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Biodiversity of sulphate reducing bacteria in Boom Clay

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The Belgian program for High Level Waste considers geological disposal in clay as the primary option for final disposal. In this frame Boom Clay is studied as the reference host rock.

Boom Clay is present at a depth of 190 to 293 m at the reference site in Mol, which is located in the northeast of Belgium. Boom Clay is a sedimentary deposit with a water content of 20 % and siliciclastic minerals, fossils and organic matter (1-5 wt%) as main components.

Microbiological research within the Belgian program is focussed on three major groups of microorganisms: sulphate reducing bacteria (SRB), nitrate reducing bacteria (NRB) and methane producing bacteria (MPB). MPB are studied with respect to their influence on the pCO_2 of the clay water, which is of importance for the interpretation of the chemical analysis results of pore water. The NRB may transform the large amount of nitrate present in bituminized waste to gaseous components. Finally, the SRB can have a major impact on corrosion, due to the formation of sulphide.

The Boom Clay formation contains substantial amounts of pyrite (1-5 wt%), which is partly oxidized during excavation of the gallery resulting in high amounts of sulphate in the excavation disturbed zone. The sulphate can be reduced by the SRB yielding sulphide. A good understanding of this cycle and the impact of SRB on microbially influenced corrosion under these particular environmental conditions is important for safety assessment. Therefore, the focal point of our research concerns the presence and activity of SRB in Boom Clay.

The supercontainer design attempts to counter the negative influence of the SRB by imposing harsh conditions. The stainless steel container will be surrounded by a carbon steel overpack, 1,5 m of concrete and a stainless steel envelope. The concrete provides a pH of 13,5 combined with a temperature of 80˚C (during the thermal phase) at the concrete-clay interphase. Experiments are foreseen to investigate if these conditions are appropriate to suppress the activity of SRB.

Early measurements showed high concentrations of hydrogen sulphide (150 ppb) in sampled clay water. Biochemical analysis of these samples is being performed using a variety of different techniques. Most probable number determinations have been done to estimate the size of the SRB population. DNA extractions of the original water samples and enrichment cultures were performed. The DNA extracts are currently being used for community analysis using 16S, aps-A and dsr-AB primers. The method of choice for evaluating bacterial diversity is terminal restriction fragment length polymorphism.