Evidence for an alternative position for the primary active strand of the San Andreas Fault along its restraining bend in southern California

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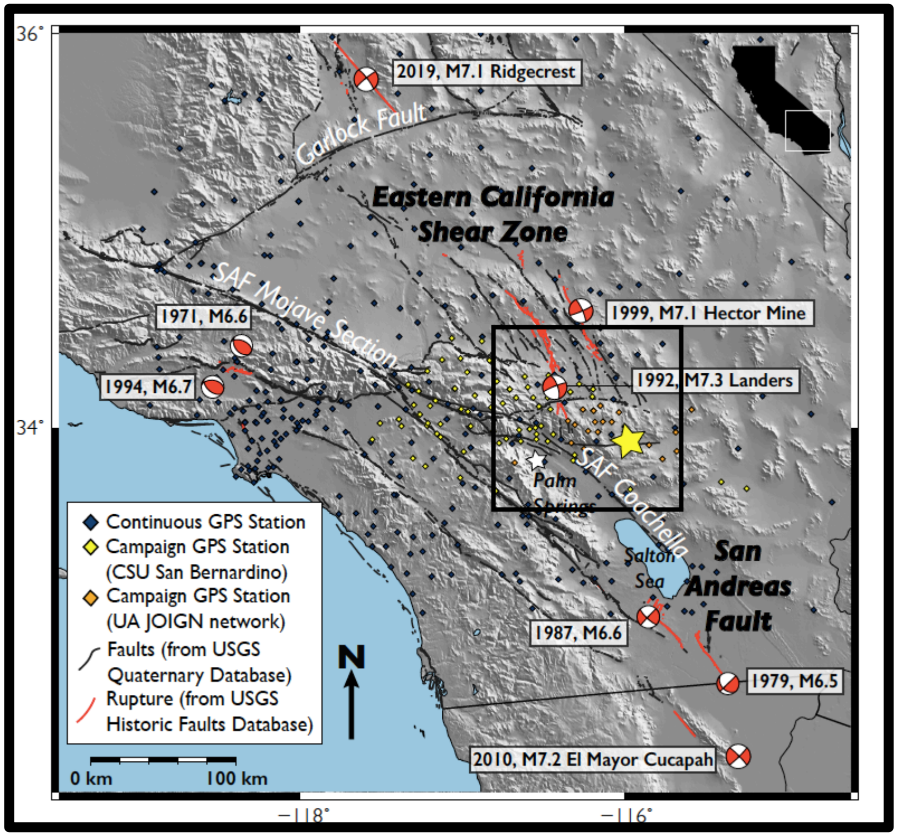
NSF

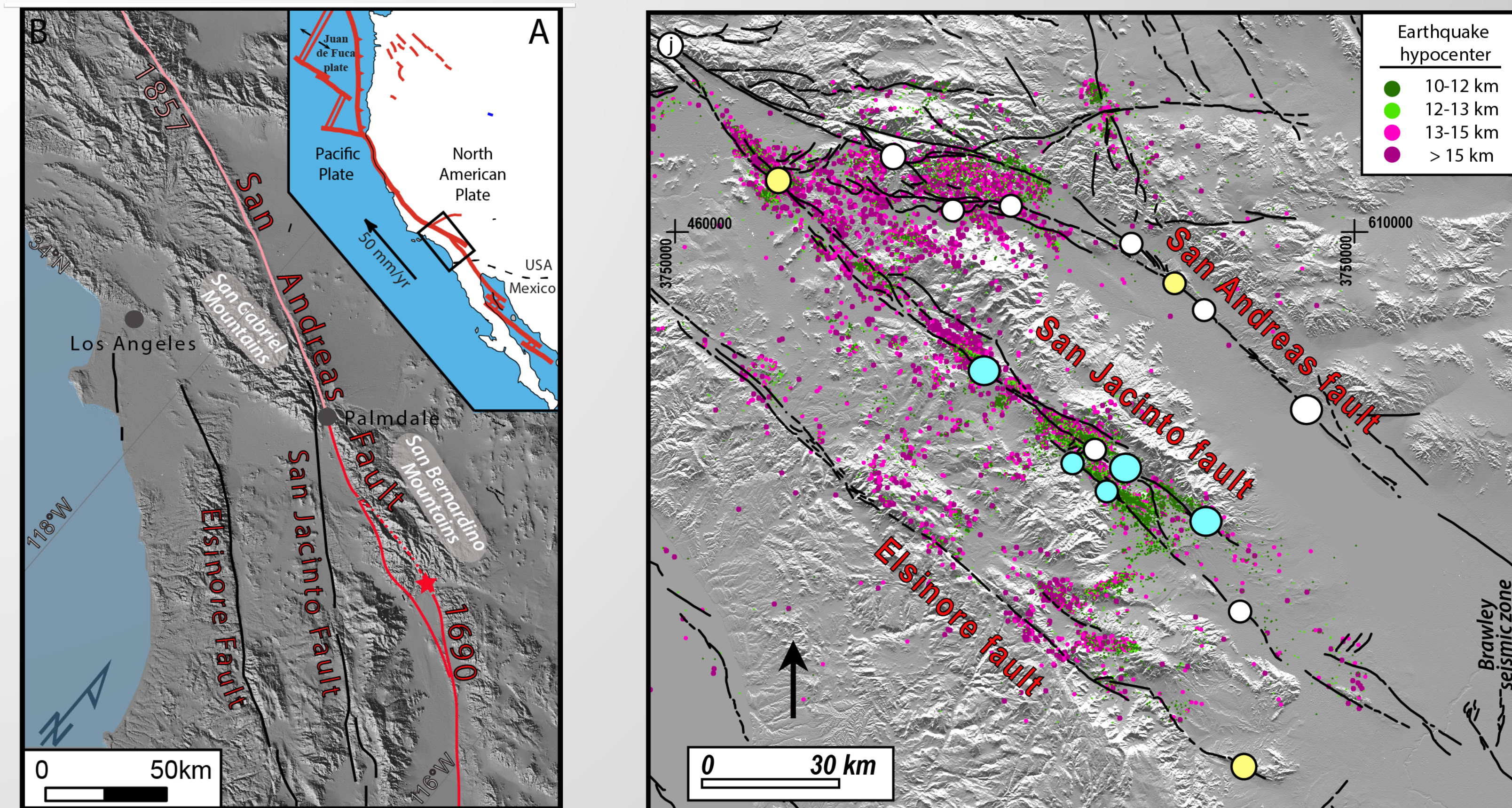
BGC Berkeley Geochronology Center

SCEC an NSF+USGS center — Southern California Earthquake Center

Continental Transform Plate Boundaries

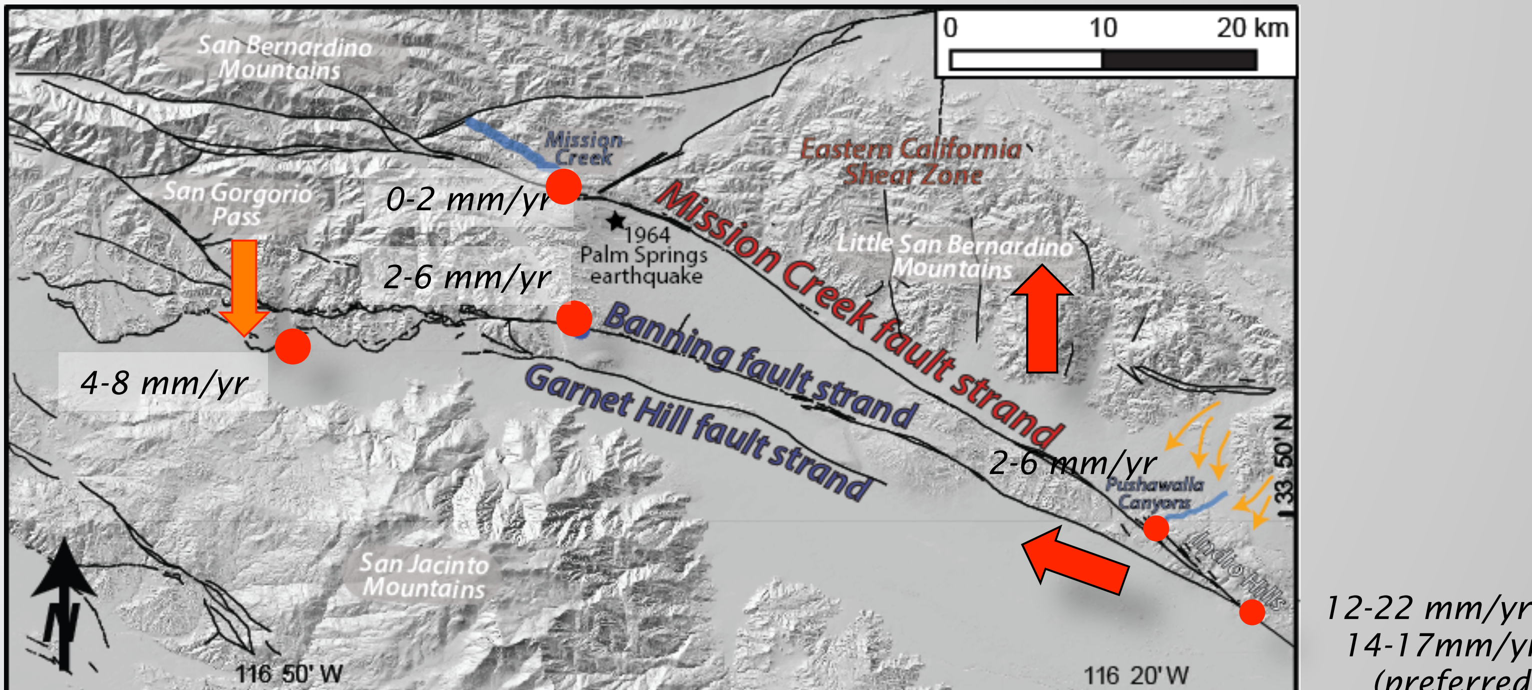


Southern San Andreas fault



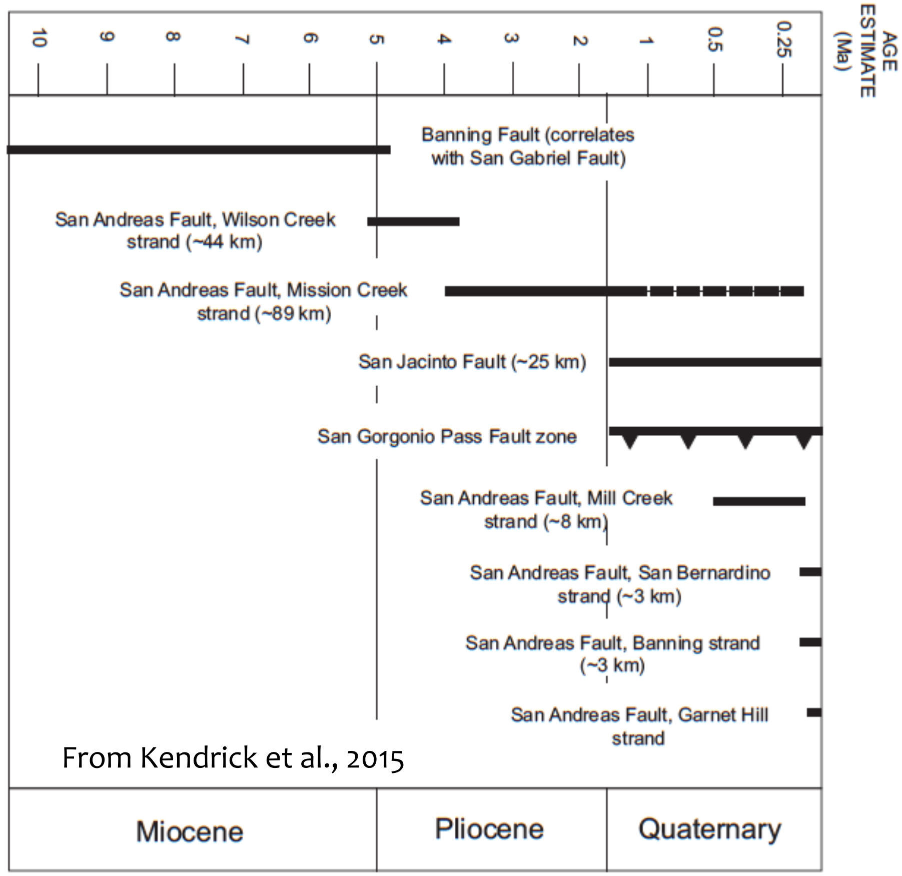
No historic EQ, last rupture >300 years ago (Fumal et al., 2002; Philibosian et al., 2012).

