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MAGNITUDE OF DEVIATORIC STRESS ALONG THE SAN ANDREAS FAULT

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There is still a debate concerning the magnitude of deviatoric shear stress along major transform faults. Rock friction studies suggest that faults can maintain deviatoric stress as high as 50 MPa at seismogenic depths, while the absence of heat flow requires deviatoric stress to be less than 15 MPa in the upper crust. Furthermore, typical stress drops from seismic events are only 1-10 MPa. In order to constrain the magnitude of deviatoric stress along the San Andreas Fault, we use estimates of deviatoric normal stress derived from isostatically-compensated topography. We have developed a three-dimensional (3-D) semi-analytic solution for the loading of an elastic half-space from both surface topography and compensating Moho topography. A large, high-resolution topographic grid of the San Andreas region, including both continental and oceanic areas, is used to generate the 3-D stress field. These results indicate that at seismogenic depths, deviatoric normal stress along the San Andreas system varies from 5 MPa of compression in low-lying areas to 12 MPa of extension in the Transverse Ranges of the Big Bend area. Because the method of faulting through the Big Bend area is primarily strike-slip, either the deviatoric horizontal shear stress must exceed 12 MPa, or there must be an equal and opposite tectonically-induced normal stress. Here we investigate the role of tectonically-induced normal stress using the same 3-D semi-analytic formulation, now applied to 400 fault elements of the San Andreas Fault system with associated locking depths constrained by 1099 GPS-derived velocities. Stress accumulation rates predicted by this model [Smith and Sandwell, 2003, in press] are then compared with the topographically-induced normal stress. Preliminary results suggests that 350-800 years are required to achieve a balance of normal stress along the San Andreas Fault system. These results are approximately three times longer than typical earthquake recurrence intervals, suggesting that earthquakes relieve only 1/3 of the total deviatoric shear stress.