Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SIT039-P03 Room:Convention Hall Time:May 24 14:00-16:30

Transition from velocity weakening friction to velocity strengthening friction

Osamu Kuwano[1*], Takahiro Hatano[1]

[1]ERI, Univ. of Tokyo

Various mechanisms that weaken the fault strength at sub-seismic to seismic slip rate have been proposed: melting, silica-gel formation, thermal decomposition, moisture absorption/desorption , and flash heating (e.g., Shimamoto et al., 2003; Di Toro et al., 2004; Rice, 2006; Beeler et al.,2008). On the other hand, steady-state kinetic friction of dense granular matter such as fault gouge is revealed to be velocity strengthening in nature, and that is confirmed by numerical experiments (e.g., GDR MiDi, 2004; Hatano, 2007) . The velocity strengthening behavior has been also confirmed by laboratory experiments on glass beads at normal stress up to 0.05 MPa where frictional heating is negligible (Kuwano et al., 2009) . In this study, we conducted friction experiment on granite specimens at normal stress up to 0.9MPa where frictional heating plays an essential role. Experiments were performed with rotary shear apparatus at normal stress ranging from 0.01 to 0.9 MPa and slip rate ranging from 10ˆ-6 to 1m/s. Experiments were performed under both dry and ambient humidity condition. At lower slip rate, a typical friction coefficients of about 0.8 is observed. At slip rate of about 0.01 to about 0.1, decreases of friction coefficient occurred and minimal friction coefficient is about 0.2. This friction decrease is consistent with the results of the previous studies. At higher slip rate, however, friction increases linearly with slip rate. Scaling the slip rate by square root of normal stress, friction increasing parts of different normal stresses are well collapsed onto universal curve. Thus, it is inferred that the friction increase is due to energy dissipation by inelastic collision of granular matter.

Keywords: friction, constitutive law, rheology, granular matter, flash heating