Figure 4. View looking west from west end of Rincon Mountain of eastern part of Santa Barbara coastal plain. City of Carpinteria and Rincon Point are visible in right and left center of photograph, respectively. Part of extensive landslide complex on south flank of Rincon Mountain is visible in lower left part of photograph (area of bright green vegetation). Southwest part of map area includes landscape visible in lower half of photograph.

Figure 6. Close-up photograph of principal fault slip surface, formed in pebbly sandstone bed of the Rincon Shale (Tr), preserving carbonate mineral coatings (white patches) that were precipitated in the fault zone during its slip history. Slickenside striae (trending diagonally across photograph from upper right to lower left), along with distribution of mineral coatings preferentially on lower left sides of surface asperities, indicate that missing fault block slipped in direction of black arrow. Coin is about 2.5 cm in diameter.

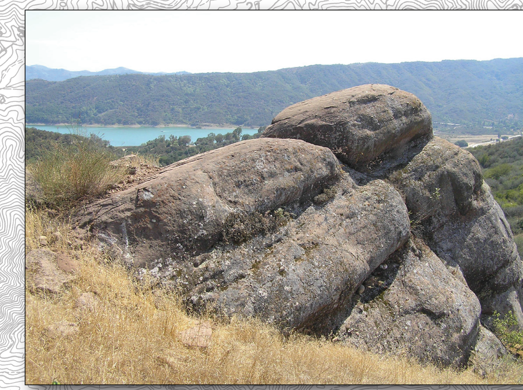


Figure 7. Outcrop of gently dipping beds of conglomeratic sandstone of the Oligocene middle conglomerate and sandstone unit (Tspm) of the Sespe Formation. Lake Casitas and Laguna Ridge visible in background.

Figure 8. View looking northeast of exposure in Devils Gulch of southeast-dipping beds of Rincon Shale (Tr) in footwall block of nearby Devils Gulch fault (not visible here; located to right of photograph view). Flat surface covered with grass and shrubs above gulch on left side is late Pleistocene intermediate alluvial strath terrace (Qia4) that is also cut by Devils Gulch and other subparallel faults.

Figure 9. View looking northeast along hinge of anticline formed in shale and mudstone of the upper siliceous unit of the Monterey Formation (Tmu). Fold is exposed in Highway 33 roadcut in southeastern part of map area about 1.5 km north of its southern border. Pick in lower center of photograph is about 0.5 m in length.

Figure 10. Lion Creek cutbank exposure of moderately dipping boulder-, cobble-, and pebble-bearing conglomerate of Ojai (Qco) which here unconformably overlies Rincon Shale (Tr) with minor angular discordance. Clasts in the middle(?) Pleistocene conglomerate of Ojai are mostly derived from the Eocene and Oligocene sedimentary units exposed along the south flank of the nearby Santa Ynez Mountains uplift.

Figure 11. View looking west of Rincon Creek cutbank exposure of Rincon Creek fault, here juxtaposing tilted Pleistocene strata of the Casitas Formation (Qca) in the upthrown (left) block against horizontally-bedded upper(?) Pleistocene older alluvial deposits (Qoa) and unconformably underlying Casitas deposits (Qca). Fault principal slip surface excavated near top of exposure reveals reverse-sinistral oblique-slip kinematic indicators. Dotted line indicates the location is concealed. A, away from observer, T, toward the observer.

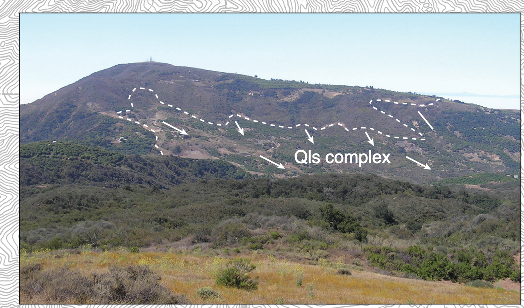


Figure 12. View looking south of landslide (Qls) complex on north flank of Rincon Mountain. Landslide deposits, which have slid and flowed downslope in directions indicated by arrows, were sourced in mudrocks of the Rincon Shale (Tr) and lower calcareous unit of the Monterey Formation (Tml) that underlie upper slopes of Rincon Mountain. White dashed line delineates the approximate location of the composite headwall scarp of the slumped area.

