Subsurface Geometry of the San Andreas Fault in Southern and Central California: A Summary

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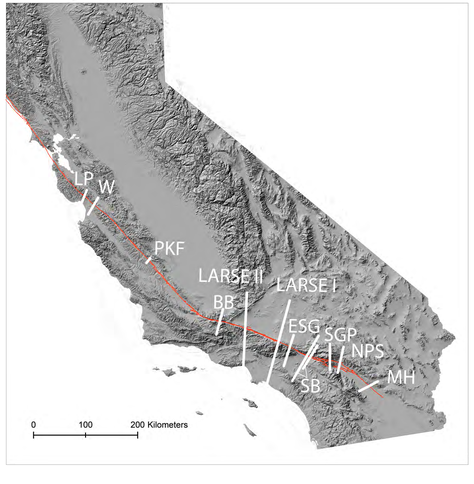
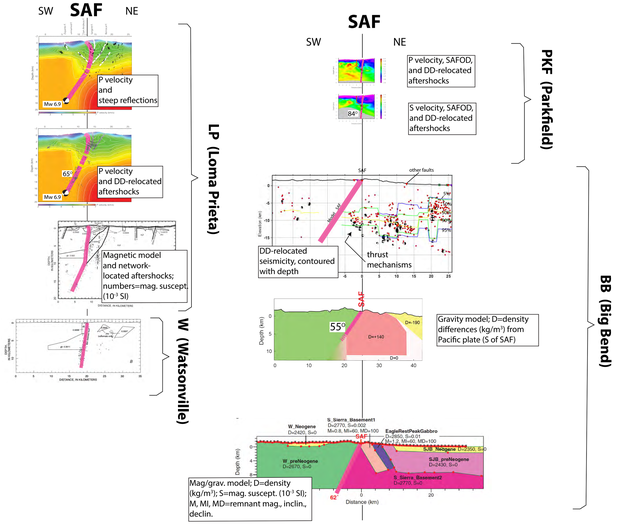
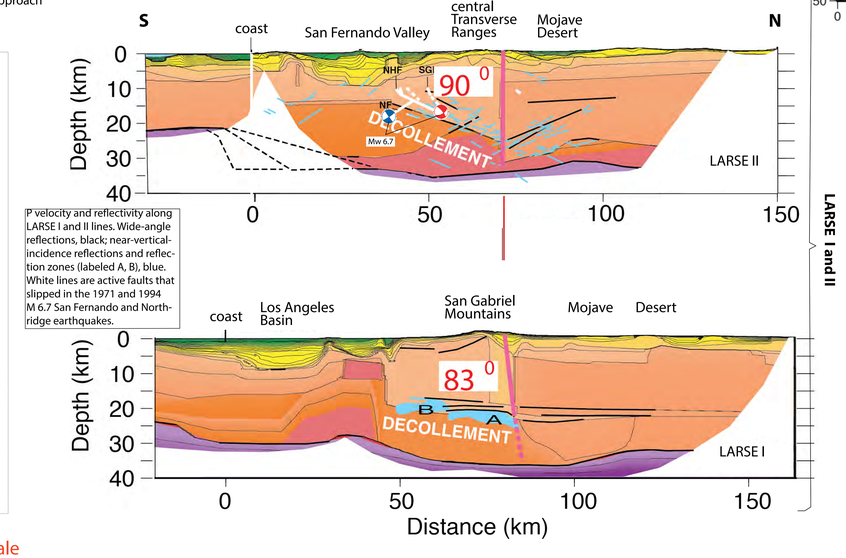
Seismic, potential-field, and earthquake data have been collected and modeled across the San Andreas fault (SAF) in a number of locations in southern and central California. In most locations the fault does not have a vertical or steep dip (>85 deg). In at least 3 locations it has a 2-part dip: below 6- to 9-km depth the fault dips moderately (between about 40 and 70 deg), and above that depth interval it is steep. The subsurface geometry of the fault from southeast to northwest is as follows. In two locations in the Coachella Valley, spanning a major bend in the SAF, the deeper segment of the SAF dips moderately northeast and the shallower segment is steep. Through the San Gorgonio Pass and San Bernardino areas, the SAF continues to dip northeast (as gently as 37 deg at one location), but the 2-part dip seen in the Coachella Valley is not resolvable. From Cajon Pass to the western Mojave Desert, spanning the two LARSE seismic profiles, the SAF dips steeply and is approximately planar. Around the Big Bend of the SAF, southwest of Bakersfield, the fault appears to dip moderately southwest, although this dip is constrained only by potential field data, and a 2-part dip cannot be resolved. At Parkfield, the fault dips steeply southwest and is approximately planar. A southwest dip continues to be observed northwestward into the Santa Cruz Mountains where we resolve a 2-part dip for the rupture of the 1989 M 6.9 Loma Prieta earthquake. The deeper segment of the fault dips moderately southwest, whereas the shallower segment is steep and complex.

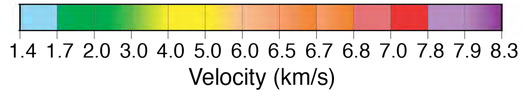
The change in fault dip in the depth interval of 6-9 km, that is observed in at least 3 locations along the SAF in southern and central California, may result in part from a change in rheology in the upper part of the crust. Rheology changes from elastic at greater depths, where earthquakes occur, to non-linear at shallower depths, where earthquakes diminish in number. A steeper dip at shallower depth likely represents a minimum-work configuration for fault rupture. The approach of the fault to the free surface may also play a part in this depth-dependent geometry.

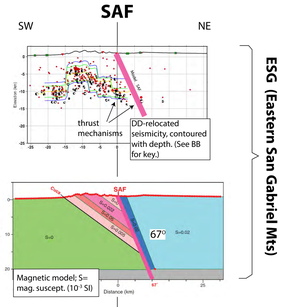


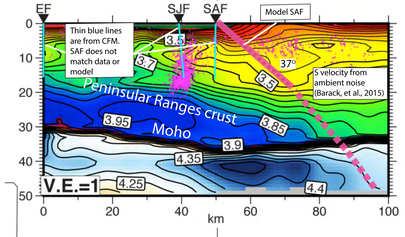
All diagrams to the right have approximately the same scale and no vertical exaggeration. Model SAF is red lines on diagrams

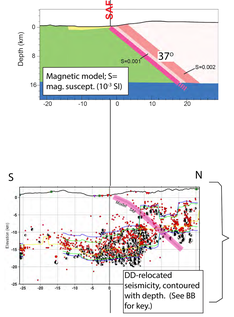


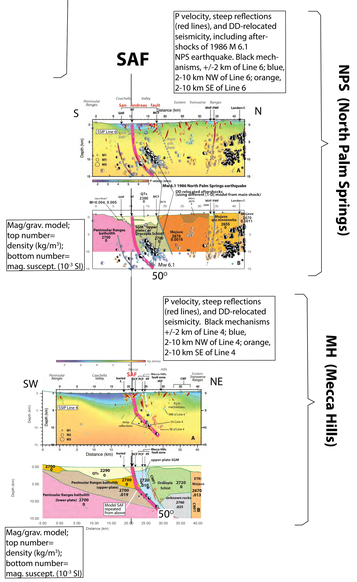












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