Temporal change of permeability in macro-fractured granite by accumulation of fine-grained minerals

Yoshitaka Nara¹, Masaji Kato², Tsutomu Sato³, Masanori Kohno⁴, and Toshinori Sato⁵

¹Kyoto University, Kyoto, Japan (nara.yoshitaka.2n@kyoto-u.ac.jp)
²Hokkaido University, Sapporo, Japan (mk@eng.hokudai.ac.jp)
³Hokkaido University, Sapporo, Japan (tomsato@eng.hokudai.ac.jp)
⁴Tottori University, Tottori, Japan (kohnom@tottori-u.ac.jp)
⁵Japan Atomic Energy Agency, Horonobe, Japan (sato.toshinori@jaea.go.jp)

It is essential to understand the long-term migration of radionuclides when considering rock engineering projects such as the geological disposal of radioactive waste. The network of fractures and pores in a rock mass plays a major role in fluid migration as it provides a pathway for fluid flow. The geometry of the network can change due to fracture sealing by some fine-grained materials over long-term periods. Groundwater usually contains fine-grained minerals such as clay minerals. Therefore, it is possible that the accumulation of such fine-grained minerals occurs within a rock fracture under groundwater flow. In this case, the aperture of a fracture may decrease, which brings about the decrease of the permeability. It is therefore essential to conduct permeability measurements using water including fine-grained minerals in order to understand the permeability characteristics of a rock. However, this has not been investigated well. In this study, we use a macro-fractured granite sample to investigate the temporal change of the permeability that occurs under the flow of water that includes two different amounts of clay.

It was shown that the clay accumulated in the macro-fracture and that the permeability of the macro-fractured granite sample decreased over time. It was also recognized that the decrease of the permeability was more significant under the water flow with the higher clay content. As a result of the observation using microscope, it was recognized that the clay minerals accumulated in the macro-fracture in the granite sample, which decreased the aperture of the fracture. We concluded that the accumulation of clay minerals in the fracture decreased the permeability of the rock. Furthermore, it is concluded that the filling and closure of fractures in rock is possible under the flow of groundwater including clay minerals.