Southern San Andreas Fault: San Gorgonio Pass



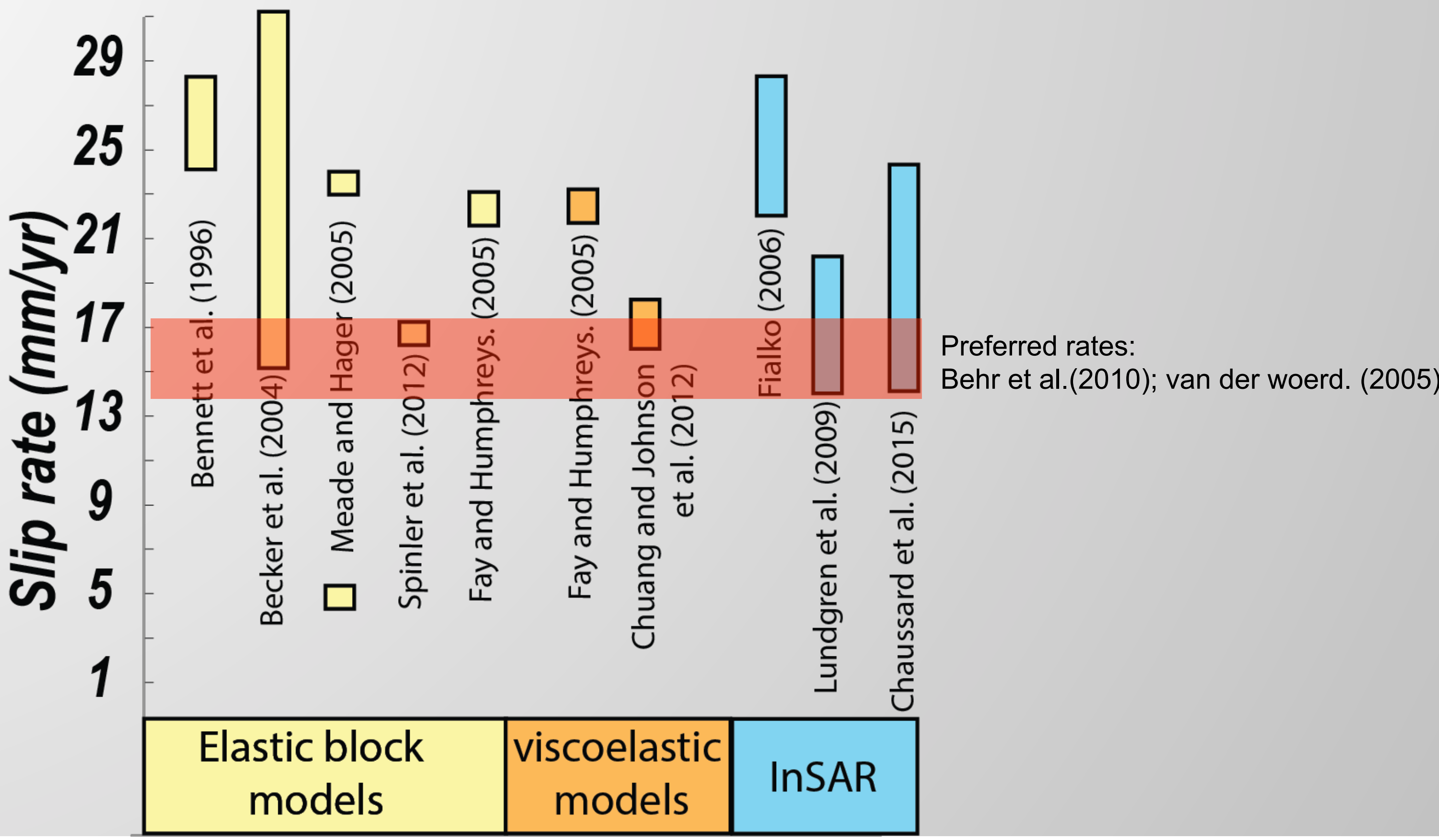
(e.g., Morton and Matti, 1993; Matti and Morton, 1993; Fumal et al., 2002; Yule and Sieh, 2002; van der Woerd et al., 2006, Behr et al., 2010, UCERF3 2015; Gold et al., 2014, Hermance and Yule, 2015)

History of fault activity



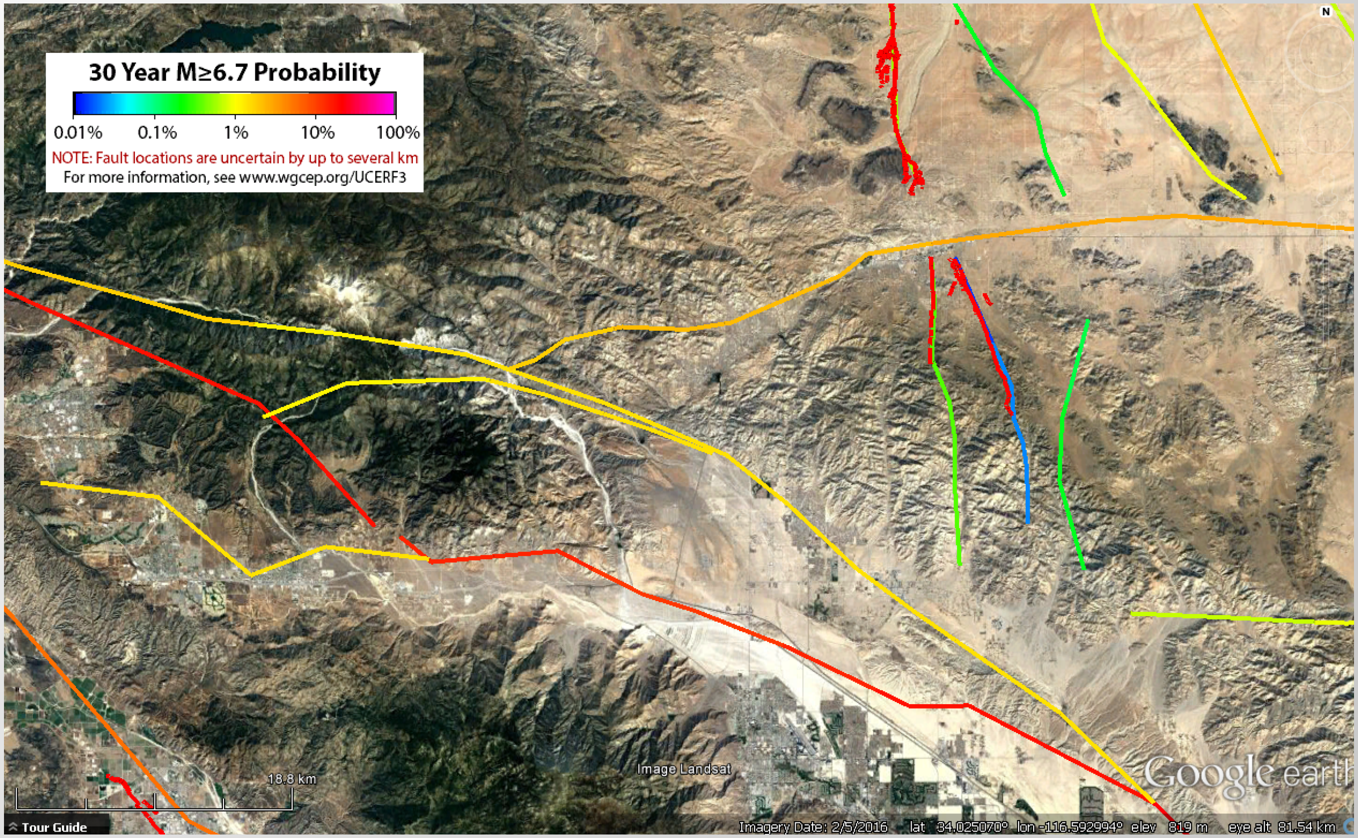
From Kendrick et al., 2015

Southern San Andreas fault
GPS slip rates



Southern San Andreas Fault: San Gorgonio Pass

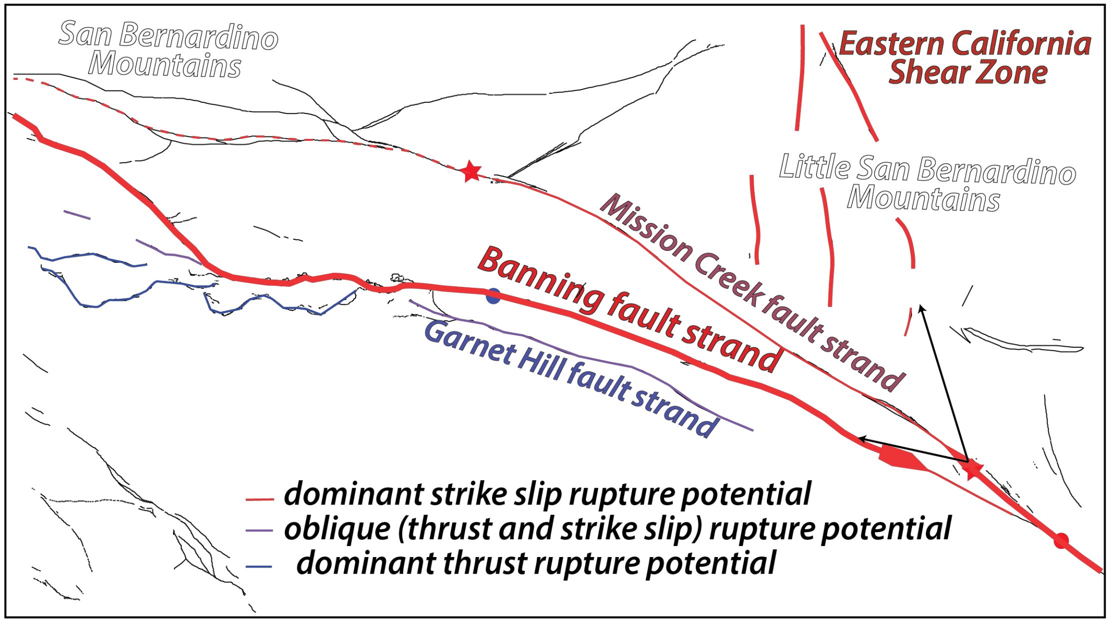
Uniform California Earthquake Rupture Forecast (UCERF3) Geologic Block Model



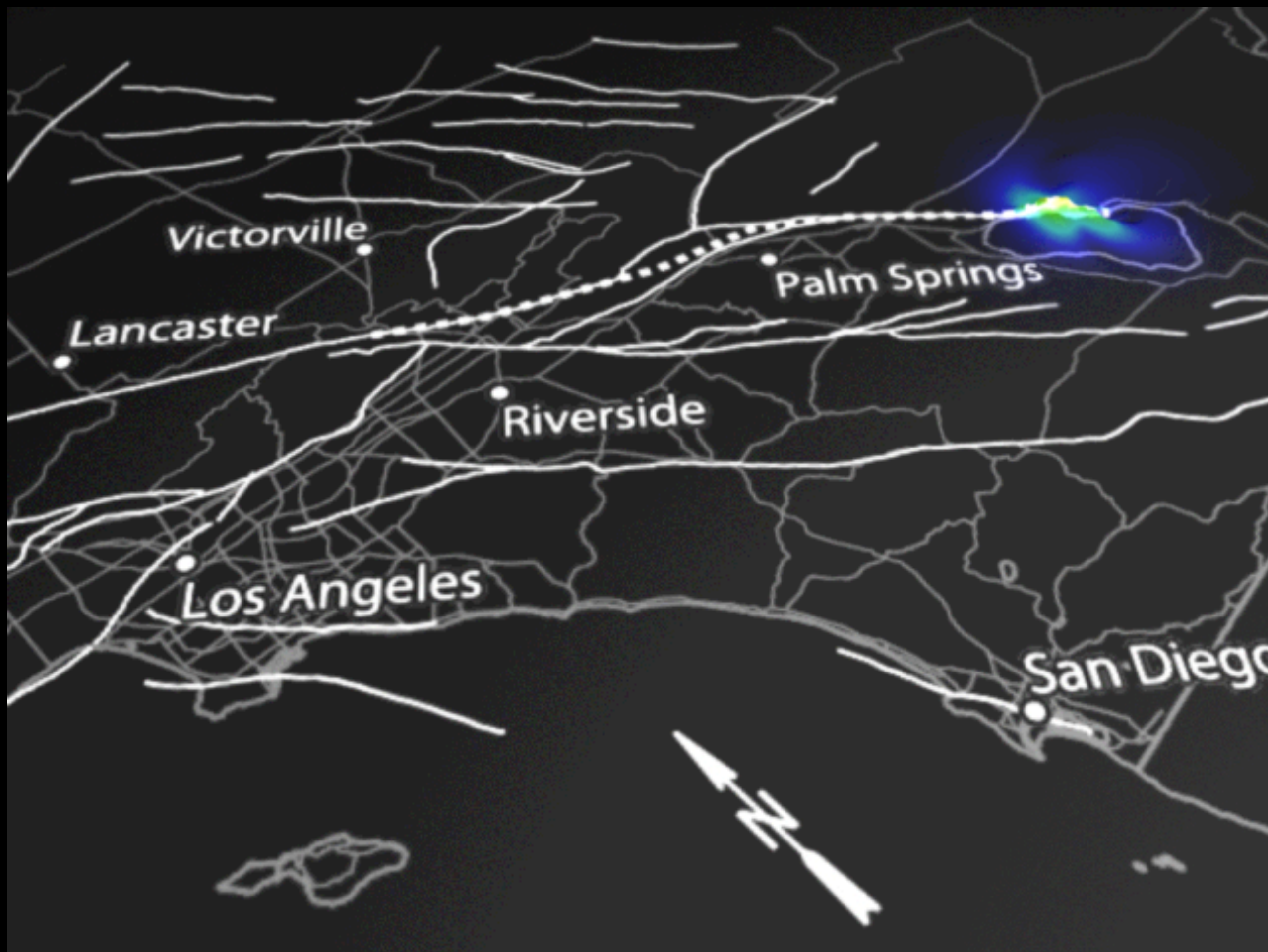
Hazard models for southern California

Preferred hazard model based on previous studies

a southern SAFZ earthquake will likely rupture on the Banning fault strand through a broadly distributed zone of right-lateral, thrust and oblique faults.



