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Cesium adsorption on redox zone pumice tuff at different geochemical condition

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Non-redox-sensitive element Cesium (Cs) was used to investigate the ionic strength effect on the adsorption behavior on a potential host rock for low and intermediate radioactive wastes. Now-a-days, formation of redox zones in subsurface host rock formation surrounding radioactive disposal facility is a major concern. As such, different geochemical reactions during water-rock interaction around the disposal facility have gained interest to nuclear researchers. The present study attempts to compare the adsorption phenomena, an important geochemical reaction in waste disposal research field, between fresh rock and rock from such redox zone of an underground research facility of Japan. The surrounding rock formation is rhyolitic pumice tuff belong to tuffaceous sandstone which has been affected by redox environment and oxidation to the rock formation has been greatly observed. Physical, mechanical and chemical analyses were carried out to distinguish between fresh and oxidized solid phase. Batch adsorption study was carried out at different geochemical condition including several initial nuclide concentration of Cs, ranging from 10^{-3} mol/dm^3 to 10^{-7} mol/dm^3; wide range of pH from 4-12, and very low to very high ionic strength ranging from 0.001 to 3.0 mol/dm^3. The ionic strength was controlled by Na^+ ion concentration of $NaClO_4$. Based on experimental distribution coefficient values, K_d, ionic strength was found to be the most influential for Cs adsorption on both oxidized and fresh pumice tuff. With increasing salt concentration, the K_d of cesium apparently decreases, reflecting the competition of the electrolyte Na^+ with the sorption of Cs^+. However, such salt concentration effect became minimum at higher nuclide concentration due to its saturation capacity and a threshold concentration has been observed. Oxidation of pumice tuff did not affect the adsorption of Cs significantly even at variable salt concentration, due to being redox inactive element. Simple surface complexation model without considering the electrostatic layer has also been adopted to explain the adsorption mechanism.

Keywords: Cesium, Redox zone, Pumice tuff, Salt concentration, Adsorption coefficient, Surface complexation model