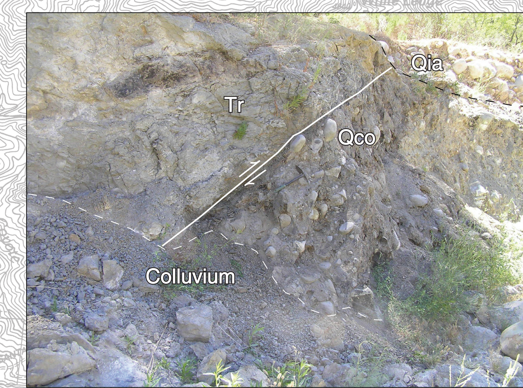
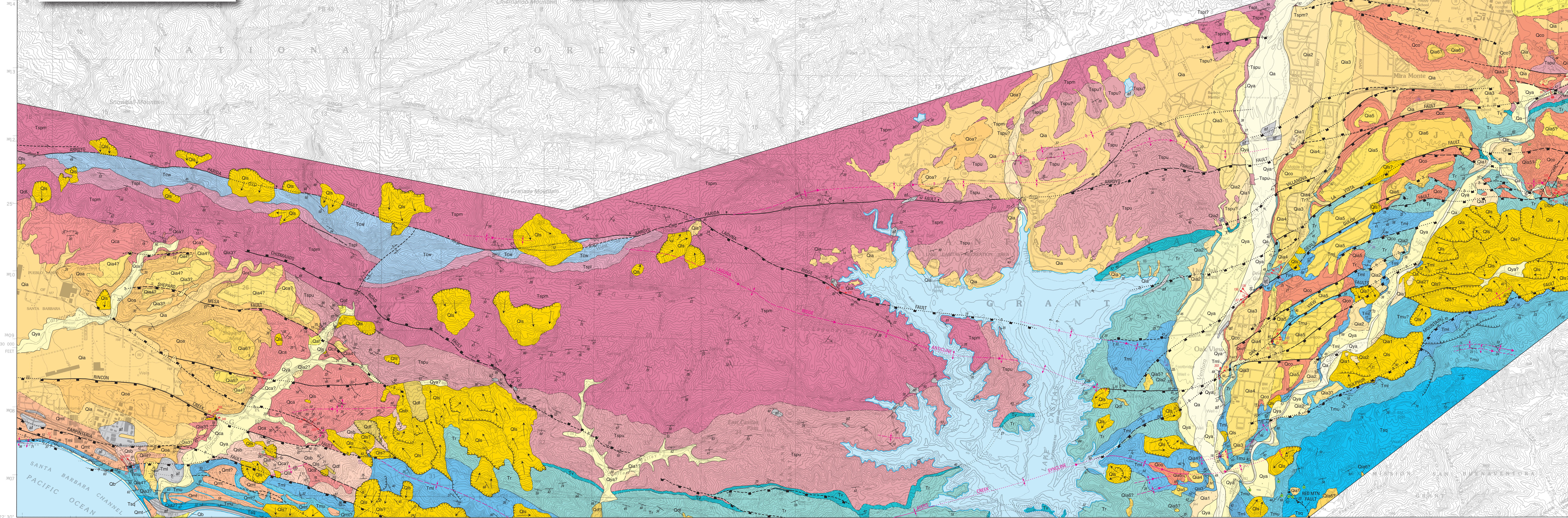


Figure 13. View looking west of Lion thrust fault exposed in cut bank of Lion Creek near central east border of map area. Here fault thrusts Miocene Rincon Shale (Tr) over tar-impregnated Pleistocene conglomerate of Ojai (Qco). Late Pleistocene alluvial terrace (Qia) overlies and postdates fault. Pick in center of photograph is about 0.5 m in length. Dashed line indicates contact location is approximate.

