Rates of Hydrogen and Sulfate Consumption by Microbes in Radioactive Waste

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An important step to evaluate the potential impact of biogeochemical processes on the safety of deep geological radioactive waste repositories is the identification and quantification of the metabolic reactions of the present microbiota. The main gas expected to evolve from waste degradation and metal corrosion in the waste is hydrogen (H_2), followed by methane (CH_4). The gas pressure build up in a geological repository may potentially harm the integrity of the hostrock and thus needs to be carefully considered. The Swiss concept for a geological repository for low and intermediate waste is currently exploring the utilization of the microbial metabolic potential to consume H_2 produced by the corrosion of steel. For this purpose, operational tunnels could be backfilled with materials engineered to provide sufficient porespace for microbial growth, which may allow for the biological consumption of excess gases via sulfate reduction. Here, we present the first results of an *in situ* small scale test in Opalinus Clay rock in the Mont Terri Underground Rock Laboratory in St.-Ursanne, Switzerland. We stimulated the formation of a hydrogen-fueled biofilm under repository relevant conditions in a pressure resistant bioreactor filled with sand:bentonite mixtures at varying ratios. Opalinus Clay pore water from a borehole drilled at the transition between shaley to sandy facies was supplied to the reactor. All experiments were performed under strictly anaerobic conditions in an *in situ* glovebox to minimize the influx of oxygen. Quantitative models of the deep biosphere metabolic potential will be built by identifying the resulting microbial communities and evaluating the rates of hydrogen and sulfate consumption. These models will allow the national authorities responsible for nuclear safety to refine their safety cases for the long term storage of radioactive waste.