http://www.scec.org/resources/movies/TeraShake_Velocity_3D.mov



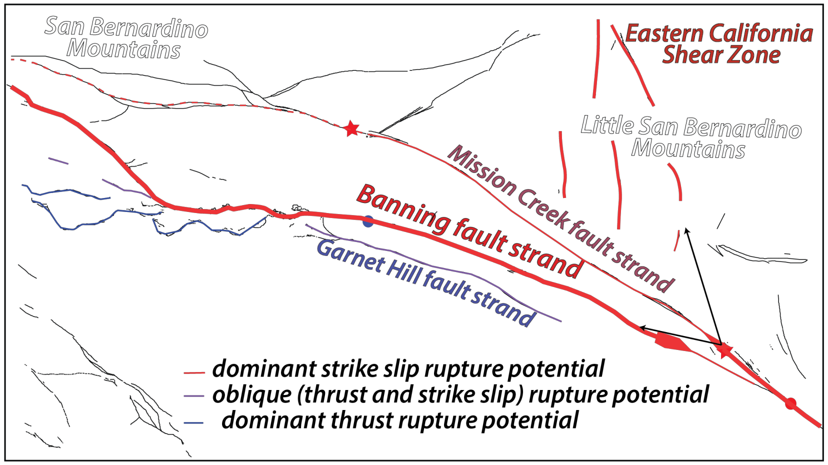
Hazard models for southern California

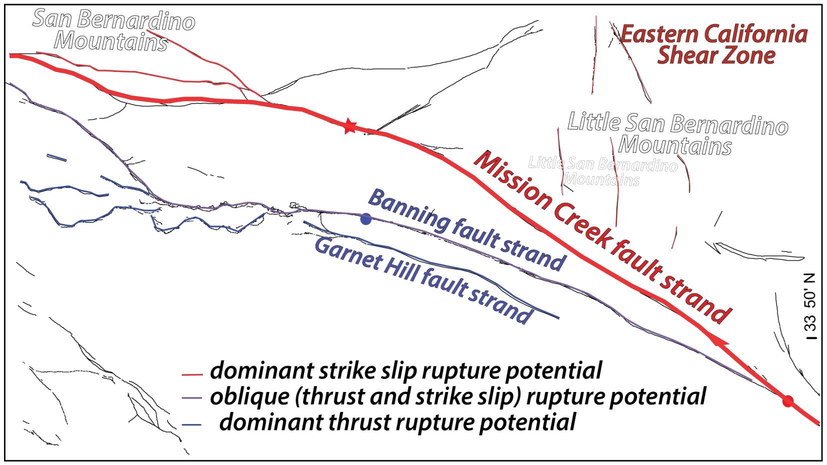
Preferred hazard model based on previous studies

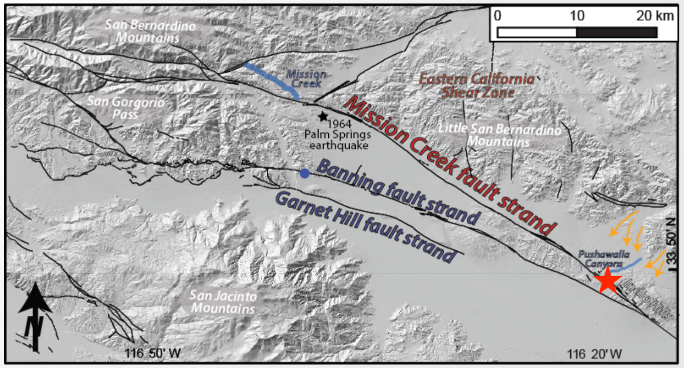
a southern SAFZ earthquake will likely rupture on the Banning fault strand through a broadly distributed zone of right-lateral, thrust and oblique faults.

Alternative hazard model based on this study

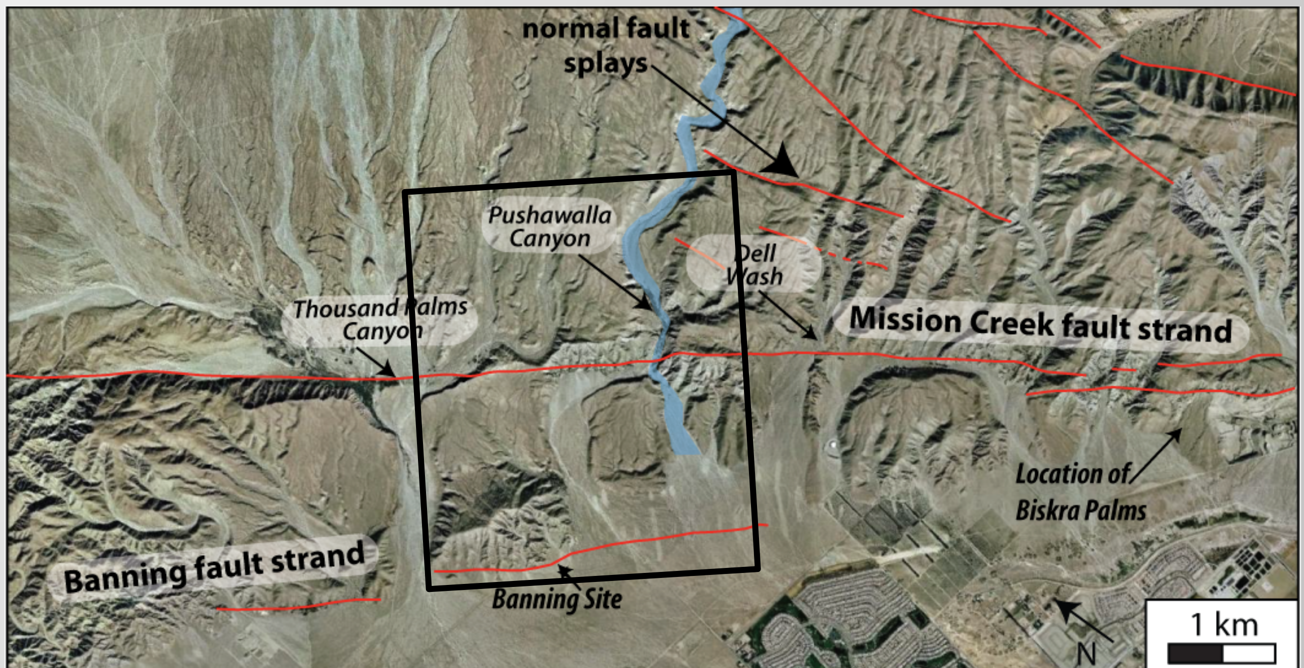
A southern SAFZ earthquake may rupture on the Mission Creek fault and continue northward on a narrow structure through the San Gorgonio Pass, instead of following the Banning fault strand.







Slip rate site: *Central Indio Hills*



Mission Creek fault strand

a) 3 channels completely beheaded
b) 3 old surfaces that grade into Pushawalla Canyon, the only plausible source.
c) Terrace deposits across the fault correlate to deposits in the 3 channels.

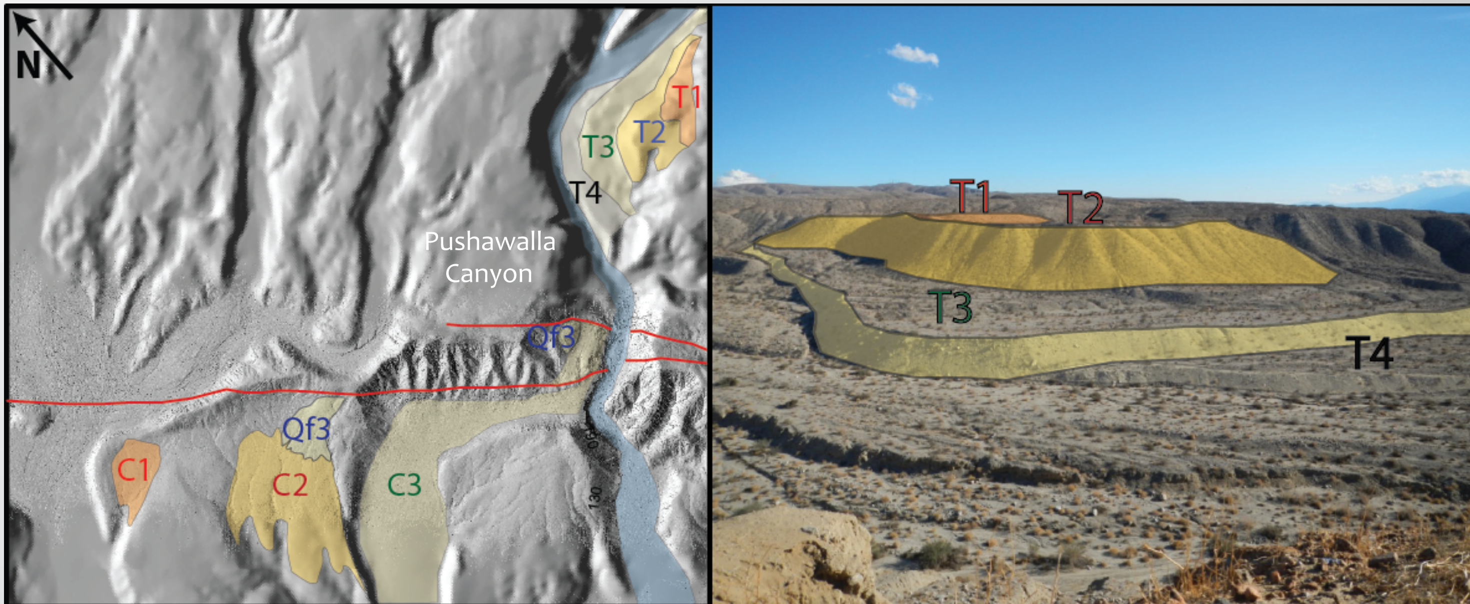
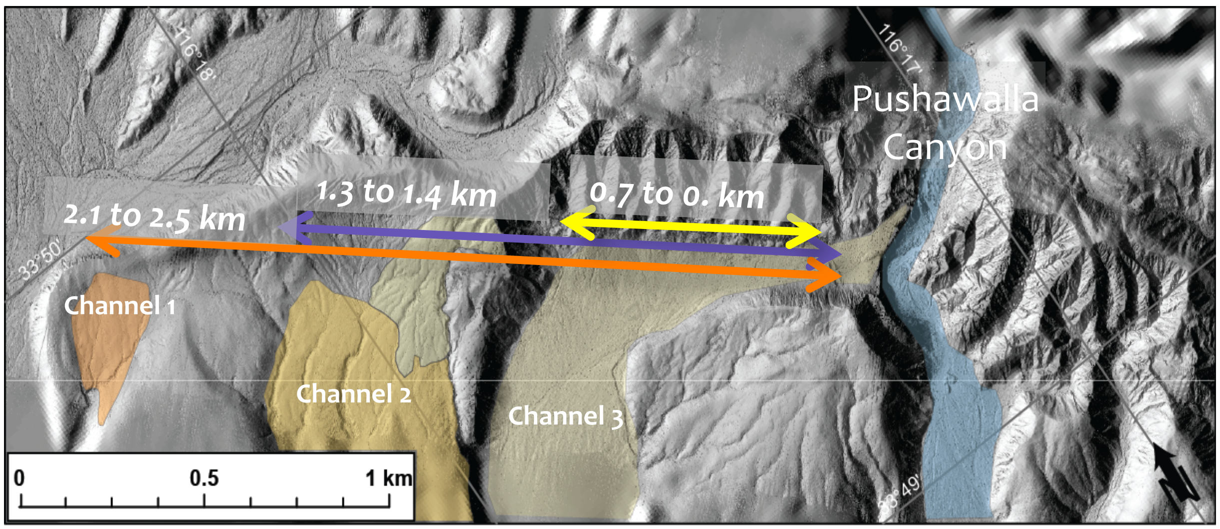


