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Retardation behavior of Sr and Cs in Crushed and Intact Rocks : Two potential LLW repository Taiwan host rocks

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This study investigates sorption and diffusion of Strontium (Sr) and Cesium (Cs) in two potential host rocks (granite from Kinmen Island and basalt from Penghu Island) by using batch and through-diffusion methods in order to establish a reliable safety assessment methodology. These methods were applied to crushed and intact rock samples to investigate the actual geological environment. According to solid-phase analysis, including X-ray diffraction, elemental analysis, auto radiography, and polar microscopy, the sorption component primarily contained iron–magnesium (Fe–Mg) minerals in basalt and granite. Moreover, the distribution coefficient (K_d) of Sr and Cs in various concentrations ($\sim 10^{-2}$ – 10^{-7} M) obtained from batch tests indicated a higher sorption capacity in basalt than that in granite because of the 10% Fe–Mg mineral content. The diffusion of Sr and Cs both in crushed granite and basalt reach steady state after 110 days and apparent diffusion coefficient (D_a) were 3.29×10^{-11} m²/s (for Sr in crushed granite), 4.17×10^{-12} m²/s (for Sr in crushed basalt), 2.86×10^{-11} m²/s (for Cs in crushed granite), 1.82×10^{-12} m²/s (for Cs in crushed basalt), respectively. However, diffusive result (D_a) of Sr and Cs in intact rocks was estimated a lower value than those obtained using crushed rocks. According to the diffusive results in crushed and intact rocks, it showed that major retardation of Sr and Cs depended on the microporous structure of tested media, such as decreases of constrictivity (δ) and increases of tortuosity (τ). In fact, the solid/liquid (S/L) ratio decreased as is the case when switching from batch to column experiments and the sorption effect on minerals became even more negligible in retardation of radionuclide migration.

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