Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SSS020-07 Room: 302 Time: May 26 10:45-10:57

Formation process of the fine-grained black fault rock from the Kodiak Island, Alska

Akito Tsutsumi[1*], Yuki Inoue[1]

[1]Kyoto University

In Kodiak Island, Alaska, an accretionary complex that has been interpreted as an ancient analogue of decollement zones is exposed. (Fisher and Byrne, 1987). Recently, dark gray to black, locally vitreous, ultra-fine grained fault rock (black fault rock, BFR) was reported from the fault zones in the Kodiak accretionary comlex(Ghost Rokcs Formation) as a possible rare example of rocks that preserved a record of seismogenic faulting along subduction zones (Rowe et al., 2005). Previous studies have revealed that the fault rock is characterized with the following features; In the BFRs, pseudotachylyte occurs as a possible evidence for the operation of frictional melting (Meneghini et al., 2009), and on the other hand, the BFRs contain ductile deformation fabrics, which suggests association of cataclastic flow (liquefaction) process at high slip rates (Brodsky et al., 2008). These observations may indicate that the BFRs were generated during high-velocity fault slip. It is important to study the frictional properties of the BFRs for understanding the fault deformation mechanism of the BFRs, including the problem of this exceptionally thick slip zone.
In this study, frictional properties of cataclastic melange rock exposed adjacent to the BFR was investigated using a rotaty-shear frictional testing machine. The samples for the experiments were collected from cataclastic argillaceous melange rock, which is likely the source of BFRs. Shear deformation experiments were conducted at low- to high-slip rates (from 0.003 to 1300 mm/s) in order to investigate the velocity dependence of friction in wide range of the slip rate. In addition, thin section of the deformed sample was observed to examine the textures generated during the experiments.
Experimental results show that at low-slip rates the level of friction is almost constant at around 0.57-0.6, and at intermediate-slip rates (v = 1mm/s) the level of friction is high (0.85-0.9). At intermediate- to high-slip rates, v = 30mm/s to 1300mm/s, the level of friction is low (0.2-0.4). The results from the velocity-step change test show that at slowest slip rates (v = 0.001mm/s - 0.01mm/s) the velocity dependence of friction is negative (velocity weakening), however, for slip rates up to 1mm/s the velocity dependence of friction is positive (velocity strengthening). This result indicates that the material which shows velocity weakening changes to velocity strengthening behavior for intermediate-slip rates (1mm/s). Thus velocity weakening at slowest slip rates changes to velocity strengthening with increasing slip rates. At the same time, level of friction increases remarkably at fast slip rates (v > 1mm/s). Such strengthening properties of fault materials might affect acceleration of fault slip.
The results of textural observation reveal that no clear deformation texture is developed for the experiments up to 300mm/s. However, in thin section, some part shows darker color than initial material. The reason is unexplained, though it may reflects something related to deformation texture. It seems that the gouge material produced in the high-velocity sliding experiments becomes darker and finer-grained than the samples generated at slower slip rates. In particular, at the fastest slip rate (v = 1.3m/s), brown-colored zone, which is considered as a deformation concentration zone, develops. This kind of deformation textures are absent in the results of frictional experiments at slow-slip rate. Hence the texture can be a peculiar deformation texture indicative of high-slip rate faulting.

Keywords: rock friction, Kodiak, fault rock