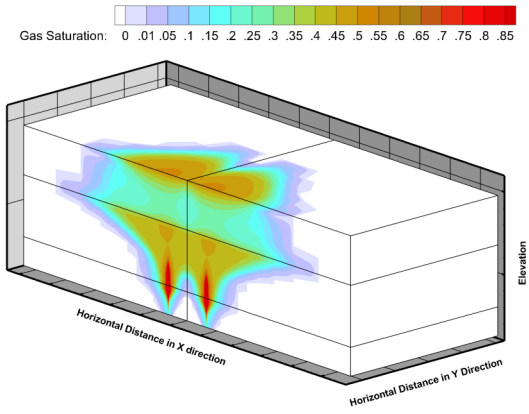
Numerical Modeling



Since our founding in 1974, the development and application of numerical models and other quantitative decision support tools have been core competencies of INTERA. Under contracts with the United States Geological Survey and Sandia National Laboratories, we developed the first public domain groundwater flow and transport modeling simulators capable of treating variable fluid density, dual porosity (i.e., fractured media), and multi-chain radionuclide transport. This code, called SWIFT (Sandia Waste Isolation Flow and Transport), became the standard code for deep-well injection modeling for the USEPA's Underground Injection Control (UIC) program.

Conducting sophisticated, multiphase subsurface modeling is one of the most significant hurdles in the permitting of Class VI injection wells. INTERA staff bring decades of experience using multiphase simulators such as STOMP (Subsurface Transport Over Multiple Phases) and TOUGH for a number of applications including injection of CO_2 in saline and basalt reservoirs, coupled heat and mass transfer, enhanced oil recovery, and reactive transport. INTERA staff have been co-developers of STOMP, contributing in particular, to capabilities such as a fully coupled well model, extension of conventional capillary pressure and saturation functions to account for dessication due to CO_2 injection, and the vertically integrated mass per area (VIMPA) method to quantify CO_2 plume extent.

We apply these tools to evaluate reservoir injectivity, estimate CO_2 storage capacity and plume development, assess reservoir pressure management options, determine threshold pressure fronts, and delineate an Area of Review (AoR). INTERA has also completed simulation-based design of gas injection tests to estimate gas threshold pressure in low permeability formations. INTERA staff are experts in applying multiphase codes to complex subsurface systems.

Numerical Modeling to Support Permitting of Class IV Injection Wells for the FutureGen 2.0 Carbon Capture and Storage Demonstration Project, Morgan County, Illinois, USA

Challenge: To obtain Class VI permits from USEPA for commercial scale geologic storage of CO_2.

Solution: Several current INTERA staff members, during their previous employment with Pacific Northwest National Laboratory (PNNL), simulated the injection and redistribution of supercritical CO_2 ($scCO_2$) in the Mt Simon sandstone using the STOMP-CO2 simulator. An injection rate of 1.1 million metric tons per year was distributed among four lateral wells in a highly stratified reservoir for a duration of 20 years. A local sensitivity analysis was conducted to evaluate reservoir injectivity and plume area and additional simulations were conducted to evaluate the potential for water-quality impacts associated with potential $scCO_2$ and/or brine leakage resulting from $scCO_2$ storage operations. These simulations supported the injection well and operational design, the Area of Review and corrective action plan, the testing and monitoring plan, and the post-injection site care (PISC) and site closure plan components of the Class VI injection well permits.

Results: In 2014, FutureGen 2.0 received the first-ever USEPA permits for four Class VI CO_2 injection wells to store a total of 22 million metric tons of CO_2.