Figure 14. Panorama looking west-to-southwest across San Antonio Creek valley, of a faulted late Pleistocene alluvial strath terrace (Qia6). Terrace, expressed as gently south-tilted "treads" visible along ridge crest in upper center and left parts of photograph, is cut by a series of intervening southwest-striking, south-side-up oblique-reverse faults expressed as north-facing slopes or "risers" visible in upper left, center, and right parts of photograph. Lower bench visible on far-right side of photograph and open grassy surface in center foreground are younger alluvial terraces (Qia3 and Qia2, respectively) that postdate faulting.



Base from U.S. Geological Survey 1:24,000-scale maps Matilija, 1995; White Ledge Peak, 1995
Lambert conformal conic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 5
1,000-meter Universal Transverse Mercator grid ticks, zone 11
Shaded-relief base from U.S. Geological Survey National Elevation Dataset (NED) (accessed in 2005 at http://ned.usgs.gov/) 10-meter resolution elevation data

APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:24 000

CONTOUR INTERVAL 40 AND 20 FEET
DATUM IS MEAN SEA LEVEL

MAP LOCATION

Geology in the map area was mapped by S.A. Minor chiefly in 2007 through 2011. T.R. Brandt assisted in the design and editing of the geographic information system (GIS) data used in the database and carried out the database integration. The geologic map is based mainly on new mapping from observations and interpretations made at the ground surface or in shallow surface excavations, photo-interpretation of ~1:24,000-scale 1999 and 2001 color, and ~1:39,000-scale 2002 color-infrared National Aerial Photography Program (NAPP, http://eros.usgs.gov/#/Guides/napp) aerial photographs, and new biostratigraphic data. Most of the mapped geology was compiled in ArcGIS by heads-up digitization of linework using georectified digital aerial imagery and plotting of point data using GPS-determined coordinates.

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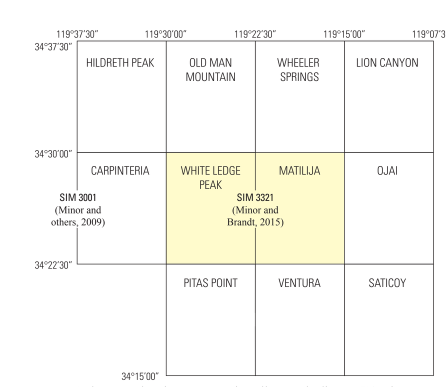
Geologic Map of the Southern White Ledge Peak and Matilija Quadrangles, Santa Barbara and Ventura Counties, California

By
Scott A. Minor and Theodore R. Brandt
2015



Index map showing map area in yellow, and adjacent 7½-minute quadrangles.

