Evaluation of water-mineral interactions focused on uranium retention using microfluidic tests on thin sections

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Water-mineral interactions affecting radionuclide migration behaviours were investigated using microfluidic tests on groundwater and thin sections of core rocks from the Underground Research Tunnel (KURT) located in the Korea Atomic Energy Research Institute (KAERI), Daejeon, South Korea. Results of groundwater analysis showed that the groundwater of the KURT has high uranium concentration of 749.11 μg/L. Chemistry and mineralogy of core rocks were analysed through whole-rock analysis, X-ray diffraction (XRD) analysis, and thin section analysis. The results revealed that the fresh rock was mainly granite consisting of quartz, plagioclase, muscovite, biotite, and chlorite. Core rocks from the fracture zone had chlorite and laumontite as fracture filling minerals. For the microfluidic tests, retention properties of uranium in groundwater obtained from the KURT site onto primary and secondary minerals of core rocks were compared. Element distributions on thin sections before and after flowing groundwater onto the thin sections were determined using μ-XRF imaging methods. Results showed that uranium concentration in groundwater decreased and uranium appeared on thin sections after microfluidic tests. From the μ-XRF imaging, altered secondary minerals, especially chlorite, was revealed to have a high uranium sorption capacity. Muscovite, quartz, and plagioclase had a low affinity for uranium ions. Results of this study suggest that the microfluidic test can be useful for evaluating water-mineral interaction because the microfluidic test can more closely mimic water-mineral interactions and the mineral surface after interaction with water can be analysed without disturbance of the sample.