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Can microorganisms significantly influence cast iron corrosion in a DGR?

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For the safe storage of high-level radioactive waste (HLW) in deep geological repositories (DGR), several metals could potentially act as canister material and are under investigation with respect to their properties under disposal-relevant conditions. An essential requirement for the selected metal(s) is the long-term stability which is mainly realized by the resistance to corrosion. The process of corrosion depends on the overall environment in the surrounding of the metal canister and which will change over time. Here, parameters like redox potential, pH, the presence of (pore-) water, the salinity and also the presence of metabolically active microorganisms are of relevance, among others. In order to analyze the influence of different pore waters and the natural microbial community of a Bavarian bentonite, which acts as geotechnical barrier and will be in direct contact to the canister, microcosm experiments were set up. These slurry experiments contained B25 bentonite, synthetic Opalinus Clay pore water or saline cap rock solution as well as copper- or cast iron plates in various combinations. During an incubation time of 400 days under anaerobic conditions at 37 °C, several bio-geochemical parameters (e.g. pH, redox potential and the concentration of minerals, sulfate, iron(II/III) and organic acids) were analyzed as well as the corrosion process and a potential microbial influence. The obtained results provide insights into the complex interplay between bentonite, pore water, metals and microorganisms. Different precipitates like carbonates, iron oxides and sulfides were identified on the cast iron surface, potentially accelerating or slowing down the corrosion process and, thus, affecting the long-term stability of the metal canister in a DGR.