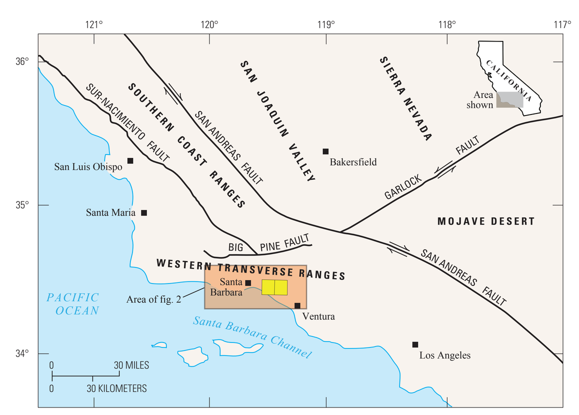
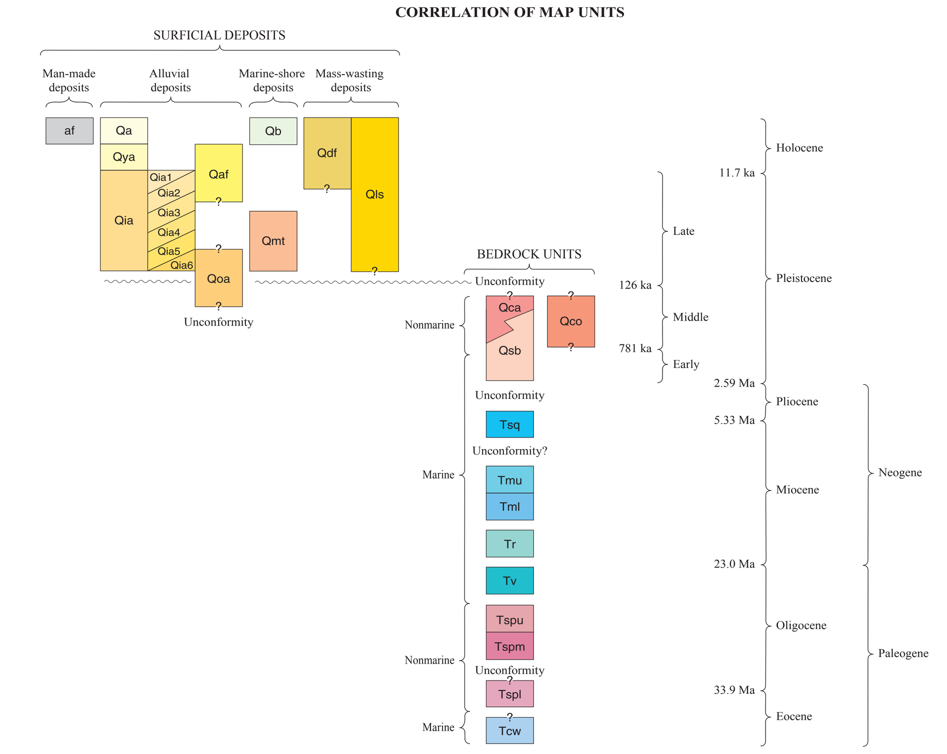


Figure 1. Generalized location map of part of southwestern California showing major tectonic faults, the area of fig. 2 (in orange), and the two quadrangles containing the geologic mapped area (in yellow).

CORRELATION OF MAP UNITS



ABBREVIATED DESCRIPTION OF MAP UNITS

[Unit symbols are queried on map where the unit identification is questionable. The database contains additional features (minor folds and faults) that do not appear on the map]

SURFICIAL DEPOSITS

Man-made deposits

af — **Artificial fill (Holocene)**—Fill used for construction of highways, roads, buildings, and dams

Alluvial deposits

Qa — **Active alluvium (Holocene)**—Unconsolidated sediments in modern stream and river channels, primarily pebble to boulder gravel

Qya — **Younger alluvium (Holocene)**—Poorly consolidated silt, sand, and gravel deposits occupying valley floors and floodplains of modern drainages

Qaf — **Alluvial fan deposits (Holocene and late Pleistocene?)**—Weakly to moderately consolidated silt, sand, and gravel forming variably dissected fans

Qia — **Intermediate alluvial deposits, undifferentiated (late Pleistocene)**—Weakly consolidated gravel and lesser sand and silt that form weakly to moderately dissected stream and river strath terraces positioned above adjacent modern floodplains, and broad, low-relief, piedmont alluvial aprons. Along larger drainages terrace-forming intermediate alluvial deposits are subdivided into six age groupings based chiefly on relative levels (elevations) of terraces, with the oldest terraces being the most elevated:

Qia1 — **Intermediate alluvial deposits, terrace level 1**

Qia2 — **Intermediate alluvial deposits, terrace level 2**

Qia3 — **Intermediate alluvial deposits, terrace level 3**

Qia4 — **Intermediate alluvial deposits, terrace level 4**

Qia5 — **Intermediate alluvial deposits, terrace level 5**

Qia6 — **Intermediate alluvial deposits, terrace level 6**

Qoa — **Older alluvial deposits (late? and middle? Pleistocene)**—Moderately consolidated, stratified sand and sandstone, gravel, conglomerate, and breccia, and rare interbeds of clay, silt, and mudstone composing erosional remnants of older alluvial fans shed from the Santa Ynez Mountains

Marine-shore deposits

Qb — **Beach deposits (Holocene)**—Unconsolidated beach sediment, mostly sand, along coastal beaches

