HRE31-03 Room:419 Time:May 2 10:00-10:15

Evaluation of permeabily fault related damage zone in sandstone from a viewpoint of microstructure

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It is known that strengthened fragmentation is often observed in damage zones along the fault planes. Studying permeability of faults and damage zones is important because they control fluid migration in subsurface environment (e.g. oil migration and reservoir development, carbon dioxide storage, methane hydrate development). Field and laboratory permeability test have shown that permeability within shear bands, fault gouge or cataclasite is lower than of wall rocks (Zhang and Tullis. 1998), and permeability of damage zones is higher than wall rocks (Fowles and Burley. 1994). The authors compared permeabilities of the wall rocks and damaged zones and their relation to the changes in porosity and pore-size distribution obtained by mercury porosimetry.

The sample was chosen from sandstones from the Nichinan Formation. We conducted shear test on cylindrical sample 90mm in diameter and 180mm long to develop damaged zones in the sample. Cylindrical sample of 50mm in diameter and 25mm long were then cored from the 90mm sample, that intersected the shear plane and damages zones at right angle. The permeability tests were conducted on the cored sample using transient pulse method (Brace et al. 1968) at effective confining pressures 5 and 10MPa. We calculated permeability by Hsieh method (Hsieh et al. 1981) that considered the specific storage value of sample and apparatus. Porosity and pore-size distribution were measured using mercury porosimetry on 10mm cube samples taken from 0 to 10mm, 10 to 20mm, 20 to 30mm, 30 to 40mm from the shear plane.

The permeability of the intact wall rock was 9.40x10^{-9}m/s at 5MPa effective confining pressure, and 2.52x10^{-9}m/s at 10MPa. Permeability of damaged zones were 1.41x10^{-8}m/s at 5MPa effective confining pressure, and 2.70x10^{-9}m/s at 10MPa. Porosity of the intact wall rock was 7.9% and the pore size was dominantly ˜0.1 micro meter. Along the damaged zone, the frequency of 0.1 micro meter pore decreased and that of 0.5 to 10 micro meter pore increased with decreasing distance from the shear plane. On the other hand the porosity of the damaged zones was 5% in average and no clear correlation was observed between the distance from the shear plane and porosity. We suggest that pore structure was affected by micro-fractures or rearrangement of grains from the porosity reduction in the damaged zone samples; nevertheless permeability of the damaged zone samples is higher than that of wall rock samples.

Keywords: permeability, permeability test, mercury porosimetry, pore-size distribution, shear test