Sorption of Cs-137 by muscovite separated from kaolin ore.

W. CRAWFORD ELLIOTT*[1] DOMINIQUE MOSES,[1] J. M. WAMPLER,[1] BRIAN A. POWELL,[2] DAVID M. AVANT, JR.[3]

[1]Department of Geosciences, Georgia State University, Atlanta, GA 30302
[2]Environmental Engineering and Earth Sciences, Clemson University, Clemson, SC 29625
[3]Georgia Industrial Minerals, Inc., Deepstep, GA 31082

Muscovite is a prevalent gangue mineral in the Georgia Kaolin deposits. This muscovite is separated from kaolin ore for use in many industrial products. To assess the suitability of such muscovite for the purification of radiocesium-contaminated water, a sample of muscovite separated from kaolin ore has been studied to determine its (1) mineralogical and chemical composition, (2) acid-extractable natural Cs and Rb, and (3) uptake of ^{137}Cs from dilute NaCl solution (1 mmol/L, pH 5) across a range of added stable Cs concentrations. This muscovite separate consists of 76% muscovite, 21% kaolinite, 3% quartz, and trace feldspar. The K_2O content of the separate (7.51 wt %) shows that the muscovite has about 15% less K_2O than ideal muscovite, indicating substantial loss of K from the muscovite interlayers by weathering. After 12 hours of contact in batch experiments, (non-equilibrium) K_d values for ^{137}Cs were 1995 ± 50 L/kg and Cs solid loading vs. Cs aqueous concentration was linear across a Cs concentration range of ~1×10^{-8} to ~6×10^{-6} mol/L. The average K_d value for Cs was not significantly different when Rb (10 μmol/L) was included with the ^{137}Cs and stable Cs in corresponding batch experiments. The linear behaviour indicates the exchange sites responsible for the high Cs uptake were not saturated with Cs despite the wide range in concentration. The linear K_d relationship and the large K_d values indicate that fine muscovite separated from kaolin may serve effectively as a practical sorbent for aqueous radiocesium. The insensitivity of the K_d values to added stable Cs may indicate fixation of Cs by collapse of K-depleted interlayer regions in frayed edges of the muscovite grains. If such a fixation mechanism can be confirmed, a possiblity exists for engineering the sorption process for maximum uptake of radiocesium.