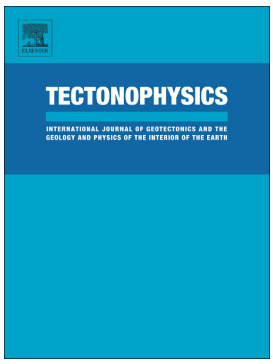

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Elasto-plastic deformation and plate weakening due to normal faulting in the subducting plate along the Mariana Trench

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Abstract

We investigated variations in the elasto-plastic deformation of the subducting plate along the Mariana Trench through an analysis of flexural bending and normal fault characteristics together with geodynamic modeling. Most normal faults were initiated at the outer-rise region and grew toward the trench axis with strikes mostly subparallel to the local trench axis. The average trench relief and maximum fault throws were measured to be significantly greater in the southern region (5 km and 320 m, respectively) than the northern and central regions (2 km and 200 m). The subducting plate was modeled as an elasto-plastic slab subjected to tectonic loading at the trench axis. The calculated strain rates and velocities revealed an array of normal fault-like shear zones in the upper plate, resulting in significant faulting-induced reduction in the deviatoric stresses. We then inverted for solutions that best fit the observed flexural bending and normal faulting characteristics, revealing normal fault penetration to depths of 21, 20, and 32 km beneath the seafloor for the northern, central, and southern regions, respectively, which is