Geologic map of the San Emigdio Mountains

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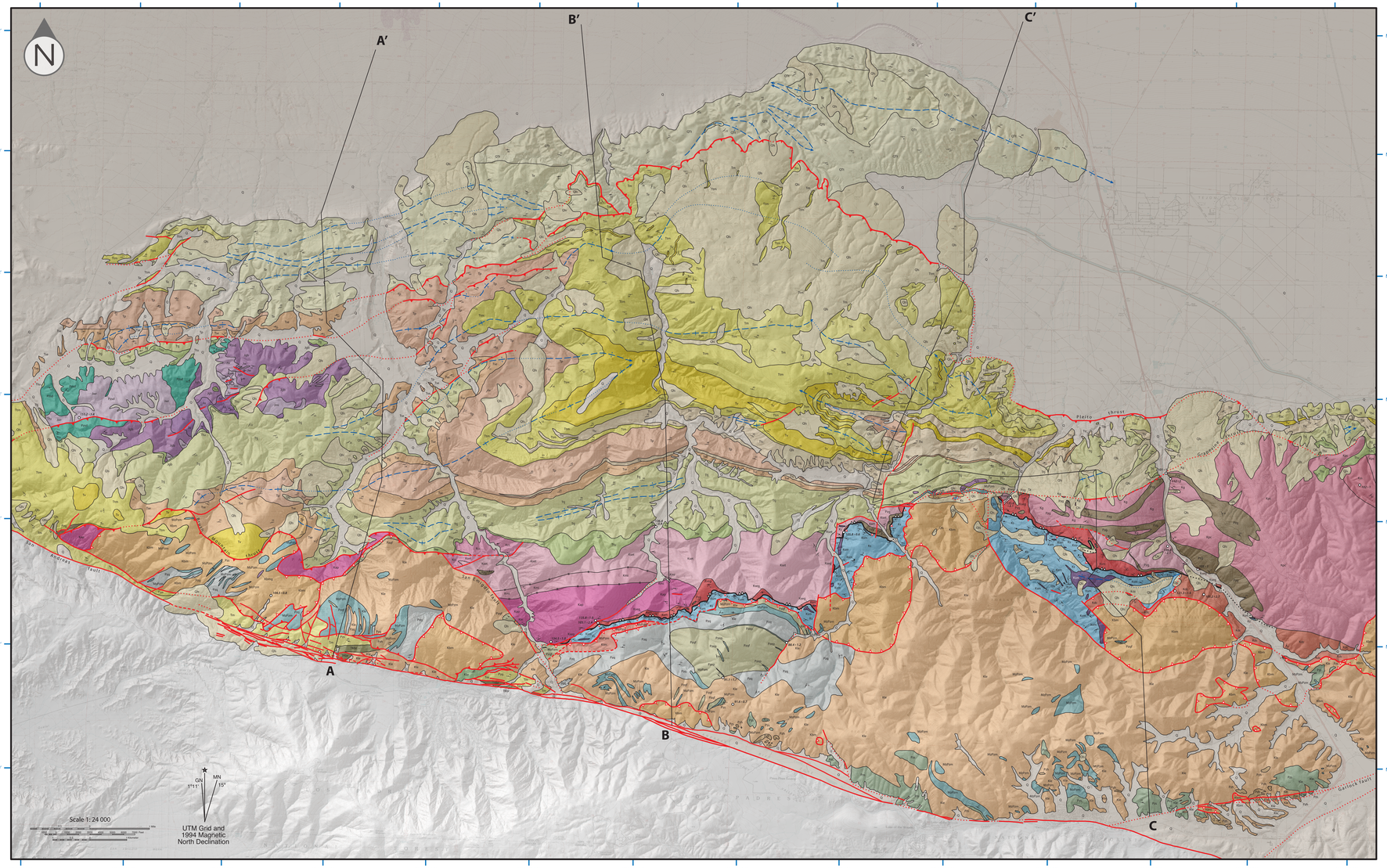


DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Q — **Surficial Deposits (Pleistocene - Holocene)** Unconsolidated alluvium, colluvium, and gravel deposits containing detritus derived exclusively from south of the San Andreas fault.

Qls — **Landslide Deposits (Quaternary)**

QTt — **Tulare Formation (Upper Pliocene)** Pebble gravel, sand, and clay, light gray, pebbles of siliceous (Monterey) shale derritus from Temblor Range.

