Frictional properties of sediments from Nankai Trough IODP Expedition 316 in an intermediate velocity range

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Frictional properties of subducting materials over a wide range of slip rate are important to understand the faulting mechanisms along the plate subducting boundaries. Shear deformation experiments were performed on NantroSEIZE Stage1A discrete core samples from the expedition sites C0004 and C0006, at normal stresses of 1.0 to 5.0 MPa and at slip rates from 0.0026 to 26 mm/s, with a rotary-shear, intermediate- to high-velocity friction apparatus at Kyoto University.

To be used in the experiments, the discrete samples was disaggregated, oven dried at 90 degrees centigrade for 24 hours and then sieved in order to eliminate clasts larger than about 100 micrometer. The experimental fault is composed of a 24.8 mm diameter granite cylinder cut perpendicularly to the revolution axis in two halves that are ground to obtain rough wall surfaces. The two cylinder are re-assembled with an intervening thin layer (less than 1.0 mm) of the disaggregated materials. A Teflon ring surrounds the fault in order to avoid gouge expulsion during rotation.

Our preliminary results show that the level of friction recorded for the tested samples are relatively low at around 0.4, than ordinary observed rock friction (0.6-0.7), over the range of experimental conditions used in this study. The velocity dependence of friction of the tested samples is complex and it varies for different samples. For example, sample from C0004D-26R-1 at 260.5 mbsf exhibits strong velocity strengthening behavior at slower velocities (0.0026 to 2.6 mm/s) and almost no or a weak velocity weakening behavior at the fastest velocities tested in this study (2.6 to 26.0 mm/s). In contrast, sample from C0006E-31X-4 at 260.5 mbsf exhibits a weak velocity weakening behavior to a step change in loading velocity at velocities from 0.0026 to 0.26 mm/s, with a transition to a subtle dependence of friction at velocities from 0.26 to 26 mm/s. Such transitions in velocity dependence with the increase of slip rate might affect the mode of sliding of faults.

A knowledge of the frictional behavior of the NantroSEIZE samples at the intermediate slip rates is important to our understanding of fault slip within the mega-splay fault system. Additional work to examine associations between the velocity dependence and the composition of the tested materials over a wide range of experimental conditions is needed.