Qmt — **Marine-terrace deposits (late Pleistocene)**—Sequence of basal marine, weakly to moderately consolidated, variably stratified, fossiliferous gravel, sand, and silt deposited in neritic, intertidal, beach, and estuarine environments and overlying nonmarine eolian sand and silt, alluvial gravel, and colluvial deposits. Marine-terrace deposits rest on elevated wave-cut platforms and form single terraces or flights of terraces

Mass-wasting deposits

Qdf — **Debris-flow deposits (Holocene and late Pleistocene?)**—Massive, weakly consolidated rock-debris breccia derived from rock units exposed upslope

Qls — **Landslide deposits (Holocene and late? Pleistocene)**—Deposits of diverse slope-movement processes ranging from poorly sorted, disrupted mixtures of rock fragments and soil to relatively intact bedrock slide blocks

BEDROCK UNITS

Qca — **Casitas Formation (middle? Pleistocene)**—Nonmarine, moderately to well-consolidated siltstone and silt, multi-colored sandstone and sand, and conglomerate and gravel deposited mainly as alluvium likely shed off of the Santa Ynez Mountains and other nearby uplands. Unit resembles, and may be at least partly correlative with, the older alluvial deposits (Qoa) and the conglomerate of Ojai (Qco)

Qco — **Conglomerate of Ojai (middle? Pleistocene)**—Nonmarine, moderately to well-consolidated conglomerate and gravel, sandstone and sand, and subordinate siltstone and silt deposited mainly as alluvium likely shed off of the Santa Ynez Mountains and other nearby uplands. Unit resembles, and may be at least partly correlative with, the older alluvial deposits (Qoa) and the Casitas Formation (Qca)

Qsb — **Santa Barbara Formation (middle and early Pleistocene)**—Marine, pale-gray, -yellow, and -tan, friable, bioturbated and massive sandstone; includes subordinate interbeds and intervals of shale, siltstone, and silty to clayey sandstone. Contains diverse assemblage of marine invertebrate fossils. Contains rare conglomeratic beds and lenses, and uppermost part of unit locally interfingers with nonmarine conglomerates of the Casitas Formation (Qca)

Tsq — **Sisquoc Formation (lower Pliocene and upper Miocene)**—Marine, pale-gray-, pale-gray-brown-, and white-weathering, diatomaceous mudstone and shale, and subordinate dolomite and basal conglomerate. Unit distinguished from underlying upper siliceous unit of Monterey Formation (Tmu) by subtle change in color and decrease in hardness of the mudstone of the Sisquoc

Monterey Formation (Miocene)—Marine, predominantly well-bedded, siliceous and calcareous mudstone and shale with subordinate porcelanite and dolomite. Contains abundant microfossils. The Monterey Formation in map area is divided into two subunits that are distinguished from each other by lithology and age:

Tmu — **Upper siliceous unit (upper and middle Miocene)**—Diatomaceous, white-, cream-, and pale-tan-weathering mudstone and shale with subordinate porcelanite and lesser dolomite and calcareous mudstone and shale

Tml — **Lower calcareous unit (middle and lower Miocene)**—Calcareous, siliceous, and phosphatic, white- to tan-weathering mudstone and shale, with subordinate dolomite, porcelanite, and sandstone

Tr — **Rincon Shale (lower Miocene)**—Marine, primarily massive and thick-bedded, gray- and rusty-brown-weathering mudstone, with subordinate dolomite, sandstone, and conglomeratic sandstone; locally fossiliferous. Mudstone is bioturbated and pervasively fractured. Sandstone beds increase in frequency both eastward and down section toward contact with Vaqueros Formation (Tv)

Tv — **Vaqueros Formation (upper Oligocene)**—Shallow-marine, massive and bioturbated to laminated and bedded, resistant, pale-tan- and -gray-weathering sandstone. Uppermost part consists of thinly interbedded sandstone, siltstone, and mudstone; base typically marked by a 0.5–2-m-thick, thinly bedded, calcareous pebbly sandstone containing abundant fossil-shell fragments

Sespe Formation (Oligocene and upper Eocene)—Nonmarine, fluvial, maroon, reddish-brown, and greenish- to pinkish-gray sandstone, mudstone, and conglomerate. In map area, divided into three units that are distinguished from each other mainly by differences in lithology, provenance, and age. An intraformational unconformity, representing a depositional hiatus lasting much or all of early Oligocene time, separates the lower (Tspl) and middle (Tspm) units

