Inhibitive effects of clay particle organization on cesium desorption: Prediction of intrinsic cesium desorption from Na-smectite in cation solutions

K. FUKUSHI*, K.ASAHI, T. FUKIAGE AND H. SAKAI

Kanazawa Univ., Kanazawa, Ishikawa, 920-1192, Japan (*correspondence: fukushi@staff.kanazawa-u.ac.jp)

Fine clay particles have functioned as transport media for radiocesium in terrestrial environments after nuclear accidents. Because radiocesium is expected to be retained in clay minerals by a cation exchange reaction, ascertaining trace cesium desorption behavior in response to changing solution conditions is crucially important. Natural water is usually a mixture of Na^+ and divalent cations (Ca^{2+} and Mg^{2+}). This study therefore investigated the desorption behavior of intrinsic Cs in smecite in single and mixed Na^+-divalent cation solutions under widely various cation concentrations using batch experiments, in-situ grain size measurements, and cation exchange modeling (CEM) (Fukushi et al. 2014; Fukushi and Fukiage, 2015). The results from the single cation additions demonstrated that the spatial organization of the smectite platelets triggered by the divalent cations led to the apparent fixation of intrinsic Cs in smectite, because some Cs is retained inside the formed tactoids. The results from the mixed Na^+-divalent cations additions showed that increased Na^+ concentrations facilitate Cs desorption because Na^+ serves as the dispersion agent. A linear relation was obtained between the logarithm of the Na^+ fraction and the accessible Cs fraction in smectite. That relation enables the prediction of accessible Cs fraction as a function of solution cationic compositions. The corrected CEM considering the effects of the spatial organization suggests that the stability of intrinsic Cs in the smectite is governed by the Na^+ concentration, and suggests that it is almost independent of the concentrations of divalent cations in natural water.

Fukushi K., Sakai H., Itono T., Tamura A. and Arai S. (2014) Desorption of intrinsic Cesium from Smectite: Inhibitive Effects of Clay Particle Organization on Cesium Desorption. *Environmental Science and Technology*, 48, 10743-10749

Fukushi K and Fukiage T (2015) Prediction of intrinsic cesium desorption from Na-smectite in mixed cation solutions. *Environmental Science and Technology*, 49, 10398-10404