EarthScope Seminar
Paper Summary
April 9, 2007
Presenter: Nicholas Schmerr
Paper Title: A Look Inside the San Andreas fault at Parkfield Through Vertical Seismic Profiling

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Overview

This paper seeks to observe the detailed fault structure at depth beneath the San Andreas Fault Zone (SAFZ). The authors observe several regions that scatter seismic energy and hypothesize that these represent changes in material properties that are cracks or zones of fluid saturation. The detection of these features improves the detailed understanding structure and is necessary for dynamical modeling of the fault zone.

Data

- 96 seismograms, consisting of 43 microearthquakes and 11 calibration shots within 8 km of the Pilot Hole (PH) Vertical Seismic Profile (VSP) array
- VSP array consists of 3-component 15-Hz seismometers at 32 levels every 40 meters in depth from 200-1400 m below sea level

Methods

- Kirchoff migration of secondary signals between *P* and *S* arrivals, and 2.5 seconds following the *S* arrival:
  1) divide the region into a 3D 40 meter grid surrounding the SAFZ
  2) resample the seismograms into 0.02 second increments
  3) compute travel times between each source-receiver cell geometry using ray-bending method and stack energy
- Direct *P* and *S* waves were muted to limit interference with the migration stacks.

Results

- The migration of different subsets of the data shows 4 recurring scattering structures:
  1) two secondary faults dipping to the NE at 2-3 km depth
  2) another fault at 1 km depth, detected in the SAFOD PH, and another extending over several km in depth.
- The SAFZ is imaged in the migration of *P*-*S* scattered energy from microearthquakes at > 4 km depth.

Implications

- The scattering zone located along the SAF coincides with the location of low-resistivity, which is inferred to consist of fluids in the damage zone and/or altered clays and other rock types.
- SAFOD will encounter a previously unknown fault at depth prior to penetrating the SAF.
- Unaccounted fault structure could significantly bias earthquake location studies, and provide an unconsidered mechanism for diffusing strain along the SAFZ.

Additional Thoughts

- Are the interfaces necessarily faults and cracks, or are they geologic contacts between different materials?
- Several additional interfaces are imaged in the migrations, and some interfaces do not appear in all the migrations; how robust are these results?