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INTERACTIONS OF MAJOR FAULTS WITH THE REGIONAL STRESS FIELD ACROSS THE CREEPING ZONE OF THE SAF AND IN THE BAY AREA: IMPLICATIONS FOR FAULT WEAKENING PROCESSES

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Technical Abstract

We determine how the orientations of the principal stresses change with distance from the creeping section of the San Andreas fault (SAF). Our data are 2392 earthquake focal mechanisms, which are grouped according to distance from the SAF into 33 bins parallel to fault strike; the width of the bins are dictated by the spatial organization and density of the seismicity. Only events with *M* e 1.5, depth e 2 km, and well-constrained focal mechanisms are used. The focal mechanisms are inverted simultaneously for the orientations and relative amplitudes of the principal stresses using two different inversion programs. A bootstrap resampling method provides confidence limits on the stress orientations. Our general result is that the maximum horizontal compression lies mostly at high angles to the SAF except in a narrow zone on the fault (no wider than 1 to 3 km), in which it appears to lie at a smaller angle (~45°) from the fault strike. In particular, the maximum horizontal compression lies at a high angle to the SAF trend immediately adjacent to the fault. This stress state is most readily interpreted as due to a narrow mechanically weak SAF in this region. The narrowness of this zone contrasts with the region wider than 20 to 30 km of rotated stresses found surrounding the SAF in southern California [Hardebeck and Hauksson, 1999], suggestive of different mechanical behaviors of the SAF in these two regions. This approach may provide a way to define the width of the mechanically weak part of faults.

Non-Technical Abstract

We studied how stresses change with distance from the creeping segment of the San Andreas Fault in central California using geometry of earthquake fault slip. The way that stresses are reoriented by this major plate-bounding fault indicates that in this region a relatively narrow zone (1 to 3 km wide or less) slips very easily, under unexpectedly low levels of shear stress. The situation around the creeping zone contrasts with that in portions of southern California, where the SAF appears to be somewhat stronger. Understanding fault mechanics will ultimately aid efforts to forecast large, damaging earthquakes.