Moment Release from Paleoseismic Histories: Interaction between the Eastern California Shear Zone, San Andreas, San Jacinto, and Elsinore Faults

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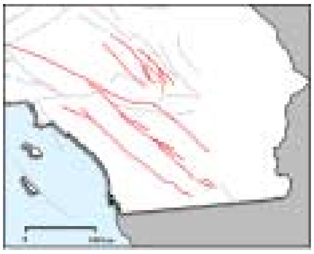


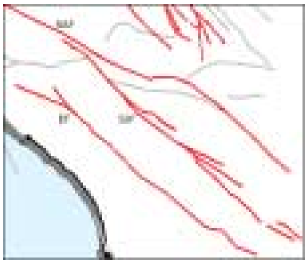
Fault map of southern California. Paleoseismic studies have been conducted on the faults in red. Modified from WGCEP (1995).

Analysis of earthquake sequences in southern California and other regions at timescales of 1000s of years suggests triggering or suppression of earthquakes from elastic stress changes is a common phenomena. Elastic stress changes from an individual earthquake depend on its magnitude, the orientation and sense of slip on the fault, and the strength of the brittle crust Elastic stress changes appear to affect nearby faults for decades, in contrast to visco-elastic changes that extend for much greater distances away from the fault that slipped in an earthquake (i.e. the width of the plate boundary in southern California). Visco-elastic stress transfer may also occur over long time periods (e.g. a century or more).

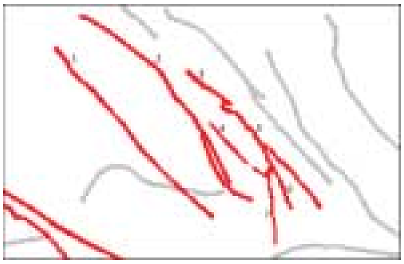
As a summer SCEC intern working with Karl Mueller and Tom Rockwell, I compiled all published and many unpublished paleoseismic records for major strike-slip faults in southern California. Compilation of paleoseismic data and construction of event plots for these strike-slip faults suggests the following:

1) Clusters of earthquakes separated by much longer time intervals is more the rule than the exception for strike-slip faults in southern CA.
2) Little long-term correlation appears to exist between the Mojave and Indio segments of the San Andreas fault (SAF RI=100s of yrs) and Eastern California Shear Zone (ECSZ RI=1000s of yrs).
3) Events along the San Jacinto fault (SJF) occur at higher frequency than the ECSZ, but still have higher RI than the SAF. Interestingly, slip rates on the SAF and SJF appear to be inversely related (SAF slows in last millennia, SJF speeds up).
4) The Elsinore fault ruptures at longer RI (~500 yrs) than either the SJF or SAF.
5) The determination of slip rates may hold little hope for understanding modern cycles of moment release, given the remarkable variation in rate for some faults, such as the Garlock.

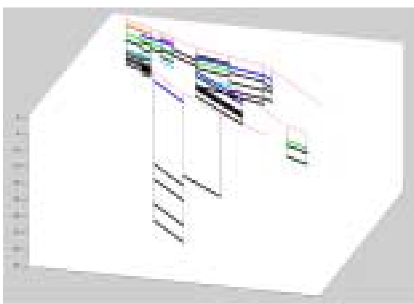
Given these results, it appears that other processes besides elastic or visco-elastic stress transfer govern first-order patterns of moment release in southern California. Subsequent efforts will be aimed at modeling stress transfer of higher second order patterns (e.g. interaction between faults that release moment in clusters at less than 1000 year timescales) and attempting to develop concepts for transfer of plate motions from the upper mantle and lower crust with brittle moment release along discrete faults.



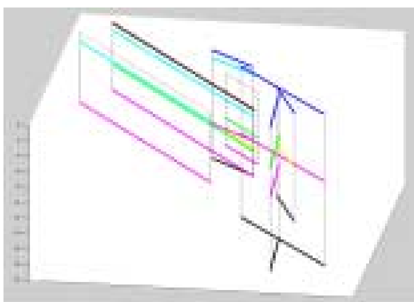
Zoomed-in fault map of the San Andreas (SAF), San Jacinto (SJF), and Elsinore (EF) Faults.



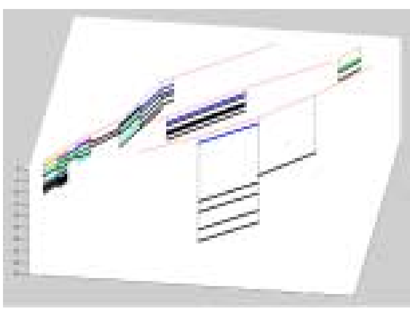
Zoomed-in fault map of the Eastern California Shear Zone (ECSZ). Numbers denote faults in the shear zone: 1 Helendale Fault, 2 Lenwood and Old Woman Springs Faults, 3 Camprock Fault, 4 N. Johnson Valley Fault, 5 Emerson Fault, 6 Homestead Valley Fault, 7 Kickapoo and S. Johnson Valley Faults.



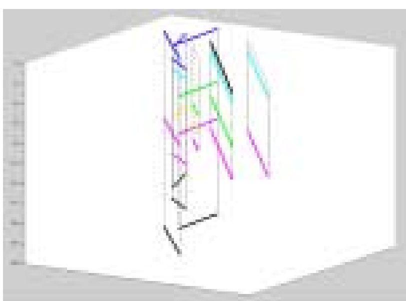
Oblique view to the N-NE of the SAF, SJF, and EF. Event plots with the same color bar represent earthquake clusters with the same event age range. Scale is in 100s of years. The red line is the fault at the Earth's surface. Yellow = 1857 eq, Magenta = 1812 eq, Blue = 240-320 ybp, Green = 440-480 ybp, Cyan = 890-920 ybp, Black = events not correlated.



Oblique view to the N-NE of faults in the ECSZ. Note: Scal is in 1000s of years. The red line is the fault at the Earth's surface. Blue = 1992 Landers eq, Cyan = 1.0-1.2 ka, Green = 5.3-5.8 ka, Yellow = 7.1-7.5 ka, Magenta = 8.7-9.5 ka, Black = events not correlated.



Oblique view to the E-SE of the SAF, SJF, and EF.



Oblique view to the S-SE of faults in the ECSZ.