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Influence of highly concentrated K^+ solutions on Ca-bentonite properties at 150 ℃

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Bentonite buffer in deep geological repositories for high-level radioactive waste (HLW) can contact groundwater of various chemical compositions. In particular, groundwater containing K^+ ions can affect the stability of bentonite buffer. In additon, the temperature may increase due to the radioactive decay of HLW. This study aimed to evaluate bentonite stability in contact with highly concentrated K^+ solutions with different pHs at 150 ℃. Batch reaction tests with Ca-bentonite were conducted in Teflon stainless steel reactors for 30 – 150 days. Deionized (DI) water (pH = 6.0), 1 M KCl (pH = 6.0), and 1 M KOH (pH = 13.8) solutions were used as reaction solutions. After completing the batch reaction tests, the mineralogical and physicochemical characteristics and Cs adsorption capacity of the reacted samples were investigated. The characteristics of the reacted sample in DI water were similar to those of the unreacted sample. In 1 M KCl solution, cation exchange of Ca with K and the transformation of smectite to non-expandable illite-smectite mixed layers were observed. However, no significant changes in the physicochemical properties and Cs adsorption capacity appeared. In contrast, in 1 M KOH solution, minerals in the bentonite samples were almost completely transformed into zeolite minerals after 150 days of reaction. Significant changes in the physicochemical properties, in particular, a decrease in the free swell capacity, appeared, but Cs adsorption capacity increased up to 2 times that of raw bentonite. These experiments were intended to qualitatively evaluate the mechanism and influencing factors of bentonite alterations under extreme experimental conditions, although the conditions did not reflect the actual repository environment.