Geophysical Research Abstracts, Vol. 8, 03808, 2006
SRef-ID:

Imaging faults in 3D from earthquakes: the Crafton Hills Fault Zone and the geometry of the San Andreas Fault near San Bernardino, Southern California.

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On June 16th, 2005, a magnitude 4.9 earthquake occurred near Yucaipa, south-east of San Bernardino, southern California. The main shock was followed by over 100 aftershocks, one of which reached magnitude 3.9. Most of the aftershock hypocenters are deeper than 10 km. Both the main shock and the largest aftershock occurred near the upper limit of the seismicity cluster.

We relocated all the events using the double-difference hypocenter location method. After relocation two dense, separate earthquake clusters can be observed, one related to the main shock, the other to the largest aftershock. These clusters outline two sub-parallel faults about 600 meters apart that are nearly vertical and trend east-northeast. We imaged the geometry of the two faults in 3-D using Gocad. The up dip projection of these faults reaches the Earth's surface in the vicinity of several fault traces attributed to the Crafton Hills fault zone. Several other faults related to this fault zone can be imaged from the events relocated by Richards-Dinger and Shearer (2000). Some of them we had already imaged in 3-D during previous work in the region, others we imaged during the course of this project.

Within the aftershock cloud a third, less dense alignment of events delineates, at depths greater than 10 km, a fault with a 60 degrees dip to the south-west whose up dip projection emerges very close to the trace of the San Bernardino segment of the San Andreas fault (SAFsb). Several focal mechanisms (Hauksson 2000) available for events in the vicinity of this fault all show a right-lateral component of slip on a southwest dipping plane. The dip-slip component is normal for some mechanisms and reverse for some others, but always smaller than the strike-slip component.

The newly imaged faults provide additional constraints on the deep geometry of significant faults in the greater San Bernardino area, including the SAFsb. In particular, the position and geometry of the two faults illuminated by the two largest events and their seismicity clusters indicate that the SAFsb is probably vertical in this area.