Natural Analogues for Assessing Long-Term Durability of Sealing Materials under Highly Saline Groundwater Conditions

The Nuclear Waste Management Organization (NWMO) is responsible for the implementation of Adaptive Phased Management (APM), the federally-approved plan for safe long-term management of Canada's used nuclear fuel. Under the APM plan, used nuclear fuel will ultimately be placed within a deep geological repository (DGR) in a suitable rock formation. Both crystalline and sedimentary rock formations are being considered.

Also in Canada, the electric utility Ontario Power Generation (OPG) is proposing to build a DGR for the long-term management of its low and intermediate level radioactive waste in the sedimentary rock under the Bruce nuclear site in the Municipality of Kincardine.

For both DGRs, and in crystalline or sedimentary rock, it is proposed that the shafts of the repository be sealed using a combination of clay-, concrete-, and asphalt-based materials.

The specific sealing materials proposed are a bentonite-sand mix, a bitumen-sand-lime mix, and a low-heat concrete (low cement content). A particular requirement in the case of the sedimentary rock formations in the Michigan Basin in Southern Ontario is the high salinity of the porewater. The porewater chemistry within this geosphere is expected to be essentially Na-Ca-Cl brine at 260-370 g/L and near-neutral pH at 10 – 25 °C.

Natural analogues are of interest with respect to supporting the durability of these materials under saline low-temperature conditions. This presentation considers what may be the most appropriate natural analogues (studied to date) of the core materials – bentonite, asphalt, and cement.