Tspu — **Upper sandstone and mudstone unit (upper Oligocene)**—Interbedded sandstone, siltstone, and mudstone that weather to various shades of maroon, pale green, tan, and gray. Proportions of different sedimentary rock types vary both laterally and vertically through the section. Sandstones commonly broadly lenticular, laminated, and thin to thick bedded

Tspm — **Middle conglomerate and sandstone unit (Oligocene)**—Interbedded conglomerate, sandstone, and mudstone that weather to various shades of maroon, tan, and pale-greenish gray. Proportions of different sedimentary rock types vary both laterally and vertically through the section. Polymict conglomerate clasts include abundant chert, greenstone, and lithic sandstone likely derived from Franciscan Complex source terrane(s), which, together with color, distinguish unit from lower conglomeratic Sespe Formation unit (Tspl)

Tspl — **Lower conglomerate and sandstone unit (lower Oligocene? and upper Eocene)**—Interbedded conglomerate, conglomeratic sandstone, sandstone, mudstone, and minor shale that mostly weather to various distinctive shades of salmon gray, reddish gray, pale-pinkish gray, and pale tan. Proportions of different sedimentary rock types vary both laterally and vertically through the section. Sandstones and conglomerates are resistant and form hogbacks. Distinguished by common arkosic compositions and pinkish to reddish hues of sandstones, and abundant rounded quartzitic, granitoid, metamorphic, and volcanic clasts in the polymict conglomerates, which are likely derived from Mojave Desert source terrane(s)

Tcw — **Coldwater Sandstone (upper? and middle Eocene)**—Shallow-marine, thin- to thick-bedded sandstone that weathers to distinctive, pale shades of buff, yellow, tan, and brown, with subordinate interbeds and thin intervals of gray, olive-gray, olive-tan, and greenish-gray siltstone, shale, and mudstone. Sandstone beds are resistant and form hogbacks where steeply dipping. Upper part of unit locally rich in fossil oyster shells

EXPLANATION

47 — **Contact**—Long-dashed where approximately located; short-dashed where inferred, dotted where concealed, queried where identity or existence is questionable; contact attitude (green tic) shows direction and angle of dip

57 286 — **Fault**—Long-dashed where approximately located, short dashed where inferred, dotted where concealed, queried where uncertain; small red arrow shows direction and angle of dip, red diamond-headed arrow shows bearing and rake of slickenlines and inferred slip direction of hanging-wall block

Normal fault reactivated as strike-slip fault—Long-dashed where approximately located, short dashed where inferred, dotted where concealed; ball and bar on apparent downthrown side (note that this only applies to the Arroyo Parida Fault in and west of Santa Ana Valley); opposing arrows indicate sense of younger strike-slip movement

Strike-slip fault—Long-dashed where approximately located, short dashed where inferred, dotted where concealed; opposing arrows indicate sense of strike-slip component of movement

Thrust fault—Sawteeth on upthrown side, short dashed where inferred, dotted where concealed

Reverse fault—Long-dashed where approximately located, short dashed where inferred, dotted where concealed, queried where identity or existence is questionable; rectangles on upthrown side

Anticline—Long-dashed where location approximate, short dash where inferred, dotted where concealed, queried where identity or existence is questionable; large arrowhead shows direction of plunge

Syncline—Long-dashed where location approximate, short dash where inferred, dotted where concealed, queried where identity or existence is questionable; large arrowhead shows direction of plunge

Landslide scarp—Hachures point down scarp

Landslide movement—Arrows show direction of downslope movement

Landslide internal contact

Marine-terrace shoreline angle—Approximately located based on subtle to strong topographic steps of terrace surface; locally coincides with contact between Qmt and older units

