Seismic imaging of the near-surface structure at the San-Andreas-Fault system near the SAFOD drill site (Parkfield, California)

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The San-Andreas-Fault system is a major strike-slip fault along the West coast of North America where it is well known to generate major disastrous earthquakes.

Our goal was to image the shallow (< 5 km) structure of this fault system in the region around the SAFOD drill site near Parkfield (California). For that we have been reprocessing the PSINE (Parkfield Seismic Imaging Ninety Eight) seismic data set, an approximately 5 kilometer long high-resolution reflection line, which runs almost perpendicular to the strike of the fault system in that area.

After an extensive pre-processing of the data, we have applied advanced pre-stack imaging methods, namely Kirchhoff prestack depth migration (KPSDM) as well as Fresnel-Volume migration (FVM), to obtain a structural image of this complex fault system near the outcrop of the known major surface trace of the San-Andreas-Fault.

Both methods yield three strongly reflective areas within the shallow subsurface. The first one can be attributed to a lithological contrast (granite vs sediments) at the southwestern part of the fault system. The second one at the northeastern part seems to be the prolongation of the surface fault trace down to greather depths. Finally, the third one adjacent to the latter reflector appears to be a strongly tilted sedimentary package dipping to the Southwest.

A couple of other minor reflectors can be observed in the obtained images, which may represent very shallow and steeply dipping branches of this obviously very complex fault system.

A comparison of our results with the images obtained from processing of the SAFOD2003 data set (a large-scale reflection/refraction line across the same area) shows partly excellent agreement. However, the PSINE data set reveals additional details and features, like for instance the southwest dipping sedimentary package, which could not be imaged by SAFOD2003 profile.