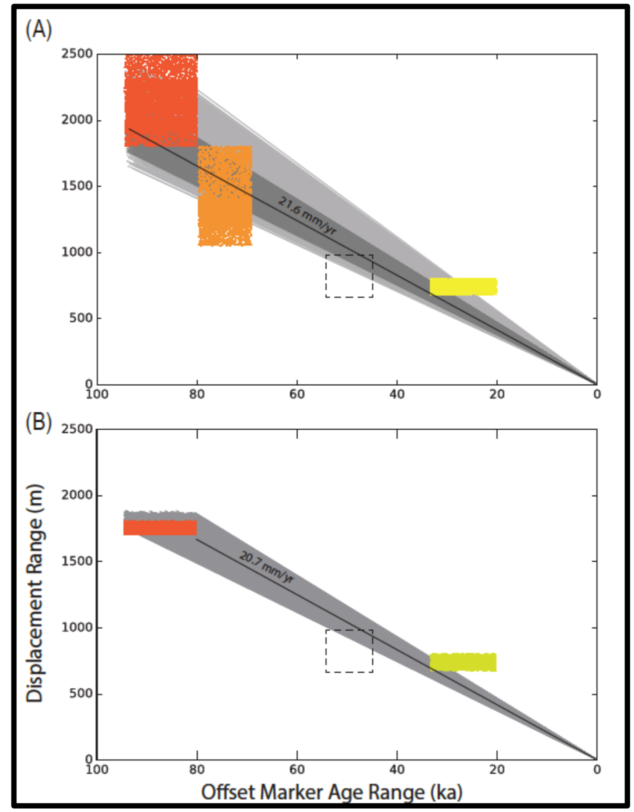
Photo looking northeast at beheaded channels 2 & 3:

Photo looking west down beheaded channel 2:

Mission Creek fault slip rates:

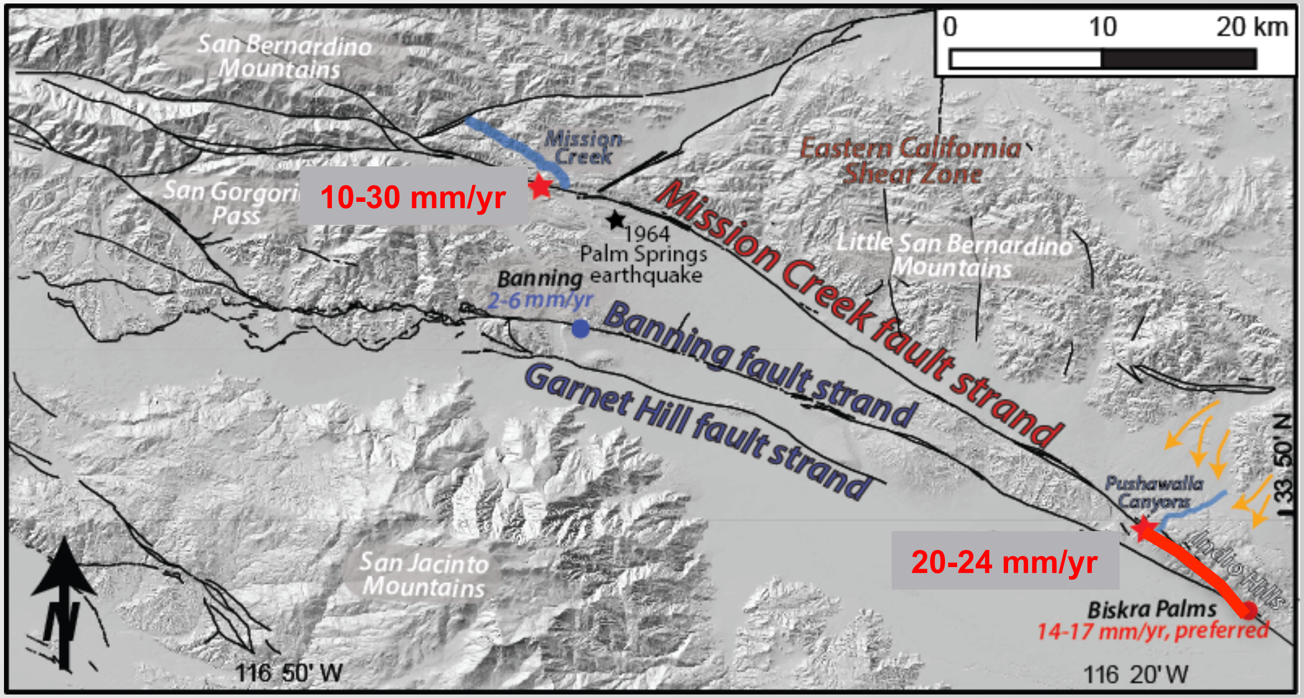
preferred: *22 $^{+2}/_{-2}$ mm/yr*
minimum: *21 $^{+2}/_{-2}$ mm/yr*





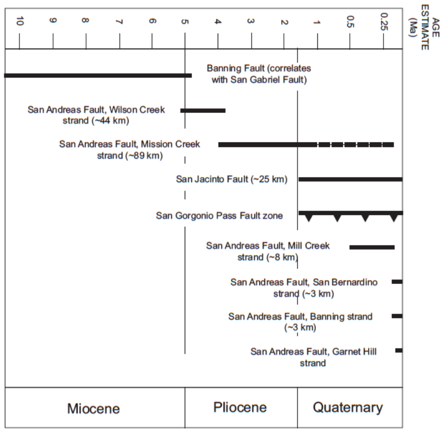
(Blisniuk et al., in review)

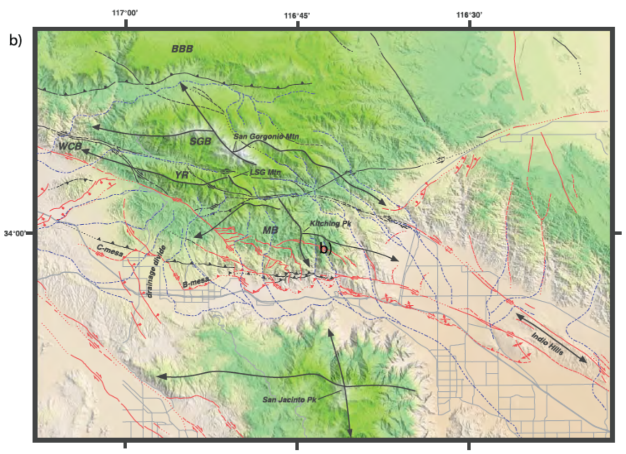
San Andreas fault slip distribution

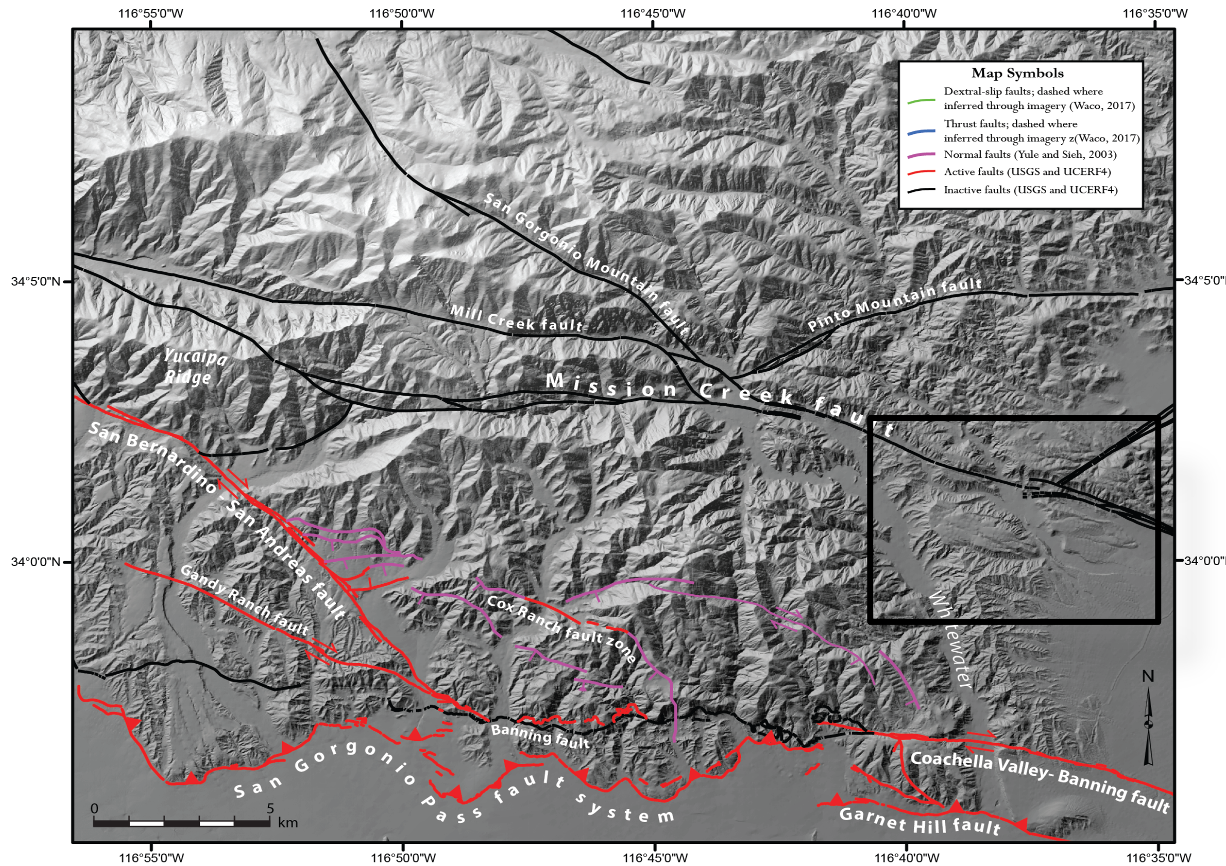


(e.g., Morton and Matti, 1993; Matti and Morton, 1993; Fumal et al., 2002; Yule and Sieh, 2002; van der Woerd et al., 2006, Behr et al., 2010, UCERF 2013; Gold et al., 2014)