Tsj — **San Joaquin Formation (Upper Pliocene)** Silt and clay beds alternating with beds of sandstone and conglomerate and contains marine, brackish water and nonmarine fossils.

Te — **Etchegoin Formation (Lower Pliocene)** Marine and terrestrial sandstone, conglomerate, and claystone, tan to greenish gray, friable, fossiliferous.

Tm2 Tm1 — **Monterey and Santa Margarita formations (Miocene)** Marine biogenic, lithified, siliceous to semi siliceous, gray to white, platy to fissile, includes thin hard intervals of dolomite.

Tbc — **Bena Conglomerate (Miocene)** Alluvial conglomerate of poorly sorted granitic detritus, gray to brown sandy matrix, crudely bedded, interfingers westward into Tm.

Ttm — **Temblor Formation (Lower Miocene)** Marine shale to sandstone, micaceous, locally silty, bedded, locally contains large brown concretions.

Tv — **Volcanic Rocks (Lower Miocene)** Extrusive basalt, olivine basalt, diabase, andesite, and dacite with fine feldspar phenocrysts, black to tan and light gray, massive, locally contains hornblende-rich airfall tuff (Ta). K/Ar age of 22.1±0.6 to 25.2 ±2.9 Ma (Turner, 1970).

Ttc — **Tecuya Formation (Lower Miocene - Oligocene)** Marine variegated red, green, and gray sandstone, clay and conglomerate of granite, quartzite, and marble detritus, local granitic landslide breccia at base of section, crudely bedded, interfingers westward into Tp.

Tp — **Pleito Formation (Lower Miocene - Oligocene)** Marine claystone to sandstone, similar to Ttm.

Tse — **San Emigdio Formation (Upper Eocene?)** Marine claystone to siltstone, includes thin layers of fine-grained sandstone. Similar to Ttm and Tp.

Tj Tsy — **Tejon Formation (Eocene - Paleocene?)** **Tfj** (Metralla Sandstone and Liveoak Shale Members) - Marine micaceous gray shale, claystone, and fine-grained friable, arkosic sandstone, locally contains hard fossiliferous layers. **Tsy** (Livas Member) - Marine light gray to tan sandstone, locally pebbly, contains some coarse conglomerate of granite and Western San Emigdio Mafic Complex, basal unit of Tfj.

TECTONIC UNITS

Trbgr — **Granitic breccia (Lower Tertiary - Cretaceous?)** Pale green, gray, and red siliceous mylonite and cataclasite. Alteration and silicification similar to Kbr. Occurs as fault slivers along the San Andreas fault.

Kss — **Silicified metasedimentary rocks (Cretaceous?)** Pale green, fine- to coarse-grained, indurated, massive to bedded silicic siltstone, sandstone, and conglomerate of granite, limestone, quartzite, and basalt, greenschist facies arkosic matrix. Occurs as fault slivers along the San Andreas fault.

INTRUSIVE ROCKS

Klw — **Lebec Granodiorite (Late Cretaceous)** Light colored, medium-grained, locally porphyritic with K-feldspar phenocrysts (< 15 mm), peppery biotite granodiorite. Hornblende phenocrysts are uncommon, but widespread. Contains discrete secondary muscovite and chlorite. Alteration varies considerably, with altered varieties containing highly saussuritized and sericitized plagioclase. Intrudes Salt Creek pendant. Aluminum-in-hornblende igneous pressure of 3.1 ±0.8 kbar. U/Pb zircon age of 88 - 92 Ma (Chapman et al., submitted).

Ksac — **Tonalite of San Emigdio Creek (Late Cretaceous?)** Medium to dark gray colored, medium grained, hornblende granodiorite. Occurs as fault slivers along the Pastoria fault zone. Aluminum-in-hornblende igneous pressure of 5 - 6 kbar (Chapman et al., submitted).

Kbrg — **Granite of Brush Mountain (Late Cretaceous)** Light colored, coarse grained, granite. Occurs in the western San Emigdio Mountains as relatively unaltered homogeneous granite with rare gabbroic enclaves (Kbmg). Occurs east of Brush Mountain as the uppermost plate of the Pastoria fault system. Extremely altered granite klippen form yellow to orange craggy exposures. Lineagaing banding and grüs are common in eastern exposures. U/Pb zircon age of 104.7 ±0.9 Ma (Chapman et al., submitted).

METAMORPHIC ROCKS OF SALT CREEK

KJPzm — **Marble (Mesozoic - Paleozoic?)** White to gray, medium grained mylonitic to cataclastic marble.

