High-velocity friction of the Longmenshan Fault gouge in Sichuan Province, China

Tetsuhiro Togo[1]; Toshihiko Shimamoto[2]; Shengli Ma[3]; Xueze Wen[4]; Takehiro Hirose[5]; Hiroki Sone[6]; Xinglin Lei[7]

[1] Graduate School of Science, Hiroshima Univ; [2] Graduate School of Science, Hiroshima Univ.; [3] Institute of Geology, CEA; [4] Seismological Bureau of Sichuan Province; [5] JAMSTEC; [6] none; [7] GSJ, AIST

http://www.geol.sci.hiroshima-u.ac.jp/

Last May, the Wenchuan earthquake (Mw= 7.9 [1]) occurred in the Sichuan Province in China and over 70 thousand people were killed and suffered enormous economic damage. The Longmenshan Fault which triggered this earthquake has been recognized as an active fault and some studies suggested the possibility of a huge earthquake based on geomorphic evidence [2]. However, due to the predominantly long earthquake recurrence period, no one was aware of the imminently dangerous situation. By this earthquake, over 250 km of surface rupture was formed and fault zone in the basement rock was exposed in several locations, which provide the opportunity for detailed investigation of the inner structure and physical property of the fault zone. Consequently, we investigated the Longmenshan Fault at the Hongkou outcrop in the suburban Dujiangyan City, and determine the physical property of this fault by the laboratory experiment.

For the high velocity frictional experiment, collected fault gauge was held between the cylindrically-shaped fine grained gabbro, and attached teflon sleeve to the outside of the fault plane [3]. This experiment was performed by the High-velocity frictional experiment machine lent from Kyoto Univ. to the Kochi Core Center, JAMSTEC. Some results are shown in the figures. Upper one shows the relationship between shear and normal stress in speeds of 1.3 m/s slip rate which nearly corresponds to the earthquake slip. The result obeys Coulomb friction criterion and frictional coefficient is 0.65 at the peak friction, but it decreases to 0.1 at the steady state (residual strength) after fault slipping. Below one is a diagram that compares the slip rate and frictional coefficient. While the values of peak friction almost stay constant around 0.8, steady state friction coefficients notably decay with increasing of slip rate, and they decrease 0.2 for over 0.9m/s. These results indicate that the frictional resistance diminishes due to the acceleration of fault movement during earthquake, and it becomes increasingly fault instability and further accelerates the fault slipping.

The Wenchuan Earthquake Fault-zone Drilling (WFSD) has already started by some Chinese government research institutes and the first borehole will reach to the Longmenshan Fault and finish the drilling by the end of this March. Institute of Geology of China Earthquake Administration is supposed to measure physical property of the core sample. In response to this, our laboratory and they are planning to make comprehensive experiment by using our testing machine reciprocally. In the future, the physical and hydrological properties will obtained for dissolving the generating mechanism of giant earthquake in the inland region.