

## Slip and Velocity Dependent Gouge Friction at High Velocities; experiments using fault zone samples from TCDP

# Hiroki Sone[1]; Toshihiko Shimamoto[2]

[1] Geology and Mineralogy, Kyoto Univ.; [2] Dept. of Geol. & Mineral., Graduate School of Science, Kyoto Univ.

We conducted high-velocity frictional experiments using fault zone samples from the Taiwan Chelungpu-fault Drilling Project. Experiments were conducted with two distinct types of velocity histories, constant and continuously evolving. Results from constant velocity tests show clear continuous slip-weakening behaviors of friction consistent with past findings from Mizoguchi (2004). A negative velocity dependent trend of friction was also seen from these experiments, however the trend could only be identified disconnectedly by comparing data sets from several experiments with different constant velocities.

To conduct frictional experiments with more realistic velocity histories, we attempted to control the slip velocity so that the velocity would accelerate from stationary to a peak velocity (2m/s), and decelerate back to stationary as in actual fault motions during earthquakes, all within a 10 second interval. This allowed us to simultaneously observe the frictional responses against a slip velocity that continuously evolves. The frictional coefficient decreased with acceleration and accumulation of slip, and then gradually recovered as the fault slip decelerated although it did not fully recover to its initial level. This indicates that a velocity-weakening behavior was observed at the same time as the simulated fault weakened with displacement. Thus it is a combined slip and velocity weakening behavior.

The constitutive relation between fault strength and slip during high-velocity fault motion is a critical factor in understanding the fault rupture process during an earthquake. Since Ide and Takeo (1997) first attempted to analyze the constitutive relation between stress and slip by solving elastodynamic equations using kinematic fault slip solutions from the 1995 Kobe earthquake, several studies have revealed the clear slip-weakening behavior during natural earthquakes. (e.g. Zhang et al., 2003) However a clear velocity dependence of stress, or fault strength, had not yet been confirmed through these studies. As our frictional experiments may be somewhat analogous to the frictional behavior of co-seismic fault slips, the combined slip and velocity dependent gouge friction found in the present study may provide new insights in interpreting results from seismological studies on natural earthquakes. We will also attempt to formulate this combined slip and velocity dependent constitutive relation.