Pzq — **Quartzite (Paleozoic)** Red to brown weathering, relatively pure, massive to foliated, quartzite. Contains less than 10 percent mica and feldspar.

Pzsf — **Quartzofeldspathic Gneiss (Paleozoic)** Red to brown weathering, massive to foliated, argillaceous and feldspathic metasandstone. Locally contains biotite, muscovite, sillimanite, and garnet. U/Pb detrital zircon geochronology suggests an early Paleozoic depositional age (Chapman et al., submitted).

Pzs — **Micaceous Schist (Paleozoic)** Gray to reddish brown weathering, lustrous, well-foliated, reddish brown biotite and/or muscovite schist. Locally contains metamorphic K-feldspar, cordierite, sillimanite, and garnet, and lacks muscovite, suggesting metamorphism under upper amphibolite to granulite facies conditions.

Pzep — **Escapula Peak Migmatite (Paleozoic)** White to gray, medium- to coarse-grained, quartzofeldspathic, stromatic migmatites with biotite-rich melanosomes. Contains conspicuous coarse (1-2 cm), skeletal, red garnet that overgrew matrix quartz and feldspar along grain boundaries during contact metamorphism with the Lebec body.

Pzh — **Hornfels (Paleozoic)** Greenish to black calc-hornfels and quartzofeldspathic hornfels.

NONDIFFERENTIATED TEHACHAPI - SAN EMIGDIO COMPLEX (TSE) — TSE

INTRUSIVE ROCKS

Kg — **Garnet-Biotite Tonalite of Grapevine (Late Cretaceous)** Light colored, medium-grained, garnet (2-5 mm) biotite tonalite of the intrusive suite of Bear Valley (Saleeby et al., 1987; 2007). Intrudes migmatitic paragneisses of Grapevine Canyon. Igneous equilibrium pressure of 9.4 kbar (Pickett and Saleeby, 1993). U/Pb zircon age of 101 ± 1 Ma (Saleeby et al., 2007).

Kgs — **Gabbroids of Squirrel Spring (Late Cretaceous)** Dark colored, medium-grained, migmatitic norite to hornblende gabbro of the intrusive suite of Bear Valley. Igneous equilibrium pressure of 7.3 kbar (Pickett and Saleeby, 1993). U/Pb zircon age of 102 ± 1 Ma (Saleeby et al., 2007).

Ksmg — **San Emigdio Quartz Diorite Orthogneiss (Late Cretaceous)** Dark colored, medium-grained, hornblende quartz diorite of the intrusive suite of Bear Valley. Locally contains coarse (1-3 cm) red garnet porphyroblasts commonly occurring with trondhjemitic halos. Unit lies structurally above the Rand fault and consequently exhibits a strongly attenuated structural fabric characterized by anastomosing ductile to brittle shear zones. Calculated temperatures and pressures range from 675 - 710 °C and 8 - 8.5 kbar. U/Pb zircon age of 105 ± 1 Ma (Chapman et al., submitted).

Kdc — **Digier Canyon Quartz Diorite Orthogneiss (Late Cretaceous)** Dark colored, medium-grained, hornblende quartz diorite of the intrusive suite of Bear Valley. Similar to Ksmg, although coarse red garnet porphyroblasts are not as common. Aluminum-in-hornblende igneous pressure of 10.7 kbar. U/Pb zircon age of 105 ± 1 Ma (Chapman et al., submitted).

Kpc — **Quartzofeldspathic Gneiss of Pastoria Creek (middle Cretaceous)** Lithologically heterogeneous mixture of tonalite, mafic rock, and granodiorite of the gneiss complex of the Tehachapi Range (Saleeby et al., 1987; 2007). Modestly to strongly layered. Igneous equilibrium pressures range from 8-9 kbar. U/Pb zircon age of 112 ± 2 Ma (Saleeby et al., 2007).

Ksc — **Migmatite Gneiss of Cloudburst Canyon (Early Cretaceous?)** Commingled tonalitic and dioritic rock with abundant diorite enclaves. Contains mainly plagioclase, quartz, hornblende, and biotite, with minor garnet, K-feldspar, epidote, and sphene. Quartz is commonly highly strained. Aluminum-in-hornblende igneous pressure of 10 kbar. U/Pb zircon age of 135 ± 1 Ma (Chapman et al., submitted).

Kmi — **Mixed Intrusives (Early Cretaceous)** Light colored to dark gray, strongly foliated orthogneiss, with abundant mafic schlieren, represents gradational contact between Kap and Ksat.