Fault activity in the San Gorgonio Pass





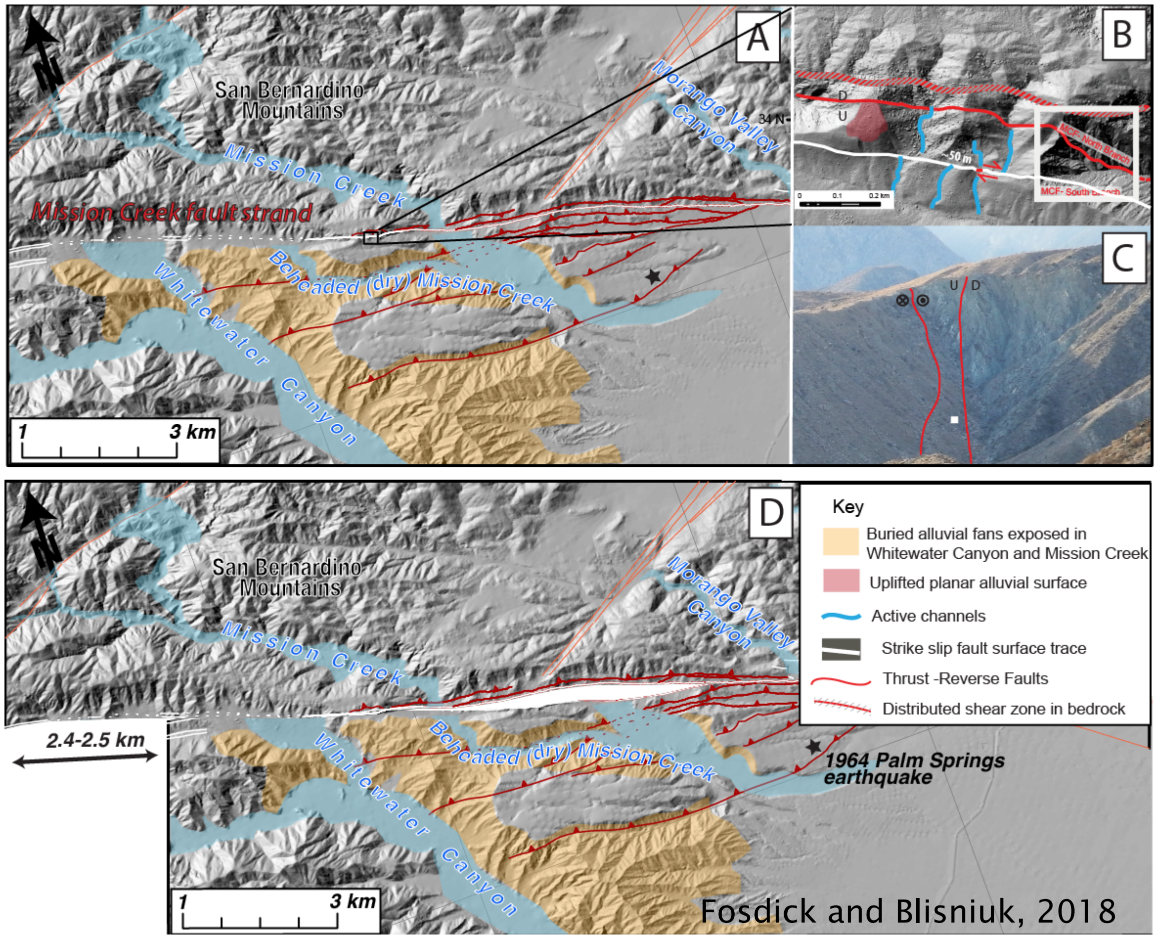


from Yule and Sieh, 2003 & Kendrick et al., 2015

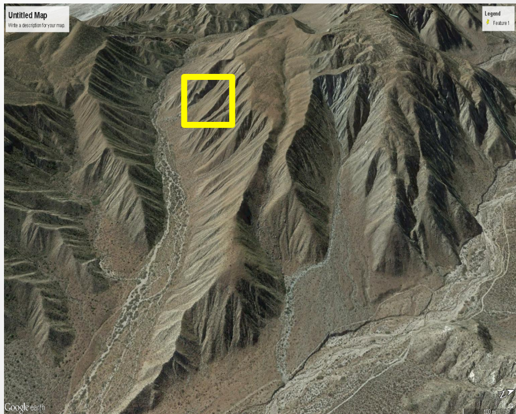
Slip rates of 10-30 mm/yr for the past ~260 ka on the Mission Creek fault strand of the SAF

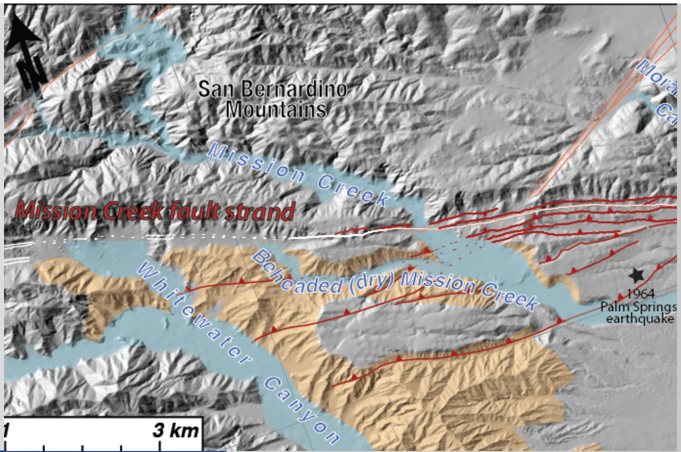
- Detailed geomorphic mapping and sediment provenance (Fosdick and Blisniuk, 2018)
- New $^{36}Cl/^{10}Be$ burial dating and previously published dates of these buried alluvial deposits (Balco, Blisniuk and Hidy, 2019)

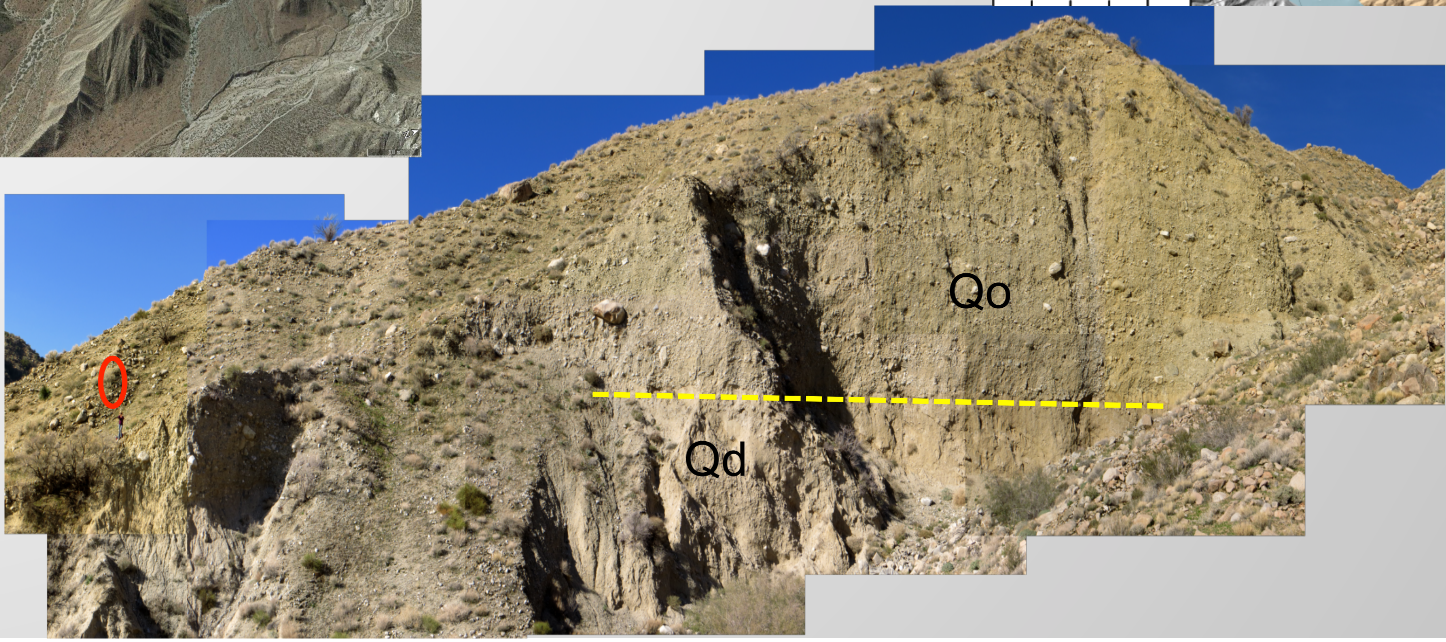
Mission-Mill Creek fault in the San Gorgonio Pass



