Sorption and transport behavior of radionuclides in fractured rock at the LILW Disposal Facility

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Adsorption experiments for radionuclides such as ^{3}H, ^{90}Sr, and ^{99}Tc were conducted using fractured rock collected in the unsaturated underlying the site of the Wolsong low- and intermediate-level waste (LILW) repository. The interaction of released radionuclides and fracture-filling materials controls the rate of migration of radionuclides in an aquifer. Therefore, it is important to investigate transport behavior (retardation) of radionuclides through fractured rock for when assessing the safety and long-term performance of a repository. Fractured rock samples were characterized by X-ray microtomography (XMT) analysis, which can be used to develop a more robust unsaturated fracture transport model. The objective of this work was to investigate the sorption and transport behavior of radionuclides including measurements of the distribution coefficient (K_d) values of ^{3}H, ^{90}Sr, and ^{99}Tc for fractured rock sampled at the Wolsong LILW repository.

Results

The coating/filling materials of fractured rock were analyzed, and most (87%) of them were found to be zeolite (heulandite 32%, laumontite 55%).

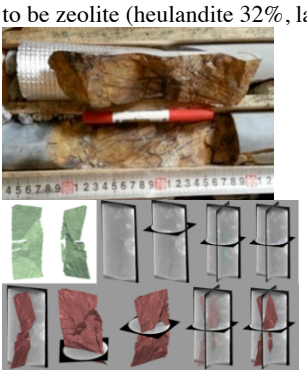

Fig.1. Fractured rock sample and the result of XMT for core sample with fractures

Table 1. Distribution coefficient of ^{90}Sr and ^{99}Tc (pH of groundwater: 6.8; initial concentration of radionuclides: ^{3}H: 100 Bq/mL, ^{90}Sr: 20 Bq/mL, ^{99}Tc: 100 Bq/mL; the amount of rock sample: ^{3}H: 1.0 g, ^{90}Sr: 0.5 g, ^{99}Tc: 1.0 g; w/: with, w/o: without)

K_d (mL/g)	^{90}Sr	^{99}Tc
w/ fracture filling rock	45.1	0.9
w/o fracture filling rock	30.3	1.1

When fracture-filling materials were present, the K_d of ^{90}Sr was higher than that of ^{90}Sr with no fracture-filling materials. The affinity of ^{90}Sr to fracture-filling materials can affect results. However, the result for ^{99}Tc was different than for ^{90}Sr. The K_d of ^{99}Tc for samples with and without fracture-filling rock was similar. The fracture-filling material did not affect ^{99}Tc adsorption.

XMT imaging is capable of displaying spatially