Ksat — **San Emigdio Tonalite (Early Cretaceous)** Light colored, homogeneous, massive to moderately foliated tonalite and trondhjemite. Contains mainly plagioclase, quartz, biotite, and reddish pink garnet. U/Pb zircon age of 136 ± 2 Ma.

METAMORPHIC ROCKS

Pzg — **Grapevine Canyon Paragneiss and Grapevine Peak migmatite (Mesozoic - Paleozoic?)** Light to dark brown, strongly foliated and isoclinally folded, variably migmatized metasandstone and metapelite. Paragneisses are generally structurally concordant with intrusive rocks. Contains mainly plagioclase, quartz, K-feldspar, biotite, red garnet, and graphite, with large (1-3 cm) tabular muscovite pseudomorphs after kyanite (Pickett and Saleeby, 1993). U/Pb zircon discordance patterns indicate assimilation by the Bear Valley suite.

SAN EMIGDIO SCHIST — Ksc

Ks — **Metasandstone (Late Cretaceous)** Light blue to dark gray, massive to highly sheared, metapsammite and quartzite. Peak mineral paragenesis of garnet + plagioclase + biotite + quartz ± muscovite defines the foliation, a weakly crenulated blastomylonitic fabric with lesser amounts of rutile, ilmenite, and graphite. Clinozoisite, chlorite, celadonitic muscovite, and tourmaline, are common retrograde phases. Highly altered kyanite grains and chloritized kyanite pseudomorphs are rare. As the Rand fault is approached from low structural levels, 1) garnet size and abundance increases, 2) plagioclase changes from unwinned, graphitic poikiloblasts to twinned, graphite-free and inclusion-poor porphyroblasts, 3) primary muscovite disappears, 4) the overall grain size increases, 5) macroscopic stromatic leucosomes and melanosomes develop, and 6) ductilely deformed quartzofeldspathic (milky quartz + plagioclase ± garnet ± muscovite) veins become more common and more strongly transposed along the foliation (Chapman et al., 2011). The schist was deposited, subducted to 9 kbar, and exhumed to upper crustal levels between 93 - 89 Ma (Grove et al., 2003; Jacobson et al., 2011).

Kpm — **Metabasalt (Late Cretaceous?)** Dark green to greenish black, massive, tectonic blocks in Ks matrix. Commonly bimineralic amphibole + plagioclase rocks, exhibiting black and white polka dotted to prison striped texture. Fabric defined by tschermakitic to pargasitic hornblende + plagioclase ± quartz and subordinate Ti-oxides ± garnet ± biotite. Plagioclase porphyroblasts are typically unzoned and range in composition from An17 to An35 (oligoclase to andesine). At high structural levels (< 100 m from the Rand fault), diopsidic to augitic clinopyroxene occurs.

Ksu — **Ultramafic (Late Cretaceous?)** Light to dark green, massive, wavy, associated with Kpm. Mainly talc and actinolite.

NONDIFFERENTIATED WESTERN SAN EMIGDIO COMPLEX (WSEMC) — WSEMC

INTRUSIVE ROCKS

Jwr — **White Ridge Tonalite (Late Jurassic)** Light colored, medium- to coarse-grained hornblende tonalite. Intrudes remainder of Western San Emigdio Mafic Complex. U/Pb zircon age of 152.2 ± 3.4 Ma (Chapman et al., submitted).

Jg — **Gabbro (Jurassic)** Light purple to green color, massive to strongly foliated, fine-to medium-grained, cumulus to non-cumulus gabbronorite, gabbro, olivine gabbro, and hornblende gabbro. Locally pervasive alteration of pyroxene to amphibole. Contains large xenoliths of peridotite and pods and dikelets of hornblende tonalite pegmatite.

Jw — **Websterite (Jurassic)** Weathers red, medium-grained, cumulus textured websterite, with minor clinopyroxene and wehrlite.

Jp — **Ultramafic Rocks (Jurassic)** Weathers red, fine- to medium-grained, massive to moderately layered, cumulus textured websterite, therzolite, olivine websterite, serpentinized dunite, and orthopyroxenite. Locally cut by peridotite dikes.

Jmi — **Mixed Intrusive Zone (Jurassic)** Fine- to medium-grained, cumulus to hypidiomorphic gabbro, gabbronorite, cumulus peridotite, medium- to coarse-grained hornblende tonalite. Peridotite grades into and intrudes gabbro. Hornblende tonalite grades into and intrudes gabbro and peridotite. Gabbro contains large xenoliths of peridotite.

