# High-velocity frictional strength across the Tohoku-Oki megathrust determined from surface drilling torque

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High-velocity frictional strength is one of the primary factors controlling earthquake faulting. The Japan Trench Fast Drilling Project drilled through the shallow plate-boundary fault, where displacement was ~50 m during the 2011 Tohoku-Oki earthquake. To determine downhole frictional strength, we analyzed the surface drilling torque data acquired at rotation rates equivalent to seismic slip rates (0.8–1.3 m/s). The results show a clear contrast in high-velocity frictional strength across the plate-boundary fault: the apparent friction coefficient of frontal prism sediments (hemipelagic mudstones) in the hanging wall is 0.1–0.3, while that of the underthrust sediments (mudstone, laminar pelagic claystone, and chert) in the footwall increases to 0.2–0.4. The apparent friction coefficient of the smectite-rich pelagic clay in the plate-boundary fault is 0.08–0.19, which is consistent with that determined from high-velocity (1.1–1.3 m/s) friction experiments. This suggests that surface drilling torque is useful in obtaining downhole frictional strength.

Keywords: frictional strength, drilling torque, Japan Trench Fast Drilling Project

 