Horizontal bedding

35 — **Overturned bedding**—Showing strike and dip

30 — **Inclined bedding**—Showing strike and dip

25 — **Inclined bedding**—Showing approximate strike and dip

15 — **Inclined bedding, questionable**—Showing strike and dip of bedding

Oil seep

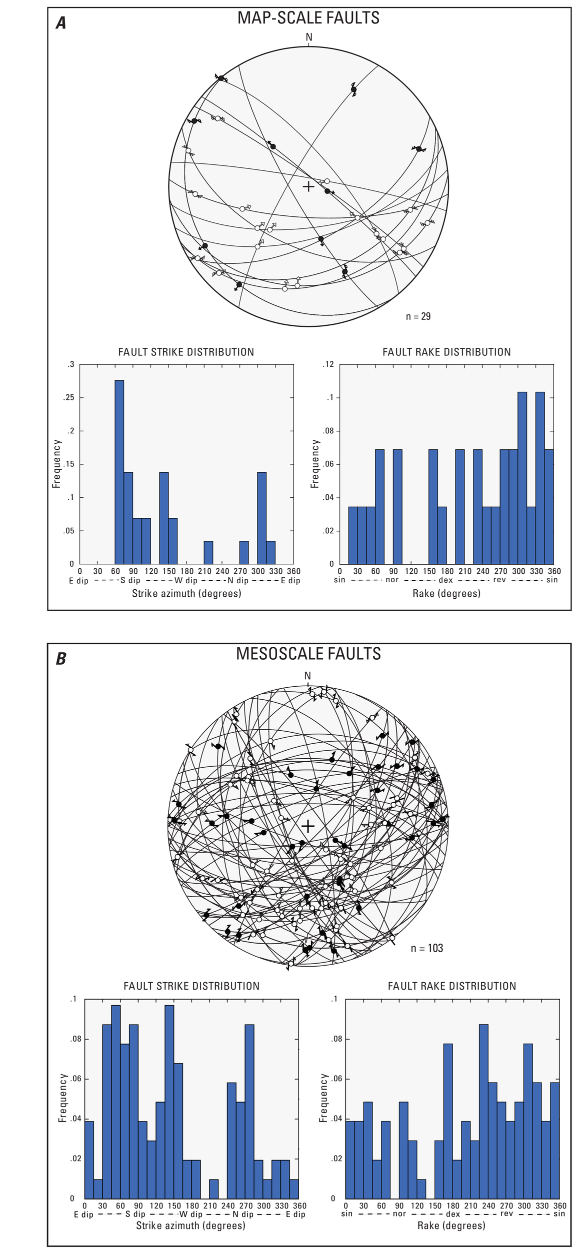


Figure 5. Structural plots of slip observations of *A,* Map-scale (plotted on map) and *B,* Mesoscale faults (see database for measurements and coordinates) exposed in map area. Upper circular plots are lower-hemisphere, equal-area projections of fault slip surfaces (great circles) and slickenlines (points); small arrows attached to points indicate slip sense (strike-slip-dominant faults) or hanging-wall movement direction (dip-slip-dominant faults); reverse and normal slip components indicated by open and filled points/arrows, respectively; N, north; n, number of fault-slip measurements. Lower histograms show fault strike and rake frequency distributions; frequency axis values are scaled to decimal fractions of the total number of measurements; strike azimuths are 90° counterclockwise from fault dip directions; rake values range from 0° to 360°, where 0° (=360°) is pure sinistral (sin) strike slip, 90° is pure normal (nor) slip, 180° is pure dextral (dex) strike slip, and 270° is pure reverse (rev) slip.

