Reservoir Response to Heat Generating Nuclear Waste Disposal in Bedded Salt

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The disposal of heat generating nuclear waste is increasingly becoming a concern for several countries worldwide. This issue is of particular concern for the United States because of the 364,000 m$^3$ of heat-generating nuclear waste currently in temporary storage. Numerous concepts for the disposal of heat generating nuclear waste have been investigated internationally, such as, mined repositories in crystalline, argillite, and salt formations, and deep borehole disposal. Currently, salt formations are being investigated as candidate disposal host rocks for heat-generating nuclear waste in the United States, Germany, the Netherlands, and the United Kingdom. Salt formations may be an ideal host media due to salt's extremely low permeability, high thermal conductivity, and self-healing capability. Salt lacks circulating groundwater, but it is not dry. Brine availability in salt has multiple implications for the safety and design of a nuclear waste storage facility. Brine transport is a potential off-site radionuclide transport vector, brine leads to corrosion of metallic and glass waste forms and waste packages, chloride in brine can reduce criticality concerns, and accumulated brine can provide back-pressure that resists long-term creep closure of porosity associated with mining the repository. In order to improve understanding of brine migration in heated salt, borehole heater experiments are being conducted at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. The salt heater test collaboration aims to collect data to gain a better understanding of brine availability, transport, and thermal evolution of salt in response to heating up to 140 °C. Due to the complex nature and coupled processes that take place within bedded salt, this study will utilize 1D, 2D, and 3D numerical simulations of the salt heater test to deconvolve the parametric controls on brine availability and migration. The purpose of this study is two-fold, in addition to understanding the hydrogeology of salt formations, we utilize two different subsurface flow codes in a code comparison study, TOUGH and PFLOTRAN. Preliminary results from this study illustrate the importance of understanding the host rock properties and the initial/boundary conditions of the salt and multiphase fluid flow near the excavation site.

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