A9-P002 Time: June 5 17:00-18:30

Change of pore structures and permeability in granites towards a fault zone: Preliminary results

Celia Tiemi Onishi[1], # Ichiko Shimizu[2], Shin-ichi Uehara[3], Kazuo Mizoguchi[3], Toshihiko Shimamoto[4]

[1] TGC-JNC, [2] Geological Inst., Univ. Tokyo, [3] Earth and Planetary Sci., Kyoto Univ, [4] Dept. of Geol. & Mineral., Graduate School of Science, Kyoto Univ.

Porosity, pore structures and permeability were investigated, using drill core samples of the Toki Granite penetrating the Tsukiyoshi Fault at the depth of ca.700 m. The central part of the Tsukiyoshi Fault is constitute of foliated ultra-cataclasites with fine grained matrix. The bulk porosity of the samples varies from 0.54% to over 5.4%. The samples were impregnated with fluorescent resin and then observed by a Laser Scanning Microscope (LSM). Microcracks were mainly observed at grain boundaries. Permeability measurements were performed by a HPT gas apparatus. The pore oscillation technique was applied, with Nitrogen gas as a pore fluid. Pore pressure was kept around 20 MPa, and confining pressure was changed from 25MPa to 200MPa.

Permeability in rocks is sensitive to pore structures. In fault zones where brittle deformation dominates, connectivity of cracks is most important factor to control the fluid permeability. The relation between porosity, pore structures and permeability were investigated, using drill core samples of the Toki Granite in Gifu Prefecture. The core samples were taken from a borehole penetrating a reverse fault of the Tsukiyoshi Fault at the depth of 700 m. are used for the microstructural analysis and permeability measurements. The Toki Granite shows textural variations towards the Tsukiyoshi Fault. The country rock is fresh and massive biotite granite. Fractures and calcite veins are well developed around the fault zone. The central part of the Tsukiyoshi Fault is constitute of foliated ultra-cataclasites with fine grained matrix. Microstructural observation indicates that fragmentation of crystals is the cause of grain size reduction at the fault zone.

The effective porosity of bulk samples measured by a Helium pycnometer varies from 0.54% for an unaltered country rock to over 5.4% for a foliated cataclasite at the central part of the fault zone. The pore structures in the granite samples were visualized by a method assisted by a confocal Laser Scanning Microscope (LSM) first proposed by Fredrich et al (1995). The samples were impregnated with low viscosity (<1.5 mPa) fluorescent resin under vacuum, and then observed by a LSM. The LSM enables us to capture digital intensity maps of green fluorescence excited by blue (488nm) Kr-Ar laser beams. Quasi 3D images of pore structures were constructed from optical slices (confocal images) of thin sections. Pores (microcracks) in granites were successfully filled with the fluorescent resin. Microcracks were mainly observed at grain boundaries. The SEM observation also confirms the existence of intergranular open fractures along grain boundaries. Fluorescence were also detected at fractures cutting plagioclase and biotite crystals. The crack density under the microscope increases towards the fault zone.

Permeability measurements were performed by a HPT gas apparatus at Kyoto University. The pore oscillation technique (Kranz et al., 1990; Fisher & Paterson, 1992) was applied, with Nitrogen gas as a pore fluid. Confining pressure was increased and then decreased in the range of 25- 200 MPa, with pore pressure kept around 20 MPa. Preliminary results indicates relatively high permeability for a fresh country rock, about 10^(-15)m^2 at the initail confining pressure (Pc=25MPa), and is gradually decreased to 10^(-17) m^2 at the highest Pc(=198MPa).