Sorption of ^{137}Cs onto a Muscovite-Rich Test Material from the Georgia Kaolins

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This study examined the ability of a weathered-muscovite-rich test material (76% muscovite, 21% kaolinite and 3% quartz) to sorb ^{137}Cs in a dilute NaCl solution (1 mmol/L; pH 5) over a 130-day test period at room temperature. Several test solutions for batch sorption experiments were created across a range of added stable Cs and Rb concentrations. Sorption of ^{137}Cs in the absence of added stable Cs and Rb yielded K_d values increasing over 130 days (1.49×10^3 L/kg to 2.25×10^4 L/kg) for ^{137}Cs sorption onto the test material. Addition of stable Cs to test suspensions produced decreased K_d values as a function of the concentration of stable Cs. K_d values were consistent with the Freundlich isotherm. The increase in K_d with time was also much greater for the smaller Cs additions than for the larger ones. The Freundlich exponent decreased with time—from near unity at the beginning to about 0.6 after 130 days. The increased K_d values with time indicated increasing sorption of ^{137}Cs in highly selective sites. However, the decrease in the Freundlich exponent also indicated involvement of less selective sites at higher Cs sorbed concentrations. Added Rb was mildly competitive with Cs, substantially suppressing Cs sorption only when 50x to 100x more Rb than Cs had been added. This study also examined the exchangeability of the sorbed ^{137}Cs via addition of Cs-free NaCl solutions (1 mmol/L and 10 mmol/L) and subsequent equilibration over a 130-day test period. K_d values for desorption in 1 mmol/L NaCl were an order of magnitude greater than the corresponding K_d values after 130 days of sorption. Thus, a large fraction (≈90%) of sorbed ^{137}Cs was interpreted to have become fixed at select high affinity sites within the test material. This weathered-muscovite-rich test material showed promise as a potential sorbent for aqueous ^{137}Cs in contaminated waste solutions.