High velocity frictional properties of subducting materials: An example study for argillaceous melange rock

Akito Tsutsumi[1]; C.D. Rowe[2]; J. C. Moore[3]; F. Meneghini[4]; Asuka Yamaguchi[5]

[1] Graduate School of Science, Kyoto University; [2] University of Cape Town; [3] University of California, Santa Cruz; [4] Universita di Pisa; [5] Earth and Planetary Sci., Univ. Tokyo

In this study, high-velocity frictional properties of accretionary materials were investigated using a rotaty-shear frictional testing machine. Samples for the experiments were collected from argillaceous melange rock at the Pasagshak Point, Kodiak Island, Alaska, which is likely the source of the recently proposed zone of extreme shear localization (black-layer, Rowe, et al., 2005).

Experiments were conducted on a pair of hollow, cylindrically shaped specimens (diameter, 25 mm; length, 25 mm) under dry conditions at room temperature, at a constant slip rate of about 1.3 m/s and at a constant normal stress of about 7.8 MPa.

At the beginning of the slip, fine-grained particles (dust) were produced initially, which likely suggested that severe wearing was accompanied within the fault at the beginning of the slip. Strength of the fault in terms of friction coefficient decreased rapidly from ˜0.59 to ˜0.15 with slip for the initial 0.2m of displacement. After this rapid friction-decreasing stage, friction stayed at an approximately constant value of about 0.15 for the displacement interval from ˜0.2 to 0.4m. Friction coefficient was then followed by a rapid increase for further displacement. Visible frictional melting initiated at about 0.74m of displacement, at which moment friction coefficient reached a peak friction value at about 0.55. Visible melting lasted until the end of the experiment. Strength of the sample during frictional melting decreased firstly to about 0.38 and then increased gradually towards the end of the run. Thin section observation reveals that the sample is separated fully with thin (0.3 to 0.8mm) layer of a mixture of likely molten materials and clasts.

Presented preliminary result indicates that strength of the argillaceous melange sample could increase with displacement if frictional melting is associated. This result makes a clear contrast to the previously reported results for different kinds of rock samples such as gabbro, where simulated fault becomes weak with the growth of a molten layer as displacement proceeds.