

## Velocity weakening behavior observed for friction of the shallow subduction zone fault material

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Recent observations of slow earthquakes along faults within shallow part of subduction zones, for example the very low frequency earthquakes at the Nankai Trough [Ito and Obara, 2006; Sugioka et al., 2012], has demonstrated that faulting there is slow yet seismic; suggesting that frictional velocity dependence along the fault at the shallow portion must be negative. However, previous experimental results have repeatedly shown that velocity dependence of the expected fault zone material is generally estimated to be positive. Here, we present our recent experimental results showing that velocity dependence of the friction of the shallow subduction zone faults are not necessarily be positive.

We have performed a series of rotary-shear large displacement (>150 mm) friction experiments on the following shallow fault simulating material: clayey fault material from the shallow megasplay fault zone within the Nankai accretionary prism, input pelagic siliceous to calcareous sediments to the Costa Rica subduction zone, and simulated artificial gouge of montmorillonite/quartz mixtures (20-40 wt% of montmorillonite). Experimental results reveal that these material do exhibit velocity weakening behavior at a range of velocities from 0.003-0.3 mm/s. Velocity weakening of these material is mostly characterized by a small degree of the friction velocity dependence (the absolute value of (a-b) is typically <0.005).

The SSEs are often described as conditionally stable sliding of faults [e.g., Shelly et al., 2006]. High pore fluid pressure could alter a velocity-weakening fault with a small value of (a-b) to conditionally stable regions by reducing the effective normal stress [Scholz, 1998]. The presented velocity weakening property with a small value of (a-b) could be responsible for generating shallow slow seismic slip events in subduction zones. Textural observation reveals the importance of studying effects of both the clay content and shear-induced deformation textures on the frictional velocity dependence.

Keywords: Nankai Trough, subduction zone, frictional velocity dependence, slow earthquakes