# Frictional properties of mylonite, feldspar, and quartz under high-pressure and high-temperature conditions

# Koji Masuda[1]; Takashi Arai[1]; Miki Takahashi[2]; Koichiro Fujimoto[3]; Norio Shigematsu[4]

[1] AIST; [2] Institute of Geoscience, AIST; [3] Gakugei Univ.; [4] GSJ, AIST

In order to understand the earthquake generation process, we need to understand the frictional and rheological properties of fault zone materials under high-pressure and high-temperature conditions. Laboratory data on frictional properties of fault surfaces of fault rocks are useful for that purpose. We designed and constructed an original Japanese-type gas-medium deformation apparatus. Frictional properties of mylonite, feldspar, and quartz under high-pressure and high-temperature conditions were obtained.

We carried out a series of conventional triaxial compression tests of mylonite at constant displacement rate. The strain rate of deformation was 5.5 x 10 -6 s-1, the temperature was raised at a rate of 10C min-1 for all experiments. We analyzed the stress-strain relation and the frictional behavior of the fault surface formed in the tests. Mylonite samples taken from an exposed brittle-ductile transition zone, the Hatagawa fault zone, northeast Japan, are tested under the confining pressure up to 200 MPa and temperatures up to 600C both in the dry and wet conditions. In the wet conditions, pore water pressure was applied up to 70 MPa. In dry condition, confining pressure of 130 MPa was applied. Effective confining pressure was 130 MPa for both dry and wet condition. The sample shape was a cylinder of 16.0 mm diameter and 40.0 mm length.

Even under the same effective confining pressure, presence of pore water dramatically reduces the peak shear stress at the temperature regime higher than 600C. Frictional properties of fault surface formed during the deformation tests are investigated. In the dry conditions, stick-slip behaviors were observed at the room temperature and 200C. For the temperature range up to 600C, frictional forces are almost the same level. In the wet condition, we did not observe stick-slip behavior for all temperature ranges. The frictional force decreased as the temperature increased. Fluid such as water in the deep crust may play an important role in deformation process.

We conducted frictional experiments by using albite, anorthite, and quartz gouges (about 3 micron-m diameter) under high-pressure and high-temperature in a triaxial apparatus, and compared frictional behaviors of three minerals with elevated temperature under the wet and dry conditions. These experiments were conducted by the velocity-stepping test. Temperature varied from room temperature to 600C. In the dry conditions, experiments were conducted under the confining pressure of 150MPa. In the wet conditions, pore water pressure was applied up to 50MPa under the confining pressure of 200MPa. Samples were put between upper and lower sawcut alumina cylinders (20mm in diameter, 40mm long). The sawcut was oriented at 30 degree to the loading axis. The values for a-b of quartz and albite were positive under the dry condition from room temperature to 600C. On the other hand, those values of albite and quartz were negative at the temperature of 200C and 300C under the wet condition respectively. Those values of quartz decreased as the temperature increased from 100C to 300C and increased as the temperature increased from 300C to 600C. Those values of albite were switched from velocity weakening to velocity strengthening between the temperature of 200C and 300C, and increased in the temperature range up to 600C. The frictional coefficient of albite decreased gradually after velocity-step from the temperature of 250C to 350C. We will discuss these frictional properties with the texture of samples by the SEM observations.