Microorganisms present in bentonites from a deep underground experiment

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The deep geological repository is one of the internationally accepted options to dispose highly radioactive waste. For this, a multi-barrier system where the radioactive waste will be encapsulated in a technical barrier (metal containers) surrounded by a geotechnical barrier (e.g. compacted bentonite) deep underground in a stable geological formation (host rock) can be used. Bentonites might be used as sealing and backfilling material due to their good properties such as high swelling capacity and low hydraulic conductivity. However, indigenous microorganisms and those introduce during the repository construction and operation can affect these properties.

Bentonite core samples were collected from the Full-scale Engineered Barrier Experiment (FEBEX) in the frame of the FEBEX-Dismantling Project [1] at the Grimsel Test Site (Switzerland) to study their microbial diversity. For that, total DNA was extracted directly from the cores. In addition, sulfate- and iron-reducing microorganisms were enriched from the bentonite samples using specific media. From those enrichments total DNA was extracted and sulfate- and iron-reducing microorganisms were isolated. The microbial communities of the cores, the enrichments, as well as the isolates were analyzed by 16S rRNA gene sequencing. The results showed that the FEBEX bentonite microbial population was directly affected by the continuous high temperature. The dominant phylum in both enrichments was Firmicutes. *Desulfosporosinus*, *Clostridium* and *Bacillus* spp. were identified from the medium for sulfate-reducers, while *Desulfitobacterium* and *Bacillus* spp. were detected in the iron-reducing enrichment. Pure cultures were isolated from both enrichments, identifying spore-forming bacteria.

This study revealed that microorganisms were detected on the FEBEX bentonite after almost twenty years of continuous heating. Sulfate- and iron-reducing microbes were enriched by using favorable conditions in specific media. Therefore, it is important to characterize the microbial population of the bentonite used as geotechnical barrier, because microbes might compromise the safety of the deep geological repository of highly radioactive waste.

[1] http://www.grimsel.com/gts-phase-vi/febex-dp/febex-dp-introduction