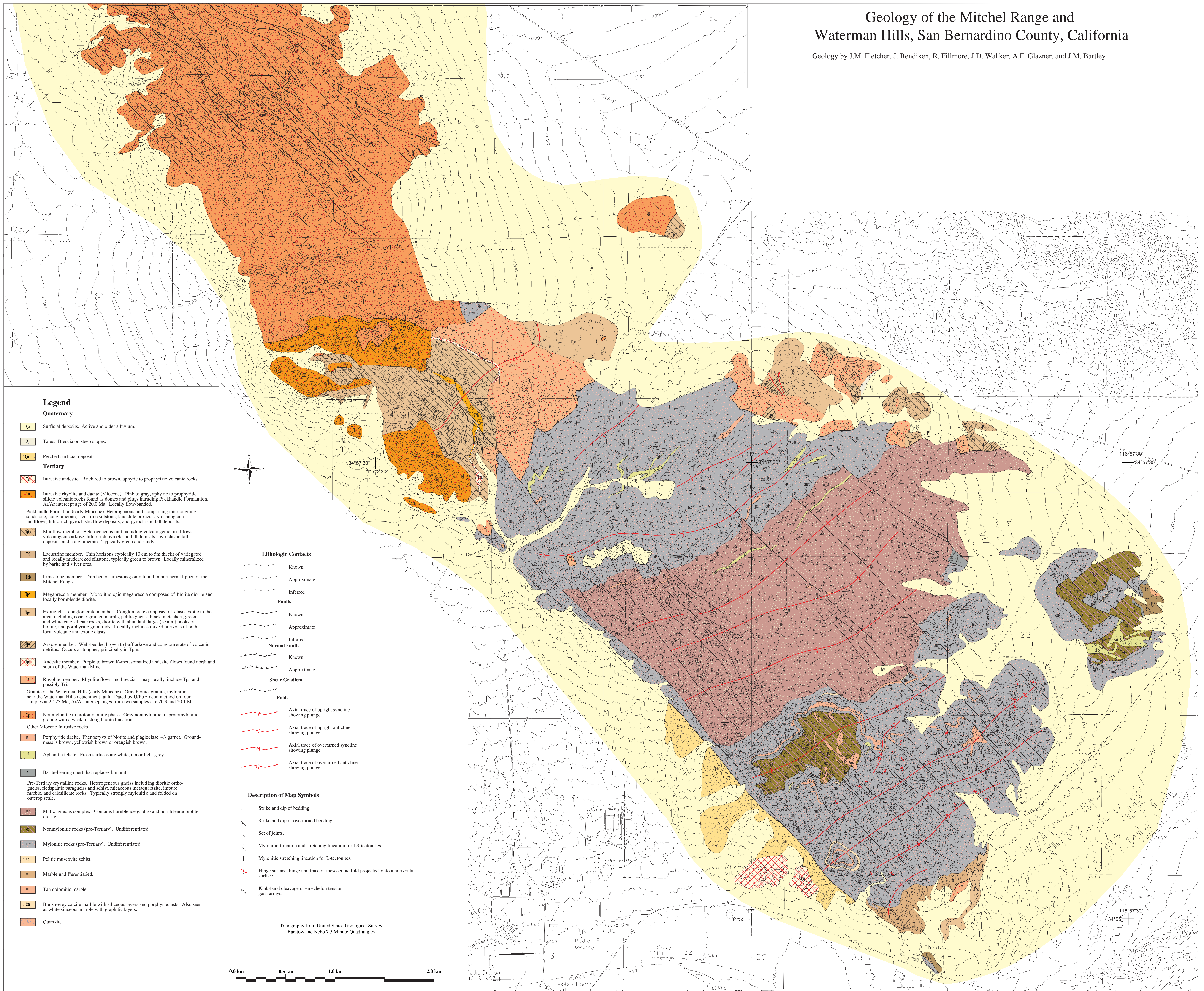


Geology of the Mitchel Range and Waterman Hills, San Bernardino County, California

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Legend

Quaternary

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

Tertiary

- Intrusive andesite. Brick red to brown, aphyric to porphyritic volcanic rocks.
- Intrusive rhyolite and dacite (Miocene). Pink to gray, aphyric to porphyritic silicic volcanic rocks found as domes and plugs intruding Pickhandle Formation. 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.
- Mudflow member. Heterogeneous unit including volcanogenic mudflows, volcanogenic arkose, lithic-rich pyroclastic fall deposits, pyroclastic fall deposits, and conglomerate. Typically green and sandy.
- Lacustrine member. Thin horizons (typically 10 cm to 5 m thick) of variegated and locally mudcracked siltstone, typically green to brown. Locally mineralized by barite and silver ores.
- Limestone member. Thin bed of limestone; only found in north horn klippen of the Mitchel Range.
- Megabreccia member. Monolithic megabreccia composed of biotite diorite and locally hornblende diorite.
- 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. Locally includes mixed horizons of both local volcanic and exotic clasts.
- Arkose member. Well-bedded brown to buff arkose and conglomerate of volcanic detritus. Occurs as tongues, principally in Tpm.
- Andesite member. Purple to brown K-metasomatized andesite flows found north and south of the Waterman Mine.
- 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.

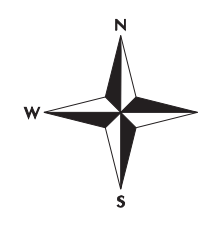
Nonmylonitic to protomylonitic phase. Gray nonmylonitic to protomylonitic granite with a weak to strong biotite lineation.

Other Miocene Intrusive rocks

- 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.
- Barite-bearing chert that replaces bm unit.

Pre-Tertiary crystalline rocks. Heterogeneous gneiss including dioritic orthogneiss, feldspathic paragneiss and schist, micaceous metapelite, impure marble, and calc-silicate rocks. Typically strongly mylonitic and folded on outcrop scale.

- Mafic igneous complex. Contains hornblende gabbro and hornblende-biotite diorite.
- Nonmylonitic rocks (pre-Tertiary). Undifferentiated.
- Mylonitic rocks (pre-Tertiary). Undifferentiated.
- Pelitic muscovite schist.
- Marble undifferentiated.
- Tan dolomitic marble.
- Bluish-grey calcic marble with siliceous layers and porphyroclasts. Also seen as white siliceous marble with graphitic layers.
- Quartzite.



Lithologic Contacts

- Known
 - Approximate
 - Inferred
- ### Faults
- Known
 - Approximate
 - Inferred
- ### Normal Faults
- Known
 - Approximate
- ### Shear Gradient
- Known
 - Approximate

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

