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Evolution from step-overs to bends on strike-slip faults: primary results

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Bends and step-overs on strike-slip faults are where transpressive mountain ranges or transtenstional basins are formed, and they are often the sites of termination, sometimes nucleation, of earthquake fault ruptures. Using a three-dimensional (3-D) visco-elasto-plastic finite element model, we investigated the 3-D stress fields and strain partitioning around bends and stop-overs to understand the evolution process of strike-slip fault. We started with simplified stopovers to illustrate the basic mechanics. For compressive stopovers, high shear stress is concentrated in the gap region, between the strike-slip faults. When the gap is wide (>75 km), plastic strain is localized in two narrow belts extending from the tips of the faults, indicating that the stepover may develop into subparallel faults. When the gap is narrow (<50 km), high plastic strain is localized between the gap, favoring formation of connecting faults and restraining bends. For dilatational stopovers, strain is localized in the gap region even when the gap is up to 100 km wide, hence wide releasing bends and pull-apart basins can be expected. When the connecting faults form to turn stopovers into bends, they generally enhance strain localization around the bends. The stress field and strain patterns around restraining bends and releasing bends vary with the geometry of the bends. In general, high shear stress is found in a broad band across the restraining bends, and strain is localized in two belts extending from the ends of the bend and sub-parallel to the strike-slip faults. For releasing bends, shear stress is generally low across the bends, strain can be localized within the bend with the effect of straightening the bends, and subsidence is often asymmetric. Applying these models to the Big Bend (a restraining bend) and the Salton Trough (a releasing bend) on the San Andeas Fault, we show that the model results are generally consistent with observations.

Key words: Step-over, Bend, Strike-slip fault, three-dimensional visco-elasto-plastic finite element model

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