Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HRE28-P06 Room:Convention Hall Time:May 25 18:15-19:30

Stress dependency of permeability through a single fracture in Neogene-Quaternary siltstone

NOGUCHI, Mami[1*] ; UEHARA, Shin-ichi[2]

[1]Department of Environmental system, Graduate School of Frontier Sciences, The University of Tokyo, [2]Department of Environmental science, Faculty of Science,Toho University

In case that mudstone seal layers for carbon dioxide geological storage have some fractures, carbon dioxide can leak at the fractures. Therefore, it is important to reveal condition which fracture of mudstone becomes a flow channel.

Uehara et al. [1] indicated that, when an effective pressure is increased, a fracture in mudstone was closed and it cannot function as a under a certain effective pressure, which is related to yield conditions of the intact rock. However, in the case of carbon dioxide geological storage, it is necessary to pay attention to a process of decompression of effective pressure, because carbon dioxide is injected and pore pressure is increased. It is not clear how the fracture permeability develops at this process of decompression under the depth for Neogene-Quaternary mudstone, which is one of the potential candidates of seal layers for carbon dioxide geological storage in Japan.

The purpose of this study is to make clear how fracture permeability in mudstone changes at an effective pressure-decompression process, and how the features depend on depth and yield condition of the rock. This study conducted water permeability tests with two siltstones from the Kazusa Group, the Ohara Formation siltstone (OHR3) and the Kiwada Formation siltstone (KWD2), which be different from the yield condition. A single fracture was made in these cylinder rock specimens by using a vice. Permeability for each specimen was measured under several compression-and-decompression cycles of effective pressure with increasing the maximum effective pressure (2∼21 MPa). These experiments were carried out three times for OHR3 and two times for KWD2.

All results of experiments had two characteristic effective pressure cycles; a cycle at which differences in permeability between process of compression and decompression become clear, and a cycle at which the permeability becomes almost the same as the permeability of the intact rock. This study calls the former cycle as ”the fracture yield starting cycle”, and the later as ”the fracture closed cycle”. The maximum effective pressure of the fracture closed cycles are 5∼9 MPa for OHR3 and 17∼21 MPa for KWD2, and the maximum effective pressure of the fracture yield starting cycles are 5 MPa for OHR3, and as well as 3∼9 MPa for KWD2. The fracture closed cycles almost equal the yield conditions of the intact rocks, which corresponds with the previous study [1]. While, the fracture yield starting cycles tend to appear lower pressure conditions than the yield conditions of the intact rocks. This is possibly because of the degree of matching between the opposite surfaces of the fracture. The stress on contact area at the fracture is larger than the effective stress applied on the specimen. In summary, the fracture closed conditions depend on the yield condition of rock, while the fracture yield starting conditions depend also on fracture condition.

Reference: [1] Uehara, S., Simamoto, T., Matsumoto, T., et al. (2011), Journal of MMIJ, Vol.127, 139-144.

Keywords: Fracture Permeability, Neogene Siltstone, Laboratory Permeability Test, Stress Dependency