Geologic Carbon Storage of Anthropogenic CO2 in the Navajo Sandstone Formation under Castle Valley, Utah

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Abstract
Geologic carbon storage (GCS) is a promising technology for storing large volumes of anthropogenic CO2 effectively and permanently. Numerical simulations are an integral part of site selection and characterization for any promising GCS site. In this study, we simulate injection of CO2 for geologic storage in the Navajo Sandstone Formation near Castle Valley, Utah, a promising storage complex for commercial-scale sequestration. Sources of CO2 include five regional power plants along with CO2 from heavy industries, like cement, oil, and petrochemical refineries.

As part of the CarbonSAFE Rocky Mountains Phase 1 project, a regional capacity analysis was undertaken. A geological model of the area encompassing Castle Valley, including the San Rafael Swell, is constructed from well tops, well logs, and outcrop data. Based on the geologic model, we developed a simulation grid that includes the Chinle Formation at the base, the Glen Canyon Formation consisting of the Wingate Sandstone, the Kayenta Formation, and our target injection formation the Navajo Sandstone, and the overlying Carmel Formation, a sealing layer. CO2 was injected over a 100-year period to simulate future commercial-scale injection to store emissions from the regional sources. We simulated systematic reduction of power generation from coal by shutting down CO2 sources (from the power plants) after 30 to 40 years of simulation time while maintaining emissions from the other heavy industries. Results indicate that this area has a capacity to securely store more than 1.4 billion tons of CO2, suggesting the complex is an ideal commercial-scale GCS site. This material is based upon work supported by the Department of Energy under Award Number DE-FO002580.

Results from 100 years of CO2 injection

CO2 Supercritical Phase Saturation

CO2 Injection Rate & Cumulative Injection

Radiative permeability and capillary pressure relationships for each of the three zones identified in the Navajo Sandstone. The Wingate, Kayenta, Carmel, and Chinle formations were assigned generic relative permeability and capillary pressure curves due to lack of formation specific data.

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