Mission Creek fanglomerates

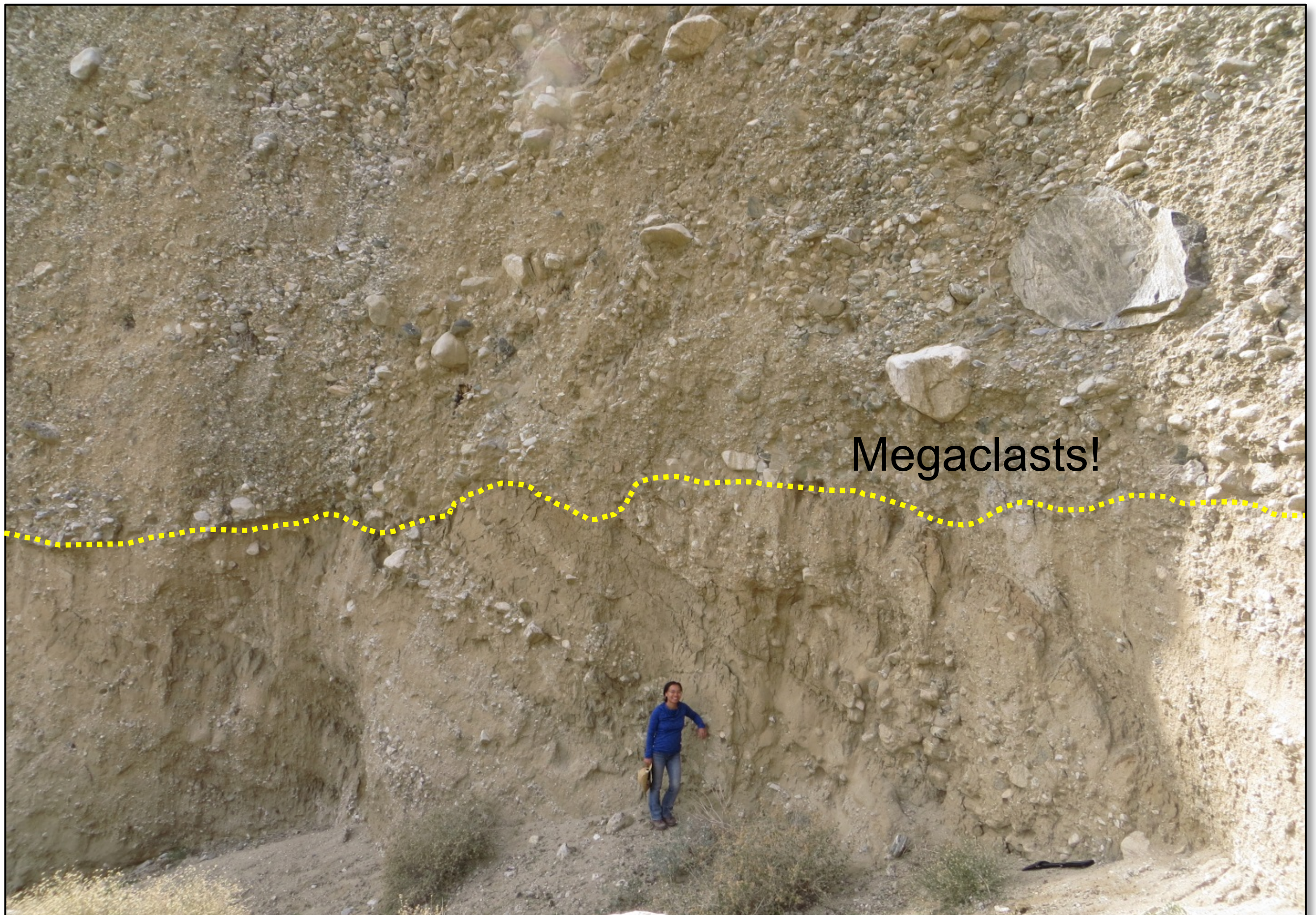


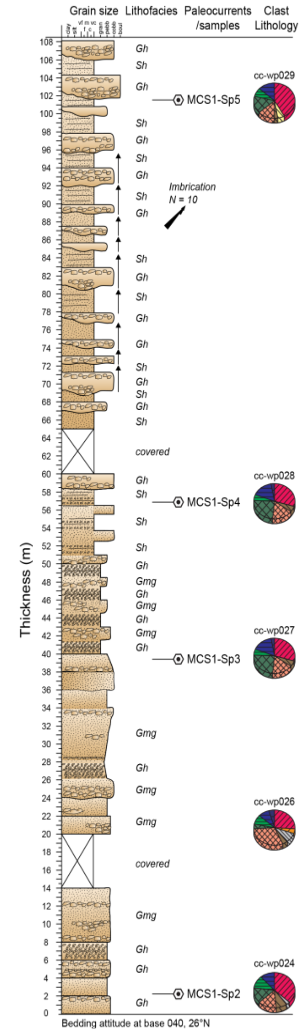




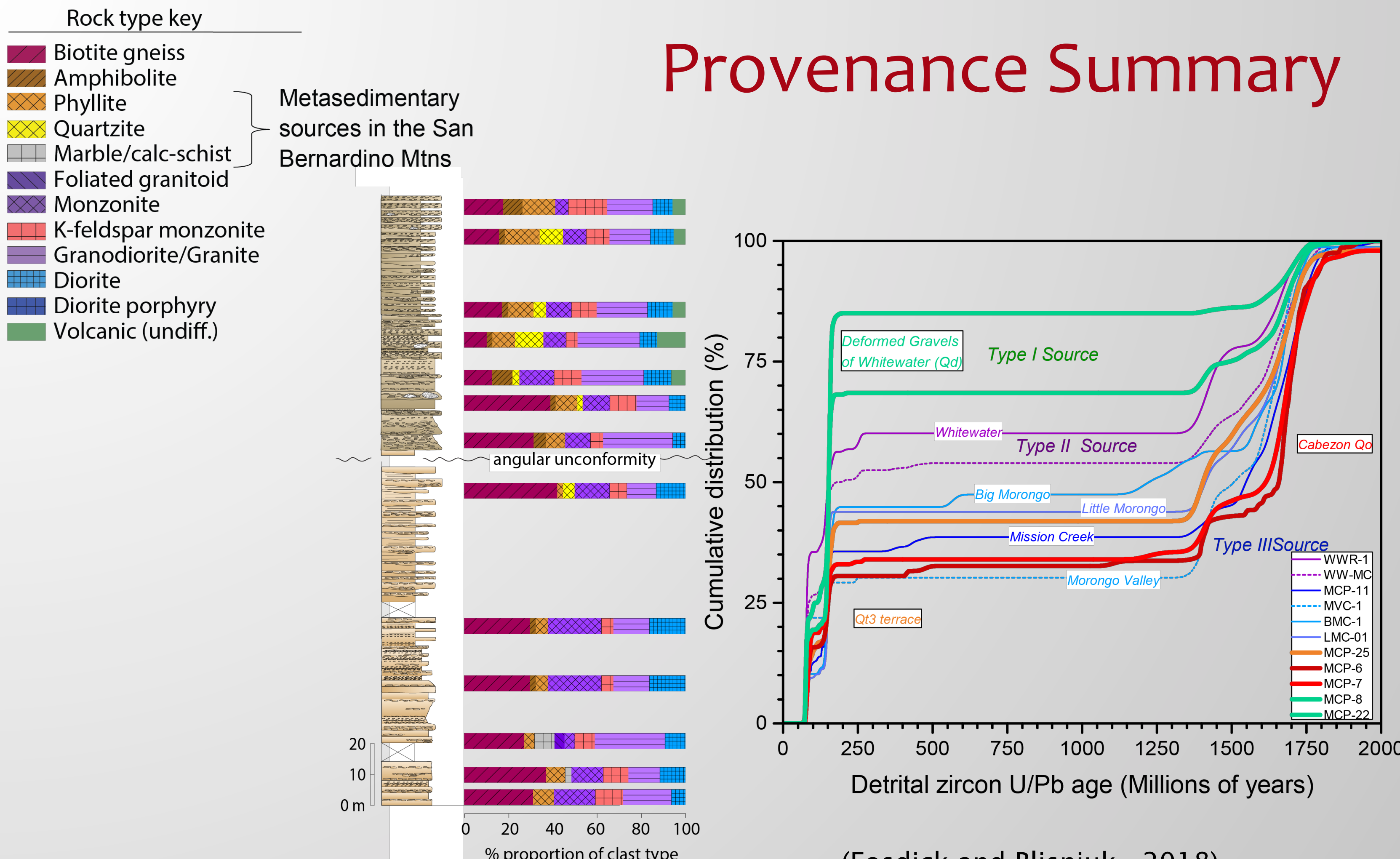
Mission Creek fanglomerates

Tilted strath, angular unconformity with overlying strata





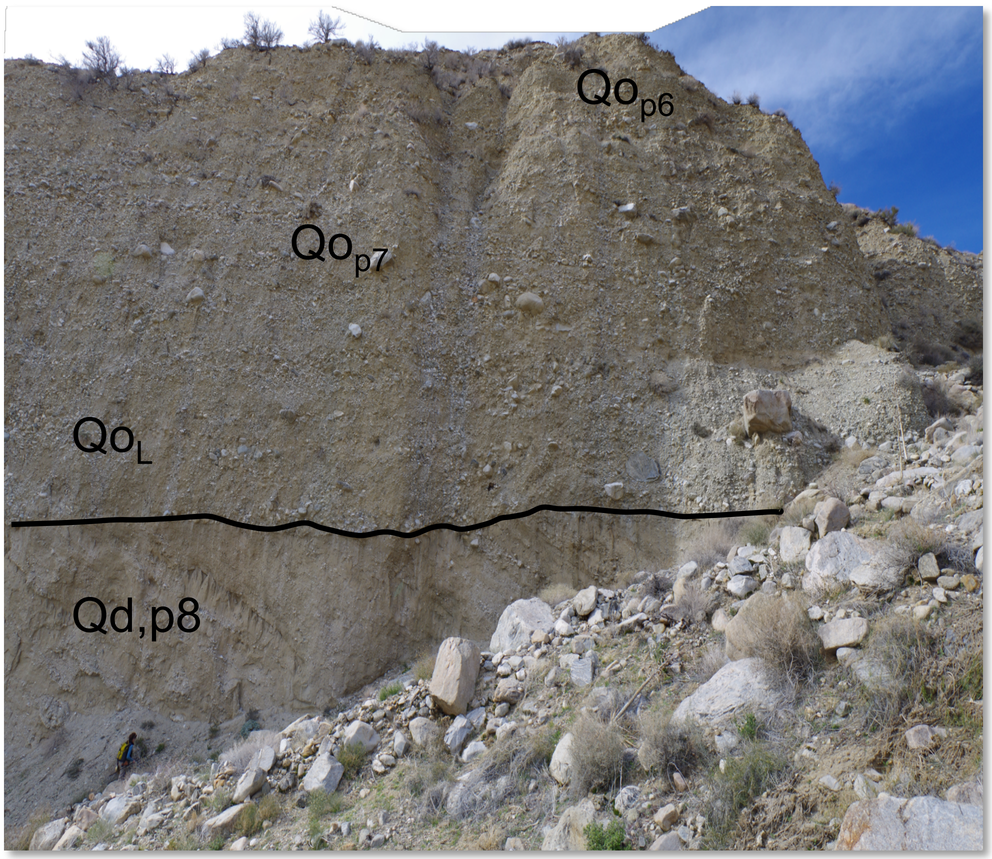
Provenance Summary

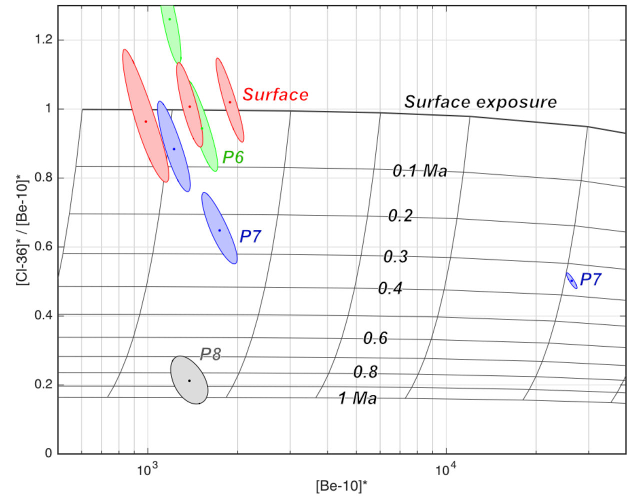


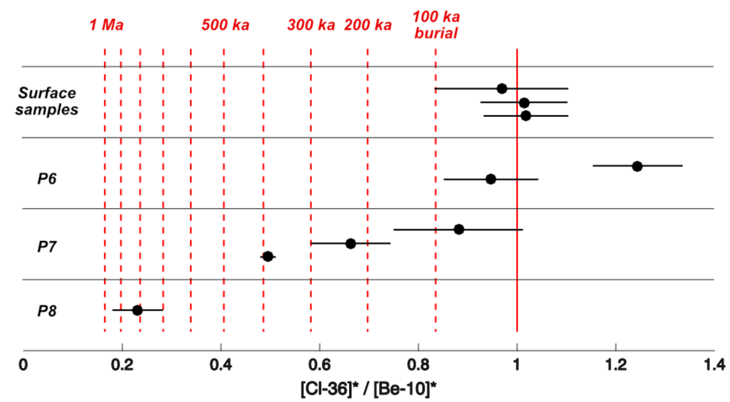
(Fosdick and Blisniuk., 2018)

Mission Creek fanglomerates

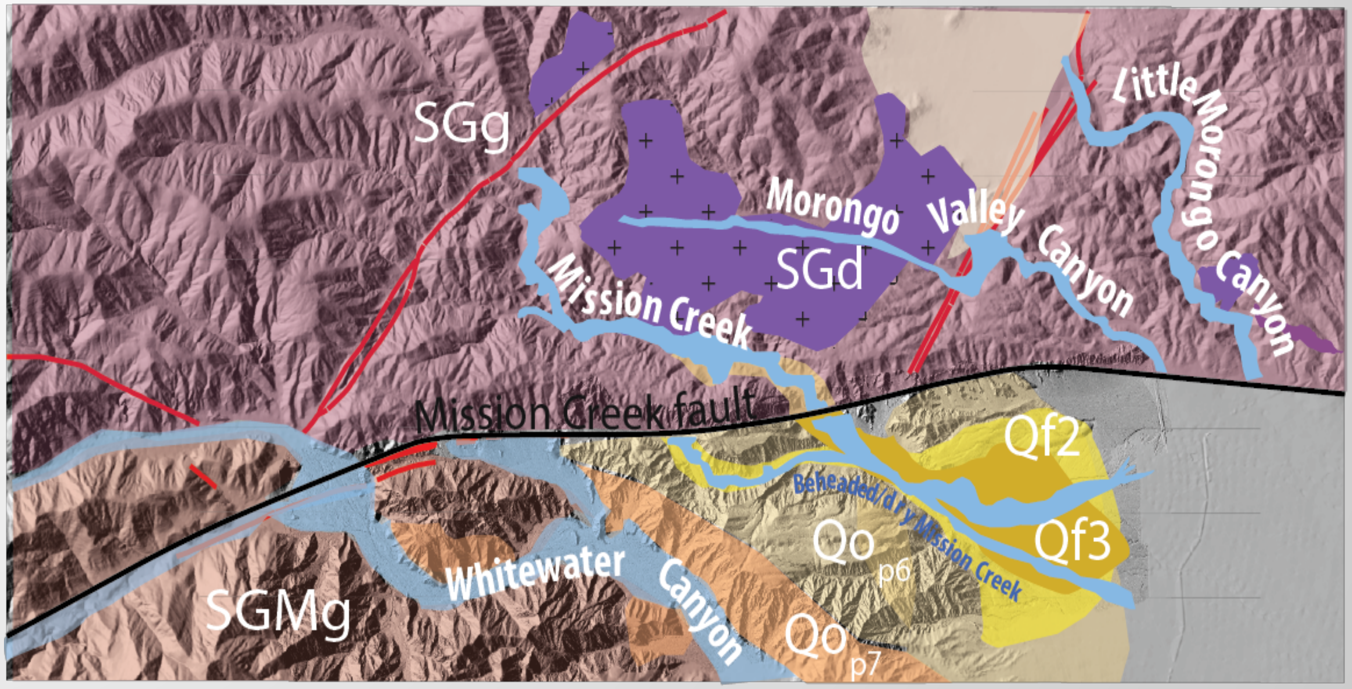
Initial $^{36}Cl/^{10}Be$ burial dating





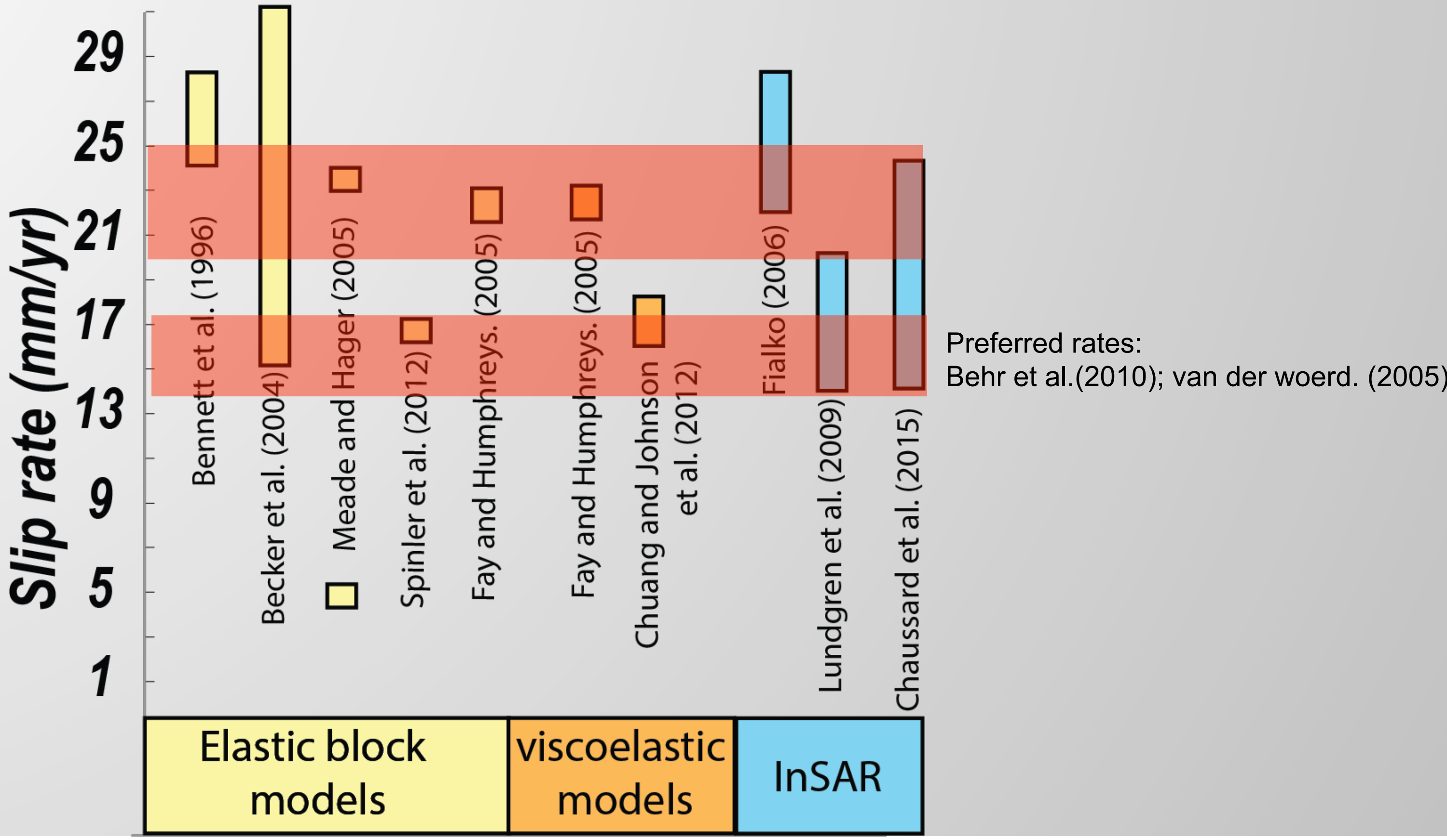


(Balco, Blisniuk and Hidy, *2019*)

