

Geochemical modelling of formation of secondary minerals and sorption of various anions under hyperalkaline conditions

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In Japanese transuranic (TRU) waste disposal facilities, ¹²⁹I is the most important key nuclide for the long-term safety assessment. Thus, the K_d values of I to natural minerals are important factor in the safety assessment. However, the degradation of cement materials in the repositories can produce high pH pore fluid which can affect to anion transport behavior. Therefore, it should be necessary to understand behavior of anions such as I⁻ under the hyperalkaline conditions.

Natural hyperalkaline spring water (pH>11) has known to generate from the partly serpentinized peridotite in the Oman ophiolite. The spring water is characteristically hyperalkaline, reducing, low-Mg, Si and HCO₃⁻, and high-Ca, while the river water is moderately alkaline, oxidizing, high-Mg and HCO₃⁻. The mixing of these spring and river water resulted in the formation of secondary minerals. Naturally-occurring hyperalkaline conditions near the springs in Oman were used as natural analogue for the interaction between cement pore fluid and natural Mg-HCO₃⁻ groundwater. The present aim of this paper is to examine the conditions of secondary mineral formation and the anion uptake capacity of these mineral in this system.

Water and precipitate samples were collected at the different distance from the spring vent to identify the effect of mixing ratios between spring and river water on mineral composition and water-mineral distribution coefficient of various anions. On-site synthesis was also carried out to support these data quantitatively.

Aragonite was observed in all precipitates, while calcite, brucite and Mg-Al hydrotalcite-like compounds (HTlc) were also determined in some samples. Calcite was observed only near the springs. At far from the springs, calcite formation was inhibited due to high-Mg fluid from river water. brucite was observed at the springs with relatively low-Al concentration and HTlc was the opposite.

During the formation of the minerals at the mixing points, HCO₃⁻ in the river water was fixed as carbonate minerals such as aragonite and calcite while H₃SiO₄⁻ in the river water was dominantly fixed into interlayers and surfaces of HTlc. Iodine in spring and river water was mainly fixed in aragonite. Consequently, even for I⁻, uptake by secondary minerals is fully expected at hyperalkaline conditions as observed at Oman hyperalkaline springs.

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