METAMORPHIC ROCKS

Jsd — **Sheeted Dikes (Paleozoic?)** Dark green to black, fine-grained, well foliated, local preservation of sheeted dikes, rare plagiogranite pods, and pillow basalt screens. Probably equivalent to basaltic rocks of the Paleozoic Sierran Foothills ophiolite belt (Chapman et al., submitted).

ROCKS SOUTH OF THE SAN ANDREAS FAULT

Rocks of Abel Mountain and Mount Pinos, Undifferentiated

DESCRIPTION OF MAP SYMBOLS

Contact - Approximately located.

Contact - Gradational.

Late Pliocene - Quaternary fault- Dashed where uncertain, dotted where concealed.

Late Pliocene - Quaternary thrust fault- Teeth on upper plate. Dashed where uncertain, dotted where

Pastoria fault (folded and cut by Pliocene - Quaternary thrust faults) - Black box on Cretaceous upper plate, teeth on Pliocene-Quaternary upper plate. Dashed where uncertain, dotted where concealed.

Rand fault (folded and cut by Pliocene - Quaternary thrust faults) - Black teeth on Cretaceous upper plate, Red teeth on Pliocene-Quaternary upper plate. Dashed where uncertain, dotted where concealed.

Anticline - Showing axial trace and plunge direction, dotted where concealed.

Syncline - Showing axial trace and plunge direction, dotted where concealed.

104.6 ± 1.8 — **U/Pb zircon ages (Ma)**

STRIKE AND DIP OF BEDS

34 — **Inclined**

Vertical

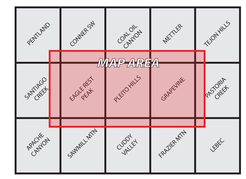
75 — **Overturned**

STRIKE AND DIP OF FOLIATION

67 18 — **Inclined, trend and plunge of lineation**

Vertical

QUADRANGLE INDEX



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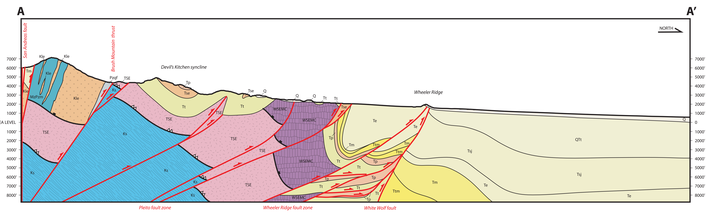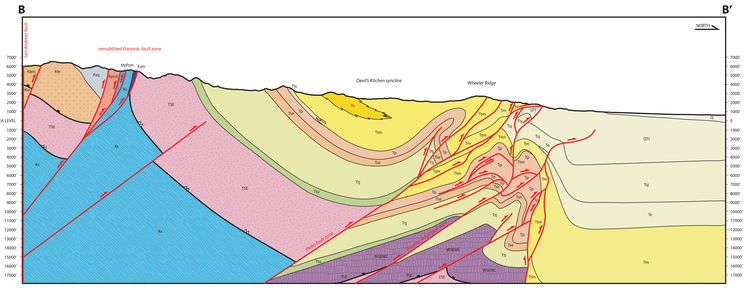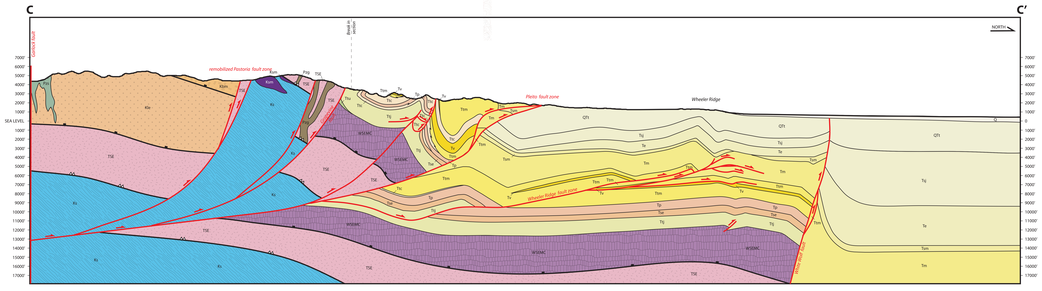
NORTH-SOUTH STRUCTURAL CROSS-SECTIONS OF THE SAN EMIGDIO MOUNTAINS; NO VERTICAL EXAGGERATION