NEHRP Award #01HQGR0033

3-D MAPPING OF ACTIVE FAULTS IN SOUTHERN CALIFORNIA: EASTERN VENTURA BASIN AND SAN GORGONIO PASS-SAN BERNARDINO REGIONS.

John Suppe
Department of Geosciences
Princeton University
Princeton, NJ 08544
609-258-4119 (phone), 609-258-1274 (fax)
suppe @princeton.edu

TECHNICAL ABSTRACT

We mapped over 100 faults in the eastern Ventura Basin and in the San Gorgonio Pass-San Bernardino Mountains region using the catalog of relocated 1975-1998 earthquakes of Richards-Dinger and Shearer (2000). A clustering algorithm was applied to the relocated earthquakes in order to obtain tighter earthquake clouds and thus better-defined fault surfaces. The earthquakes were then imported into Gocad, a 3D modeling software that allowed us to separate earthquakes into coplanar clusters associated with different faults and fault strands and to fit optimized surfaces to them. We also used the catalog of focal mechanisms of Hauksson (2000) to confirm the nature of the mapped faults.

We were able to constrain the 3-D geometry of the San Andreas fault (SAF) near San Gorgonio Pass from the 3-D geometry of the fault network surrounding it. The most likely configuration is for the San Andreas fault to merge into the shallow-dipping San Gorgonio Pass thrust northwest of Indio. We concluded that there is no direct continuity at present, but rather a network of faults, and the only kind of rupture possible for the SAF in this region is a complex rupture, involving both strike-slip and reverse faulting. GPS measurements also suggest that, despite the fact large motions must have occurred in the past, only minor ones are occurring today in this area. Applying our findings about the fault geometry, we explored several simple earthquake scenarios to determine the most favorable conditions for a through-going rupture of the San Andreas fault system from Mojave Desert to Coachella Valley.

In the eastern Ventura Basin we mapped 25 faults and fault segments with varying degree of confidence to depths of 25 km. In particular, we identified a reverse fault just west of the Northridge thrust that is part of the Oak Ridge trend. Further to the west, there are very few events, and none of the available focal mechanisms shows an orientation compatible with the Oak Ridge fault, which cannot therefore be imaged from earthquake data. There is no well-defined earthquake cluster that can be associated with the S. Cayetano thrust either, just scattered seismicity. However, there are 8 events which show reverse mechanisms with one nodal plane dipping to the N by 40°-60°. Their location is compatible with the possible location of this thrust at depth.