

Diverse volumetric faulting patterns in the San Jacinto fault zone

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We examine locations, magnitudes and faulting types of post-2000 earthquakes in the trifurcation area of San Jacinto fault zone to clarify basic aspects of failure processes in the area. Most $M > 3.5$ events have strike-slip mechanisms, occur within 1 km of the main faults (Clark, Buck Ridge, and Coyote creek) and have hypocenter depths of 10-13 km. In contrast, many smaller events have normal source mechanisms and hypocenters in intra-fault areas deeper than 13 km. Additional small events with hypocenter depth < 13 km occur in off-fault regions and have complex geometries including lineations normal to the main faults. Five moderate earthquakes with $M 4.7-5.4$ have high aftershock rates ($\sim 150 M > 1.5$ events within 1 day from the mainshock). To obtain more details on aftershock sequences of these earthquakes, we detect and locate additional events with the matched filter method. There are almost no aftershocks within 1 km from the mainshocks, consistent with large mainshock stress drops and low residual stress. The five aftershock sequences have little spatial overlap. While the mainshocks are on the main faults, most aftershocks are located in intra-fault and off-fault regions. Their locations and spatial distribution reflect the mainshock rupture directions and many also follow structures normal to the main faults. The significant diversity of observed features highlights the essential volumetric character of failure patterns in the area. The increasing rate of moderate events, highly productive aftershock sequences and large inferred stress drops may be indicative of approaching major event.