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準高速すべりに伴うスメクタイト質断層の動的強度弱化
Dynamic weakening of smectite-bearing faults at subseismic slip rates

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The hydrous clay mineral smectite, which is pervasive in sediments on subducting oceanic plates, is thought to weaken and stabilize subduction thrust faults. However, these frictional properties of smectite alone cannot explain the large coseismic slip in the vicinity of a trench. Here, we performed friction experiments to demonstrate the rate dependence of friction at slip rates from 30 μm/s to 1.3 m/s for water-saturated smectite-quartz mixtures with various smectite contents, so as to shed light on the frictional response of smectite-bearing faults at intermediate to high slip rates. At slip rates of 30 to 150 μm/s, the friction coefficients decreased gradually from 0.5-0.6 to 0.1 with an increase in smectite content from 20 to 50 wt%. In contrast, at slip rates higher than 1.3 mm/s, friction exhibited marked slip weakening, resulting in low friction coefficients of 0.1-0.05, even for low smectite contents (roughly $<$30 wt%). Drastic slip weakening occurred at smectite contents of 10-30 wt% at slip rates of ˜10 mm/s, which is one to two orders of magnitude lower than the slip rate at which slip weakening was observed in previous experiments on various rock types. The intermediate-velocity weakening could be attributed to a rise in pore pressure caused by both shear-enhanced compaction and microscopic thermal pressurization of pore fluids. This process could weaken the fault even below seismic slip rates, leading to an acceleration of fault motion and potentially facilitating large coseismic slip and a stress drop in the vicinity of a trench.

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