

## **GEOCHEMICAL DYNAMICS OF CESIUM SORPTION BY SELECTED CLAY MINERALS (RADIOACTIVE WASTE)**

Noll, Mark Richard, PhD, University Of Delaware, 1989

### **Abstract**

This study focuses on the interactions of cesium with selected clay minerals. Cesium is of interest as it is a chief component of high level radioactive waste. Primarily, the thermodynamics and kinetics of Cs exchange reactions were investigated to determine the preference for Cs of a kaolinite, illite, and vermiculite.

Thermodynamic studies indicated that Cs was most strongly preferred by Ca saturated clays. Of the three minerals studied, illite proved to be the most effective in adsorbing Cs as indicated by the Vanselow Selectivity Coefficients ( $k_v$ ). The  $k_v$  values for illite ranged from 5.87 to over  $10^{10}$ , depending on the mineral and saturating cation.

Kinetics experiments proved to be the most interesting. On 2:1 clay minerals (illite and vermiculite), two simultaneous reactions are postulated. The first, and faster of the two reactions, is believed to correspond to Cs adsorption on surface planar sites. The second reaction may be the adsorption of Cs on interlayer and wedge exchange sites. Kaolinite only shows a single reaction since it is a 1:1 clay mineral. Rate coefficients were calculated and the first reaction was found to be on the order of one magnitude greater than the second reaction. The reactions on kaolinite were similar to this faster reaction. Desorption data indicated that the rate of desorption was one or more orders of magnitude less than the corresponding adsorption rate. It is important to note, however, that studies on the effect of temperature indicated that Arrhenius behavior is not followed in many of these experiments. It is postulated that changes in cation radius ratio, or the availability of exchange sites is causing this Anti-Arrhenius behavior.

Finally, it is concluded that illite exhibits the greatest preference for the adsorption of Cs. This would propose illite as a likely adsorbent material to be used in the disposal of high level radioactive wastes.