Adsorption of ^{137}Cs on Montmorillonite and Illite: Effect of Charge Compensating Cation, Ionic Strength, Concentration of Cs, K and Fulvic Acid

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Abstract: A thorough understanding of the capacity of clay minerals to adsorb radiocesium is essential in order to predict the fate of this pollutant in the environment and to interpret routine measurements, such as desorbability. We have investigated the adsorption of radiocesium onto 2 contrasting reference clay minerals in dilute suspensions after a 2-h contact period. The results have been expressed as the distribution coefficient, Kd, or the selectivity coefficient, Kc. The adsorption properties have been studied with respect to various parameters: nature of the charge compensating cation, ionic strength, concentration of Cs, concentration of K and concentration of a soil-extracted fulvic acid.

A Freundlich isotherm has been found to fit experimental data well for levels of adsorbed cesium in the range 10^{-7} to 1 mol kg^{-1}. Evidence of surface heterogeneity is discussed, but it was not possible to deduce the exchange capacities of the groups of exchange sites with differing affinities for Cs, which are thought to exist in illites. The concentration dependence of adsorption upon montmorillonite is postulated to arise from a modification of the exchange complex with increasing presence of Cs, rather than from heterogeneity of exchange sites. Increasing ionic strength caused a decrease in the relative affinity for a trace amount of cesium on both minerals, although mass action led to a fall in Kd. This is thought to indicate a high covalent interaction between Cs and the clay surface.

Potassium caused a smaller decrease in adsorption than stable Cs, which suggests that neither K nor NH_4 plays a decisive role in the immobilization of radiocesium by clay minerals. There was a small decrease in adsorption upon addition of soil organic matter, which may contribute to the poor fixation capacity observed for some soils with a high organic matter content.

Key Words: Cesium • Illite • Ion Exchange • Montmorillonite • Radiocesium • Selectivity • Soil

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