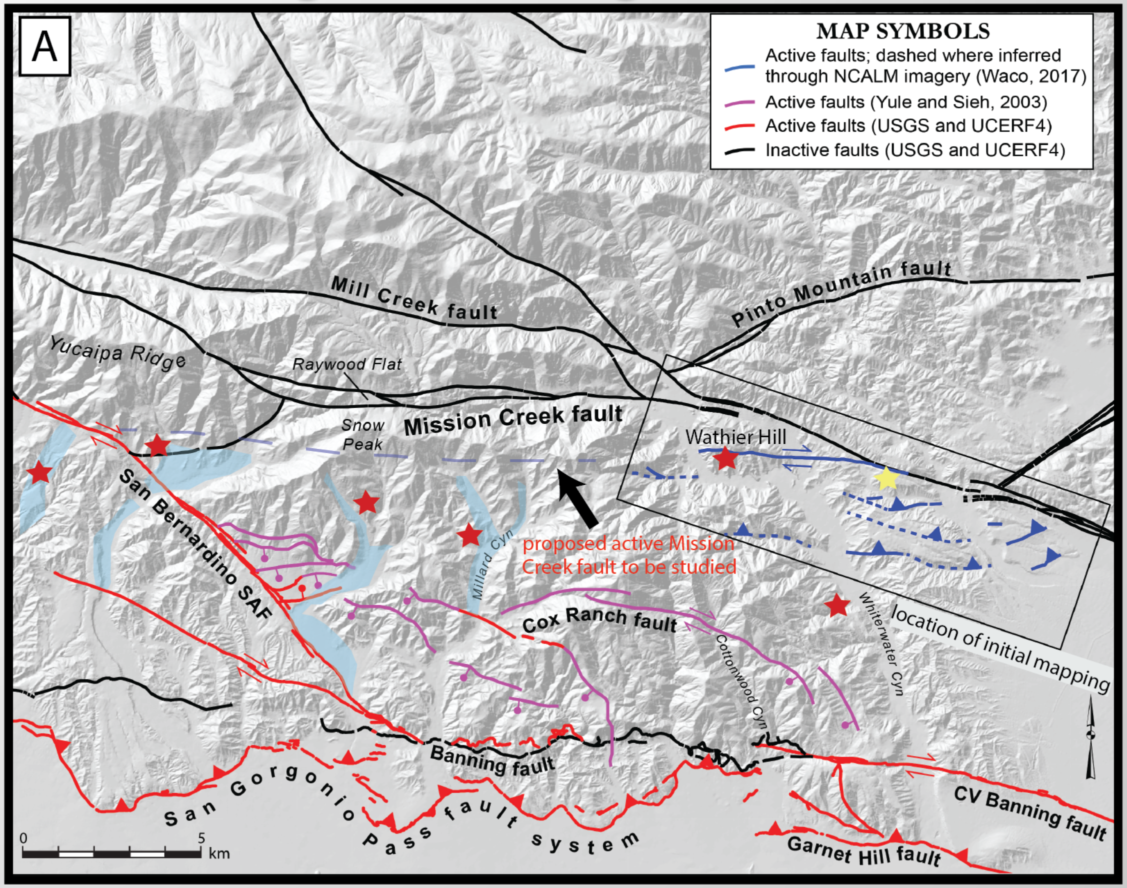


Conclusion: *These data provide evidence of potential continued dextral fault displacement along the Mission Creek fault strand near the San Gorgonio Pass region to the present day, supporting slip rates of 10-30 mm/yr near the San Gorgonio Pass.*

Southern San Andreas fault GPS slip rates



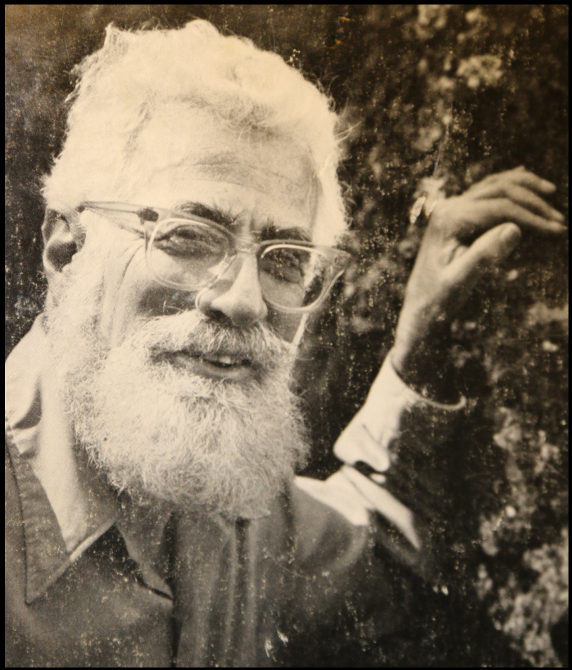
Evidence for an alternative position for the primary active strand of the San Andreas Fault along its restraining bend in southern California



REVITALIZING THE CLASSIC "STREETCAR TO SUBDUCTION" FIELD GUIDE VIA GOOGLE EARTH

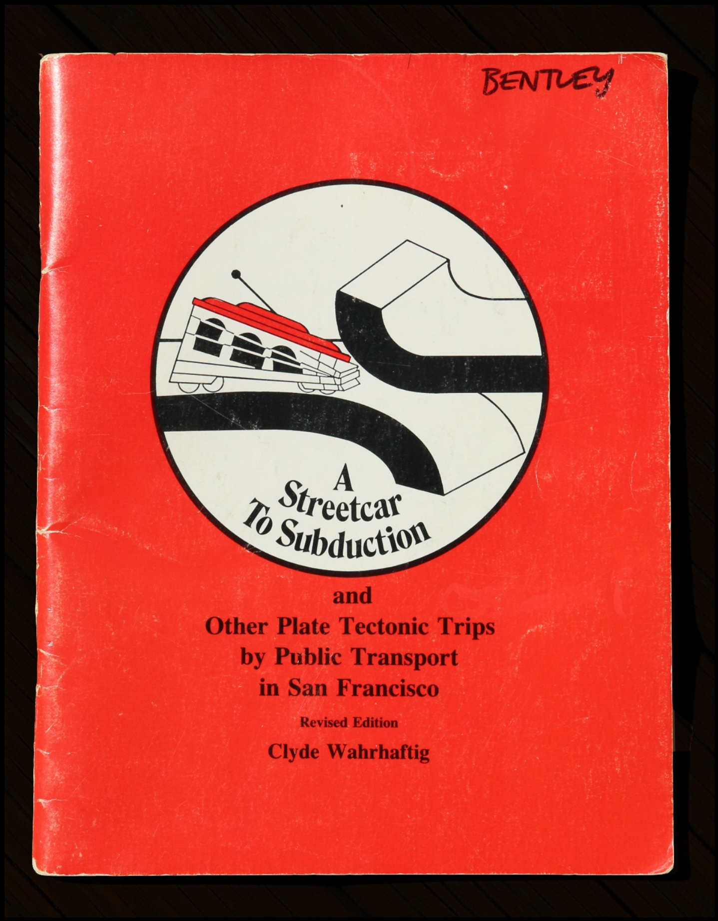
AGU 100
ADVANCING EARTH AND SPACE SCIENCE

Team: Callan Bentley,
Kim Blisniuk,
Jamie Kirkpatrick,
Christie Rowe,
John Wakabayashi a



