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Comparative study of chloride and iodide diffusion in compacted bentonite

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In the many concepts of high level radioactive waste repository (HLWR), compacted bentonite is planned as a buffer/backfill material due to its very low permeability and high sorption capacity. However, anionic species such as as 36Cl-, 129I- are not retarded due to their negligible interaction with engineered and/or natural barriers and may migrate to the biosphere much faster than cationic species. Chloride and iodide are the most stable species under in situ conditions of the deep repository and thus significantly contribute to the potential overall long-term dose. The transport of chloride and iodide in the bentonite barrier can be reduced by anion exclusion effect, which occurs due to the electrostatic repulsion of anions from negatively charged surfaces of clay minerals. Therefore, this work was focused on the fundamental understanding of diffusive behavior of chloride and iodide anions in compacted bentonite. In order to demonstrate the anion exclusion effect, chloride and iodide diffusion experiments were further compared with diffusion experiments performed with neutral species in form of tritiated water.
A set of through-diffusion experiments on the compacted bentonite B75 (commercial milled and homogenized bentonite originated from Rokle deposit, Czech Republic) at different dry densities was performed. Chloride and iodide in trace concentration (as 36Cl and 125I; radioanalytical detection) as well as in non-active form in concentration of 0.01 mol/L (ion selective electrode detection) were used. All experiments were performed under ambient condition and at the ionic strength of 0.1 mol/L in order to compare diffusive behavior of these anions.
Apparent and effective diffusion coefficients were evaluated from two types of data sets (break-through curves and concentration profiles), using own computer module EVALDIFF. No significant difference in diffusive behavior of chloride and iodide was observed despite the fact that chloride and iodide differ in the ionic radius and charge density.

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