Integrated Characterization of CO_2 Storage Reservoirs on the Rock Springs Uplift Combining Geomechanics, Geochemistry, and Flow Modeling

Award Number: DE-FE0023328

Project Summary:

The goal of this project was to increase the understanding of the effects of carbon dioxide (CO_2) injection and storage on geomechanical, petrophysical, and other properties in two potential reservoirs, the Madison Limestone, and the Weber Sandstone at the Rock Springs Uplift (RSU), in southwestern Wyoming. Rock physics studies, laboratory experiments, and computer simulations were employed. Two groups of rock samples were prepared, one aged with formation brine and the second aged with CO_2-saturated formation brine and subsequently used for geomechanical, geochemical, and petrophysical testing.

Prime Performer:
University of Wyoming

Principal Investigator:
John Kaszuba

Project Duration:
10/1/2014 – 9/30/2018

Performer Location:
Laramie, Wyoming

Field Sites:
Rock Springs Uplift, Wyoming

Program:
Carbon Transport & Storage

Figure 1: Map showing the location of the Rock Springs Uplift project study area outlined in yellow.

Project Outcomes:

The project culminated in a workflow to provide a sequence of steps to evaluate CO_2 storage in the Madison Limestone and Weber Sandstone at the RSU and to estimate CO_2 storage using multicomponent/multiphase flow simulations. The workflow is based on elements of geology, geochemistry, petrophysics, reservoir simulation, and geomechanics using current data from the RSU; and experimental results from petrophysical, geochemical, geomechanical, and multiphase flow experiments on rock and fluids characteristics of the RSU.

Researchers found time-lapse seismic data were not feasible for monitoring CO_2 displacement during injection or to mitigate leakage-risks situations at the RSU. Pressure and fluid saturation have small effects on elastic velocities and synthetic seismograms and may be challenging to capture because of the presence of noise in recorded data. Geochemical studies found that temporal and spatial heterogeneity of mineral dissolution and precipitation due to reaction with CO_2-saturated brine have a great effect on pore structure, net porosity does not change significantly, but redistribution of porosity affects permeability and connectivity, with implications for CO_2 injectivity, plume propagation and storage capacity. The geomechanical studies could not find a consistent relationship between stress data and reaction with CO_2-saturated brine.

Presentations, Papers, and Publications

Final Report: **Integrated Characterization of CO_2 Storage Reservoirs on the Rock Springs Uplift Combining Geomechanics, Geochemistry, and Flow Modeling** (December 2018) – Drs. John Kaszuba, Vladimir Alvarado, Erin Campbell, Dario Grana, Kam Ng, Erin Stoesz, Heng Wang, and Hua Yu