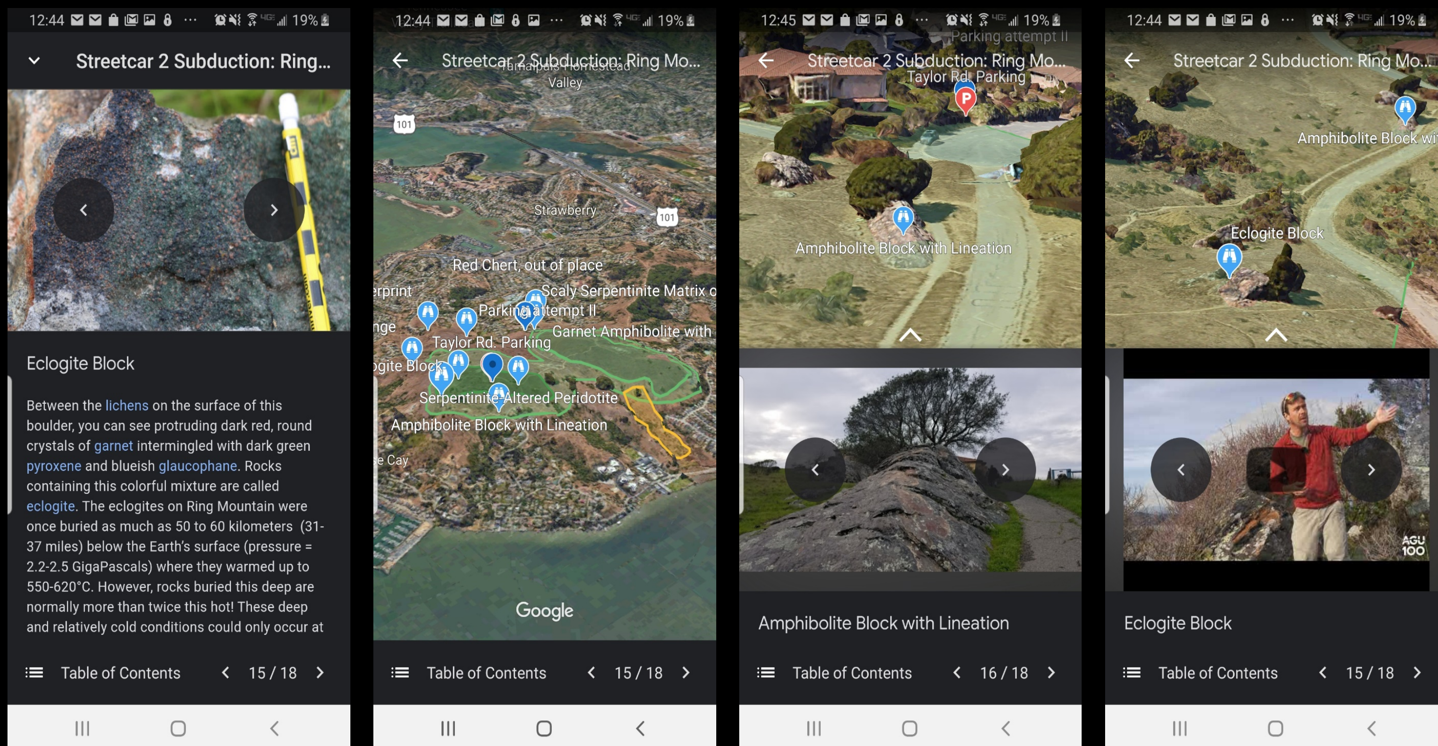
Clyde Wahrhaftig

born December 1, 1919



revised edition published 1984

Google Earth: Creative Tools



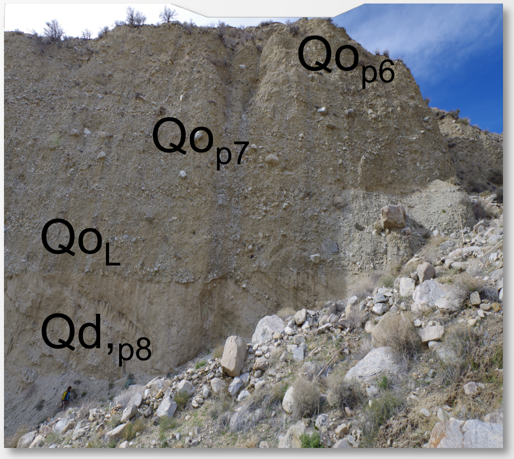
Ring Mountain

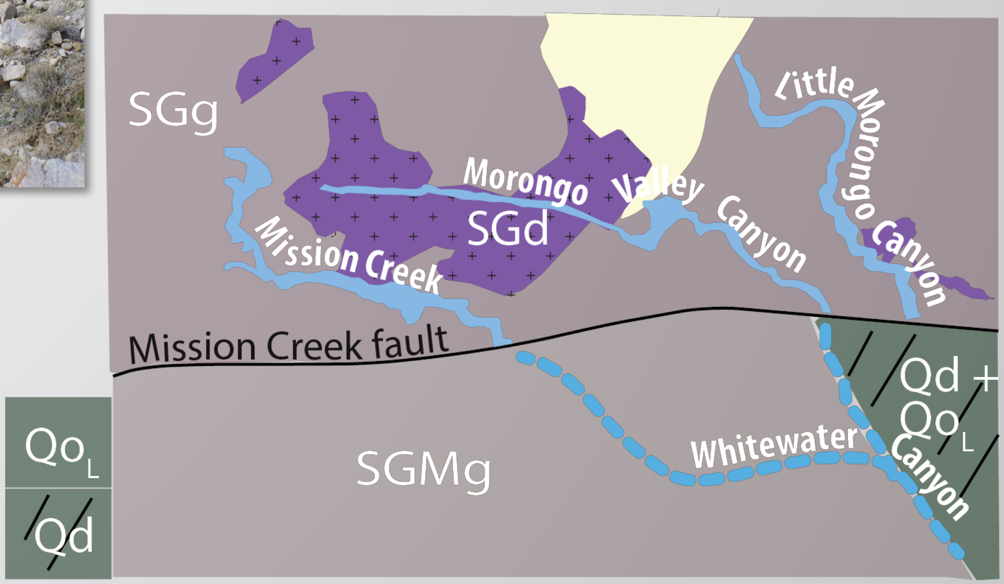
Ring Mountain Open Space Preserve, on a grassy hill in Marin County, is a world-famous site for its outcrops of a variety of metamorphic rocks. Metamorphic rocks are those which have changed physical or chemical character due to extreme conditions deep within the Earth. At Ring Mountain, the rocks record high-pressure and low-temperature conditions of a subducting oceanic plate. The mountain's two peaks are capped by peridotite, the rock of the Earth's mantle, which is rarely seen at the surface. Beneath the peridotite lies a layer of greenish-colored serpentinite, a slippery rock which contributes to landslides in California. Embedded in the serpentinite are an assortment of blocks of other kinds of metamorphic rocks (blueschist, eclogite, and amphibolite) containing high-pressure, low-temperature metamorphic minerals characteristic of subduction zones. This mixture of diverse rocks embedded in a distinct matrix is called a ***mélange***. There is only a thin band of mélange around the perimeter of Ring Mountain's twin summits, but rocks from it blanket the hillslopes below as result of landslides. The lower slopes of the mountain, which are mostly covered with landslide deposits, soils, and grass, are underlain by folded beds of sandstone and shale. As you walk around, you will see examples of the different types of metamorphic rocks, their context, and the evolution of the modern hills and slopes comprising the Ring Mountain Preserve.

This unusual serpentinite bedrock at this location produces magnesium-rich soils which are home to a number of endemic wildflowers. Stay on trails in the Preserve, avoid

Alternative interpretation of fault activity

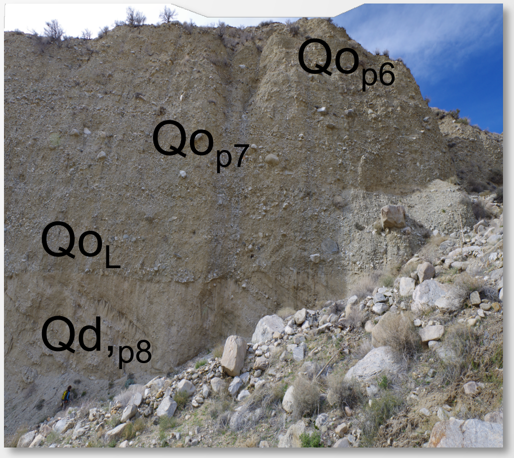
Alternative interpretation of fault activity





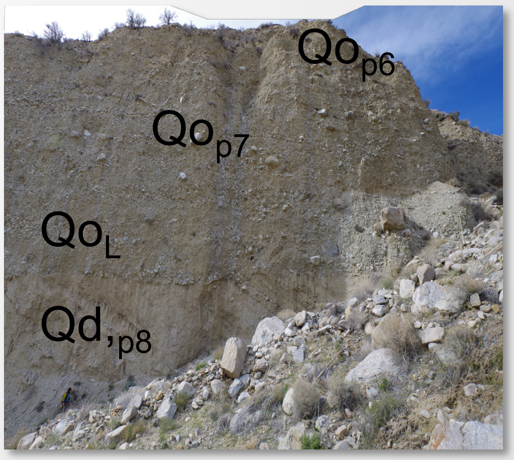
Capture and incision of Whitewater drainages by Mission Creek and Morongo Valley Canyon

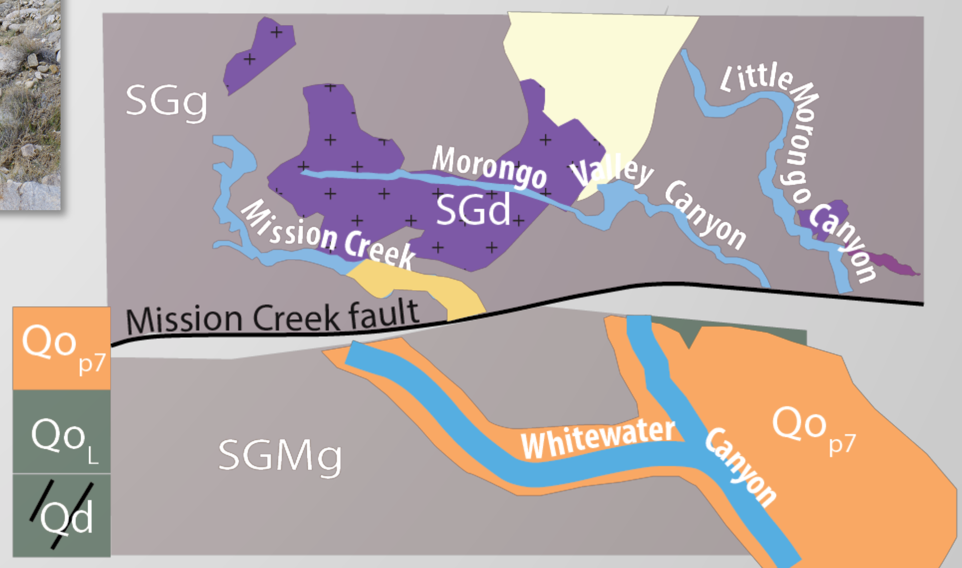
Alternative interpretation of fault activity



Deposition of lower Qo unit from Morongo Valley Canyon and Mission Creek

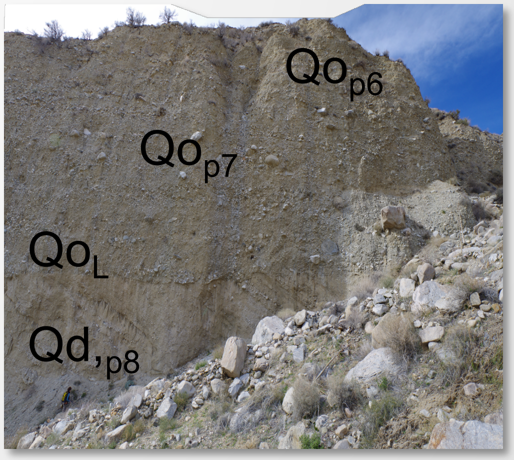
Alternative interpretation of fault activity

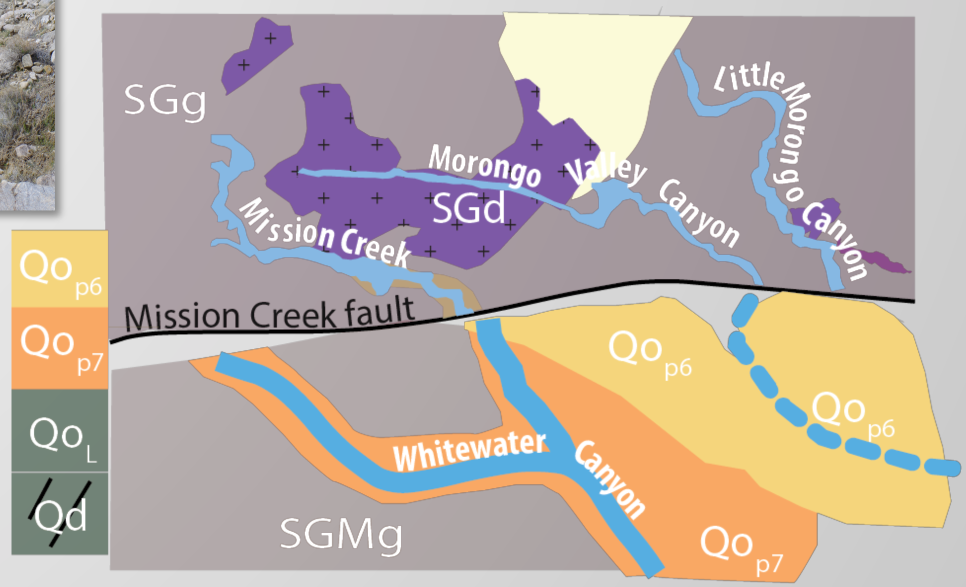




Build up and accummulation of sediment at the mouth of Mission Creek due to bedrock wall, initiation of reverse/thrust faults

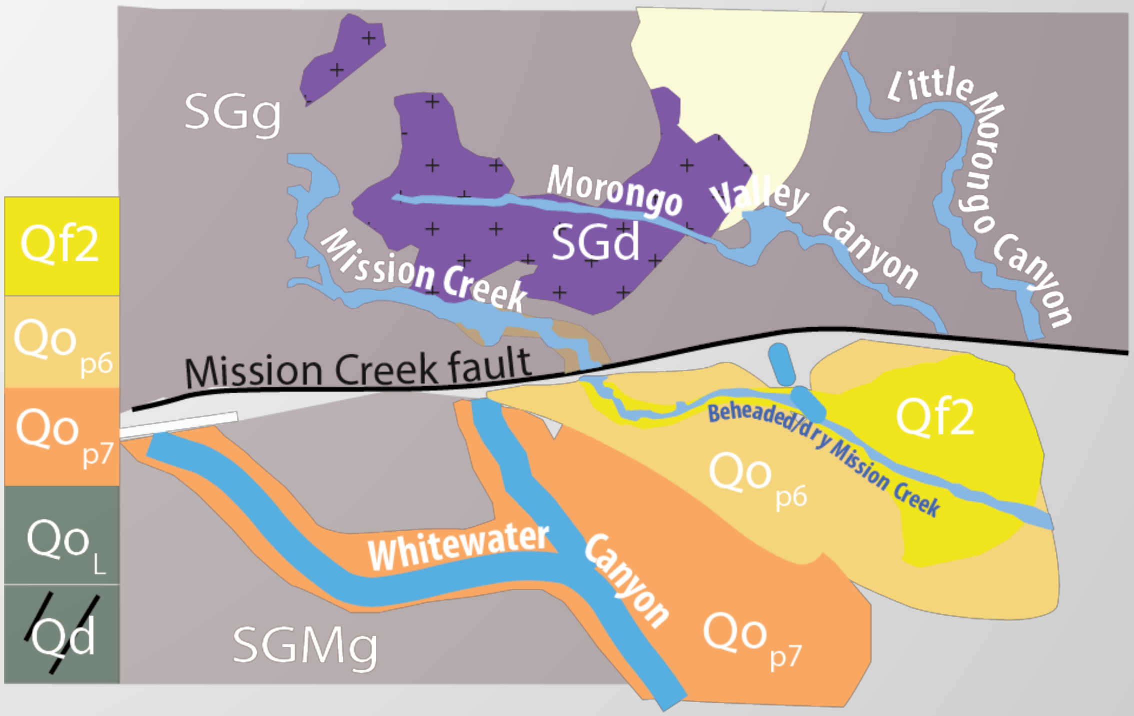
Alternative interpretation of fault activity





Capture of present-day Whitewater Canyon by Mission Creek, deposition of upper Qo_{p6} unit and incision of present day Mission Creek by Morongo Valley Canyon.

Alternative interpretation of fault activity



Incision of dry Mission Creek into Qo and Qd deposits
and deposition of Qf2 alluvial fans via dry Mission Creek

Alternative interpretation of fault activity

Capture of present-day Whitewater Canyon and Mission Creek, deposition of Qf3 alluvial fans via present day Mission Creek

Biskra Palms

(Behr et al., 2010)