Optimizing Accuracy of Determinations of CO_2 Storage Capacity and Permanence, and Designing More Efficient CO_2 Storage

Award Number: DE-FE0009202

Project Summary:

This project focused on studying the performance of carbon dioxide (CO_2) storage at a potential Rock Springs Uplift (RSU) storage site in southwestern Wyoming using a multidisciplinary approach that integrates observational, experimental, and theoretical data with numerical simulations and determinations of seismic attributes. The objectives include: (1) reduce uncertainty in estimates of CO_2 storage capacity at the RSU; (2) evaluate and ensure CO_2 storage permanence at the RSU site by focusing on the sealing characteristics and 3D interval heterogeneity of the confining layers; (3) improve the efficiency of potential storage operations by designing an optimal coupled CO_2 injection/brine production strategy that ensures effective pressure management; and (4) improve the efficiency of brine production in the RSU relative to mineral scaling.

Prime Performer:
University of Wyoming

Principal Investigator:
Fred McLaughlin

Project Duration:
10/01/2012 – 09/30/2015

Performer Location:
Laramie, Wyoming

Field Sites:
Rock Springs Uplift, Wyoming

Program:
Carbon Transport & Storage

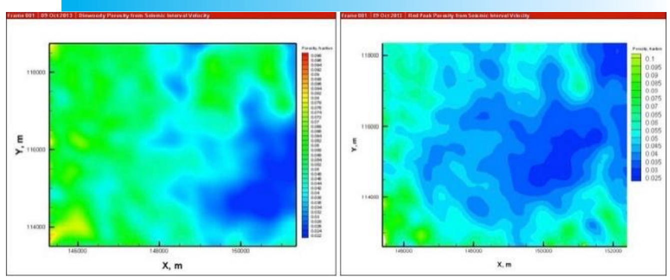

Figure 1: Contour map of the porosity distribution of the Dinwoody Formation (left) and Red Peak Formation (right). These maps serve as the basis for injection simulations.

Project Outcomes:

Four suites of field data were recognized as crucial for determining storage permanence relative to the confining layers: seismic, core and petrophysical data from a wellbore, formation fluid samples, and in-situ formation tests. Core and petrophysical data were used to create a vertical heterogenic property model that defined porosity, permeability, displacement pressure, geomechanical strengths, and diagenetic history. In-situ formation tests were used to evaluate fracture gradients, regional stress fields, baseline microseismic data, step-rate injection tests, and formation perforation responses. Seismic attributes, correlated with the vertical heterogenic property models, were calculated and used to create a 3D volume model over the entire site. Lastly, formation fluids were collected and analyzed for geochemical and isotopic compositions from stacked reservoir systems. The data was used to test various injection scenarios in a dynamic, heterogenic geologic property model that showed that the study site could retain 25 metric tons of injected CO_2 over an injection lifespan of 50 years. Findings indicate that active reservoir pressure management through reservoir fluid production (minimum of three production wells) reduced the risk of breaching a confining layer. A well completion and engineering study was incorporated to reduce the risks of scaling and erosion during injection and brine production. These scenarios suggest that the dolostone within the Mississippian Madison Limestone is the site's best injection/production target, confirming that there are multiple confining layers in southwest Wyoming that can retain commercial volumes of CO_2. This study also indicates that column height retention calculations are reduced in a CO_2-brine system relative to a hydrocarbon-brine system.

Presentations, Papers, and Publications

Final Report: [Optimizing Accuracy of Determinations of CO_2 Storage Capacity and Permanence, and Designing More Efficient CO_2 Storage] (December 2015) – Ramsey Bentley, Shanna Dahl, Allory Deiss, Andrew Duguid, Yuri Ganshin, Zunsheng Jiao, Scott Quillinan