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SIMULATING THE POTENTIAL FOR RADIONUCLIDE TRANSPORT FROM A PROPOSED DEEP GEOLOGIC REPOSITORY IN CANADA FOR LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE

Jonathan F. Sykes [*], Stefano D. Normani [*] and Yong Yin [*]

[*] Department of Civil and Environmental Engineering, Univ. of Waterloo,
Waterloo Ontario Canada N2L 3G1
e-mail: sykesj@uwaterloo.ca

Summary. A Deep Geologic Repository (DGR) for Low and Intermediate Level Radioactive Waste has been proposed by Ontario Power Generation at the Bruce site near Tiverton, Ontario, 225 km northwest of Toronto. The DGR concept envisions a repository excavated at a depth of 680 m within the low permeability (less than 10^{-14} m/s) limestone Cobourg Formation beneath 200 m of Ordovician age shale. Regional-scale (18,500 km^2) and linked site-scale (360 km^2) density-dependent flow system evolution was investigated using the FRAC3DVS-OPG flow and transport model. Important in the prediction of possible radionuclide transport from the DGR is site borehole data that indicate that the Ordovician is significantly underpressured with-respect-to the surface elevation while the underlying Cambrian sandstone is significantly overpressured. Hypotheses of the cause of the abnormal pressures includes glaciation/deglaciation cycles, mass removal of the Mesozoic at a rate that is greater than that of groundwater influx to the dilating Ordovician, and the possible presence of an immobile gas phase in the Ordovician. The model FRAC3DVS-OPG and the model TOUGH2-MP for gas and density-dependent water flow, were used to interpret the site hydraulic and geochemical data and to estimate radionuclide transport from the proposed DGR. Simulated geochemical data included the isotope $\delta^{18}O$. The study benefitted from the availability of a very detailed data set for rock-dependent diffusivity coefficients. Regardless of the explanation of the cause of the abnormal pressures in the Ordovician or the possible presence of a gas phase, radionuclide transport is diffusion dominant. From a system perspective, the pathway for a radionuclide migrating from the DGR to the biosphere will follow either the overlying Niagaran dolostone or the underlying Cambrian sandstone. Given the low horizontal gradients in these units and the relatively impermeable Salina above the Niagaran, Mean Life Expectancies for the DGR are greater than 10 ma.