Frictional properties of the Median Tectonic Line fault zone

*Miki Takahashi[1], Chisaki Inaoi[2], Jun Kameda[3], Norio Shigematsu[1]

1. Institute of Earthquake and Volcano Geology, Geological Survey of Japan, AIST, 2. Department of Natural History Sciences, Graduate School of Science, Hokkaido University, 3. Earth and Planetary System Science Department of Natural History Sciences, Graduate School of Science, Hokkaido University

We investigated frictional properties of fault gouges of the Median Tectonic Line (MTL) at an outcrop (Awano-Tabiki outcrop) exposed in the eastern Kii Peninsula, Japan, using a laboratory experiment technique to evaluate a strength-history of the MTL fault. Shigematsu et al., (2017) described that the MTL fault zone at Awano-Tabiki outcrop is suffered four stages of faulting under different depthes in brittle regime. The newest deformation at the Awano-Tabiki outcrop (stage 4) is characterized by a localized zone with a normal faulting sense of slip within ˜ 1 cm in thickness (gouges-B and F). Those gouges are rich in smectite, indicating that the depth to activate the MTL fault at this stage would be relatively shallow at which the temperature is lower that 140 deg.C. On the other hand, the oldest deformation (stage 1) is widely distributed in such as gouges D, I-L with a dextral sense of slip. They are rich in muscovite and illite, indicatiing that corresponding temperature could be higher than 200 deg.C. Therefore to investigate frictional property of each fault gouge at each deformation condition based on mineral compositions, could be a key to reveal a history of a crustal fault strength such as the MTL fault. An experimental machine we used was a gas-medium, high-pressure, high-temperature triaxial apparatus set at GSJ, AIST, Japan. We set initially temperature conditions, *T*, to 100 deg.C for gouge-B and gouge-F and to 250 deg.C for gouge-D, respectively. Then, confining pressures, *Pc*, corresponding to assumed depth were determined by assumed geothermal gradient (20˜60 deg.C/km). We thought conditions of pore pressure, *Pp*, and sliding velocity, *V*, would change in the earthquake cycle. We, therefore, varied the values of *Pp* (hydrostatic ˜ Pc) and *V* (0.011 mm/sec ˜ 115 mm/sec for stepwise change). After 75 mm mesh sieving, 0.6 g of smaller-grain-sized powder sample of the gouge was sandwiched between porous alumina pre-cut blocks, which provided c.a. 0.5 mm thick gouge layer. The powder samples of gouge-B and gouge-F contained 24 wt.% and 34 wt.% of smectite, respectively. On the othre hand, the powder sample of gouge-D was rich in muscovite (26 wt.%) and illite (21 wt.%), but did not contain the smectite. We obtained interesting results on both the shear strength and the velocity dependence of friction for those smectite rich gouges. Average values of friction coefficient, showing a dependence of the smectite content, are 0.30 for gouge-B and 0.18 for gouge-F. However, the friction coefficient for both gouges became decreasing significantly towards ˜0.05 at *Pc-Pp* < c.a. 14 MPa, while the frictional coeffcient on gouge-D showed a constant value of 0.42 with no effective pressure dependence. Common properties of the gouges were that the velocity dependence of friction became positive at high *V*, low *Pp* and high smectite content but became negative at the low *V*, high *Pp* and low smectite content.
We will, thus,add cases for other samples of gouge zones formed between oldest stage generating gouge-D and newesrt stage generating gouge-B and –F to complete a figure for the strength-history of the MTL fault.

Keywords: fault gouge, the Median Tectonic Line fault, velocity dependence of the friction, friction coefficient