Optimizing and Quantifying CO_2 Storage Resource in Saline Formations and Hydrocarbon Reservoirs

Award Number: DE-FE0009114

Project Summary:

The project sought to optimize carbon dioxide (CO_2) storage capacity and containment in critical geologic formations by establishing field methodologies focused on (1) the quantification and enhancement of CO_2 storage capacity in saline formations and (2) the optimization and quantification of CO_2 storage in hydrocarbon reservoirs in association with CO_2 enhanced oil recovery (EOR). The goal of the saline formation activities was to refine, as necessary, the equations to develop CO_2 storage capacity/resource estimates and the storage coefficients used to calculate those estimates based on regional-scale models. This project is building geologic models based on field data, performing simulations in different reservoir classes, and refining the storage coefficients and terms used to estimate storage resource in both saline formations and hydrocarbon reservoirs thereby contributing to better storage technology and thus reducing CO_2 emissions to the atmosphere.

Prime Performer:
University of North Dakota Energy and Environmental Research Center

Principal Investigator:
Charles D. Gorecki

Project Duration:
10/1/2012 – 6/30/2017

Performer Location:
Grand Forks, North Dakota

Program:
Carbon Storage

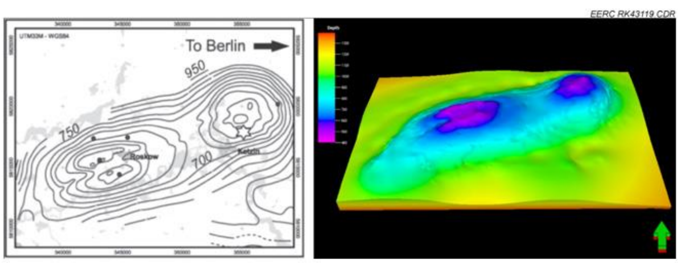

Figure 1: Stuttgart formation structural map (left) and modeled surface produced from data (right). (From: IEAGHG, "Extraction of Formation Water from CO_2 Storage", November 2012)

Project Outcomes:

The project classified potential saline formations for storage according to depositional environment. The study found that different degrees of lateral and vertical heterogeneity and ranges in petrophysical property characteristics in each depositional environment affect CO_2 injection rate by controlling fluid flow and pressure dispersion. CO_2 storage rates and efficiencies were evaluated using numerical simulation at the regional scale over a 100-year time frame. Eight facies models were constructed, representing seven clastic depositional environments (eolian, fluvial, deltaic, lacustrine, clastic shelf, clastic strand plain, and clastic slope) and three carbonate depositional environments (carbonate peritidal, carbonate shelf, and reef). The fluvio-deltaic and clastic shelf environments exhibited the greatest CO_2 storage rates. Though depositional environment affects storage rates, results suggested that the effect of depositional environment on CO_2 storage efficiency in saline formations is negligible in a closed system. The study also showed that storage efficiency values for CO_2 EOR are considerably higher than values for saline formations, since production of fluids in CO_2-EOR creates additional pore space into which the CO_2 can be permanently stored. Using lessons learned from this work, a best-practices manual was developed to guide users through a series of decision points to more accurately estimate the CO_2 storage resource potential in geologic formations.

Presentations, Papers, and Publications

Final Report: ***Optimizing and Quantifying CO_2 Storage Resource in Saline Formations and Hydrocarbon Reservoirs*** (June 2017) Nicholas W. Bosshart, Scott C. Ayash, Nicholas A. Azzolina, Wesley D. Peck, Charles D. Gorecki, Jun Ge, Tao Jiang, Matthew E. Burton-Kelly, Parker W. Anderson, Neil W. Dotzenrod, Andrew J. Gorz