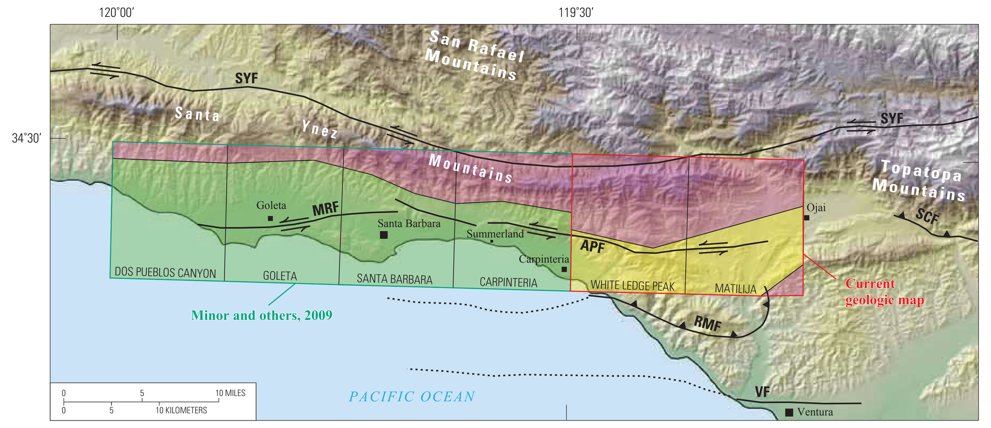


Figure 2. Regional physiographic map showing location of the current map area (yellow shading), previously published geologic map of the Santa Barbara coastal plain area (Minor and others, 2009) (green shading), 7½' topographic quadrangles overlapping geologic map areas (pink shading), and major tectonic faults (thick black lines). Faults: SYF, Santa Ynez; SCF, San Cayetano; RMF, Red Mountain; VF, Ventura; APF, Arroyo Parida; MRF, More Ranch. Fault symbols: barbs, thrust fault (barbs on upper plate); paired opposing arrows, sense of strike-slip movement, dotted lines where concealed. The base map is derived from the U.S. Geological Survey National Elevation Dataset (NED), 10-meter resolution elevation data, 2005; hillshading illuminated from the northwest; color ramping based on relative elevation, with dark green corresponding to lowest elevations and white indicating highest elevations.

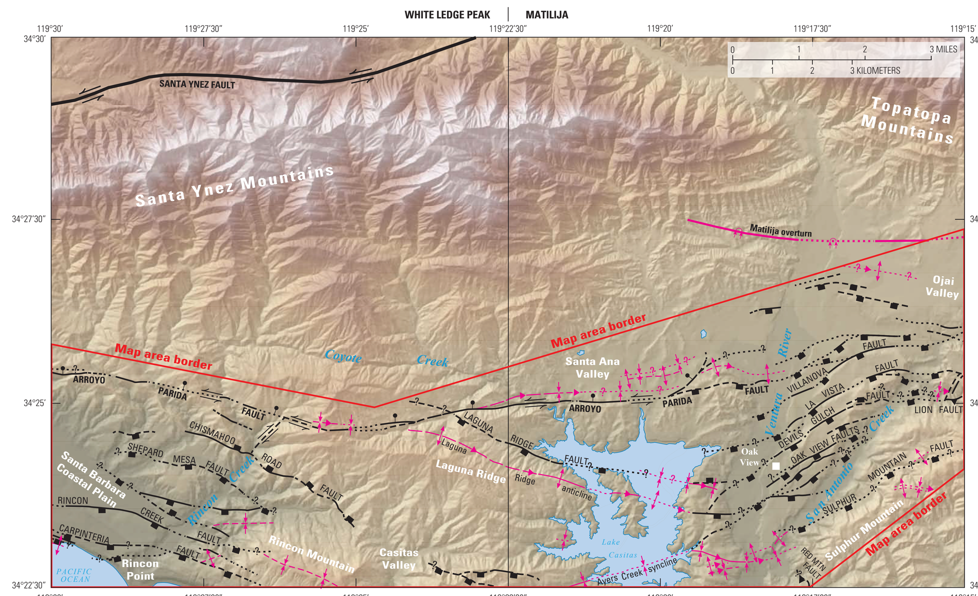


Figure 3. Tectonic and physiographic map of the combined White Ledge Peak and Matilija quadrangles showing faults (black lines) and folds (magenta lines) mapped in this study and other major structural features in the vicinity (thick black and magenta lines). Location of town is labeled and marked with white square. The geologic map area is outlined in red; structural lines and symbols are the same as those used on geologic map; see map explanation for symbol guide. The digital elevation model (DEM), hypsometric tint, and shaded-relief values composing the base map are derived from the U.S. Geological Survey National Elevation Dataset (NED), 10-meter resolution elevation data, 2005.

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