# Correlations Between Stress Orientation and Seismic Coupling in Subduction Zones

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Subduction zone megathrust faults range from being completely locked to continuously creeping. The locked regions pose the greatest seismic hazard because they accumulate stress that is often released in large earthquakes. We find that the creeping versus locked behavior of subduction zone megathrust faults correlates with the apparent frictional strength of these faults as inferred from their orientation in the regional stress field inverted from moment tensors. Our global investigation of stress orientations in subduction zones finds that the average angle between the maximum compressive stress axis and the subduction interface is significantly correlated with the average seismic coupling. The most coupled subduction zones exhibit a maximum compressive stress axis at angles of 20˚-45˚ to the megathrust, well oriented for failure with a typical laboratory friction coefficient. The least coupled zones have angles in the range of 40˚-65˚, less well oriented, and implying reduced frictional strength. Comparisons between existing maps of stress orientations and geodetically-derived coupling models for the Japan Trench show a similar correlation: the locked patches on the megathrust fault are on average at lower angle to the maximum compressive stress axis than the creeping patches. Our new finer-scale model of stress orientations in the Japan Trench reveals additional complexity. Much of the plate interface exhibits angles near 30˚, consistent with the overall coupling of the Japan Trench in the global subduction zone context. Exceptions are shallow zones of geodetically-inferred creep and deep locked zones, which are at angles closer to 45˚, suggesting they are weaker. Our observations, excluding the deep locked zones of the Japan Trench, suggest that creeping megathrust faults have on average lower frictional strength than locked megathrust faults.

Keywords: subduction zone, stress, fault coupling

 