Microbial community of MX80 bentonite and their interaction with iron

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MX80 bentonite clay has been selected as the buffer and backfill in a proposed method of long-term deep geological storage of nuclear waste in the UK. Extensive studies have been carried out on the geomechanical properties of the clay; however, it is not clear what effect microbes will have on its ability to function as an effective barrier. Specifically, in the UK, iron-reducing bacteria are of interest, as carbon steel waste canisters will contribute iron oxides and rust products to the immediate environment.. Iron-reducing bacteria can reduce structural or external Fe(III) to Fe(II) and some are adapted to high temperatures and low water availability, in keeping with conditions within the repository. Iron-interacting bacteria have been isolated from compacted MX80 bentonite from the Swedish Nuclear Fuel and Waste Management Company (SKB) facility and microbially-influenced iron-reduction was observed up to a groundwater salinity of 0.45M NaCl. Experiments were carried out with the indigenous MX80 community and various iron substrates. Direct and indirect interactions were observed through a series of plate and liquid experiments. Fe(II), Fe(Total) and pH were measured throughout the respective experiments and all substrates were collected and analysed by XRD, SEM and EDX analysis. Significant differences in structure and appearance of MX80 were seen in all indirect interaction experiments. These changes could greatly affect the mineralogy of the MX80 and its ability to act as an effective barrier because bacterial obstacles such as pore size, water availability and temperature do not apply as secreted metabolites are small enough to travel through the barrier. Direct interaction experiments showed evidence of micropitting and surface colonisation on compacted MX80. Additionally, silica release coupled to metal / microbe interactions was observed. Transformation of clay minerals through iron reduction or release of silica to groundwater could significantly impact the geomechanical properties of MX80, specifically its ability to swell, and thus negatively affect the function of the barrier.