J162-012 **Room: 302** **Time: May 16 11:41-11:55**

Significance of intermediate-velocity friction barrier on earthquake nucleation processes

Toshihiko Shimamoto[1]; Takehiro Hirose[2]

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

High-velocity friction, for which frictional heating plays decisive role, has been receiving increasing attention with respect to fault motion during large earthquakes. High-velocity friction associated with frictional melting, thermal pressurization, high-velocity gouge behavior and high-velocity rock-on-rock friction is distinctly different from ordinary fault constitutive properties (rate-and-state constitutive law or slip weakening law) that have been determined by traditional friction experiments at slow slip rates and small displacements. Contrasting constitutive properties between the two regimes clearly bring about the significance of intermediate-velocity frictional regime that links the two regimes. This regime is very important in understanding how precursory slip grows to a large earthquake, or how and when frictional properties changes to those of high-velocity friction associated with a large earthquake. Thus, the intermediate-velocity regime is likely to be the most important area for establishing physical basis for earthquake prediction, and yet no systematic studies have been carried out.

A new low to ultra-high velocity friction apparatus was developed in Kyoto to cover wide slip rates from 3 mm/yr to about 10 m/s, by using four sets of gear arrangements. An ultrahigh velocity arrangement using two sets of belts increases rate of revolution by nine times and allows to produce such a high slip rate. Six pairs of high-velocity seals, set in a pressure vessel made of stainless steel, can sustain slip rates exceeding 10 m/s and can hold water pressure up to about 50 MPa. Since hollow-cylindrical specimens are used without jackets, water pressure in the vessel acts as pore pressure and normal stress to fault is applied with a hydraulic press. An external furnace will produce temperature to around 400 degrees Celcius, thereby producing supercritical condition. This is probably the only machine in the earth science community that allows one to study frictional properties crossing completely the intermediate regime.

Old laboratory data on halite shear zone (Shimamoto, 1986) indicate that velocity weakening behavior at slow slip rates changes to velocity strengthening at slip rates on the order of a few tenths of mm/s. Whereas Tsutsumi and Shimamoto (1997) have shown that steady-state friction of gabbro increases as slip rate increases from about 10 mm/s to about 100 mm/s (velocity strengthening), but it changes marked velocity weakening behavior at higher velocities. For the sake of convenience, we define the intermediate-velocity regime as the velocity-strengthening regime between low- and high-velocity regimes, both characterized by velocity weakening. Shibazaki (2004) showed by modeling earthquake rupture propagation that the velocity-strengthening property in the intermediate regime definitely stabilizes fault motion; i.e., local slip does not immediately develop into a large earthquake. Thus we call this velocity strengthening intermediate-velocity barrier to fault motion. Our preliminary experiments on gabbro show that the barrier is 0.1 to 0.2 in terms of frictional coefficient. The any portion of a fault must possess such a barrier as an intrinsic fault property, and an interesting question in rupture propagation analysis is how local slip overcomes this barrier to grow into large earthquakes. Old halite data (Shimamoto, 1986) indicate that the velocity-strengthening property gradually changes into flow law with increasing effective pressure. Thus, partially operated plastic deformation at asperity tips seems to be the source of velocity strengthening.