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Effects of the hydrogeochemical variability of pore water in the Opalinus Clay and its surrounding aquifers on uranium migration

Pore water and groundwater from the containment providing rock zone (CRZ) and surrounding aquifers provide the initial chemical conditions and boundaries for reactive transport simulations of radionuclide migration in the context of the disposal of highly radioactive waste. Hydrochemical differences between these units cause gradients in the pore water profile across the CRZ, which affect sorption, diffusion and thus migration of radionuclides, like uranium. However, pore water and groundwater compositions differ on the spatial and temporal scales relevant to safety assessments. To quantify the impact of this variability, we performed one-dimensional simulations of uranium migration through Opalinus Clay using the geochemical code PHREEQC, varying both initial and boundary conditions. Our results show that uranium migration distances differ by several decametres over one million years depending on the initial pore water composition in the CRZ. Variations in groundwater chemistry only affect natural uranium concentrations close to the contacts between CRZ and its bounding aquifers. Consequently, the pore water composition in the CRZ is more decisive for uranium migration than hydrochemical variations in embedding aquifers.

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