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Thermal and pressure effect on frictional property of smectite: application to the plate boundary earthquakes of Nankai

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Along subduction thrust faults, the transformation from smectite to illite at 100-150 ℃ plays a key role to define the updip limit of the seismogenic zone. If this hypothesis is correct, it is required that smectite exhibits velocity strengthening behavior at in-situ effective normal stress (σ^{eff}) and ˜100-150 ℃. Here we report results of friction experiments on gouges of pure Na-montmorillonite at σ^{eff} of 10-70 MPa, a pore fluid pressure of 10 MPa, at temperatures of 25-150 ℃, and sliding velocities of 0.03-3 μm/s, using an oil-medium triaxial testing machine. We found that the coefficient of friction (μ) ranges from 0.056 to 0.120. At temperatures of 20 to 60 ℃, μ systematically decreased with increasing σ^{eff}, while at 90-120 ℃, it increased with increasing σ^{eff}. With increasing σ^{eff}, the velocity dependence of friction (a-b) became negative at 25-90 ℃ and positive at 120 ℃. Therefore, we suggest that smectite friction promotes stable slip along the decollement at the shallow Nankai subduction zone.

Keywords: subduction thrust fault, decollement, aseismogenic zone, smectite, laboratory experiment, velocity dependence of friction