Improved Characterization and Modeling of Tight Oil Formations for CO_2 Enhanced Oil Recovery Potential and Storage Capacity Estimation

Award Number: DE-FE0024454

Project Summary:

The project objective was to characterize and determine the carbon dioxide (CO_2) storage capacity and enhanced oil recovery (EOR) potential of the Bakken Formation. Specifically, the project developed methods to better characterize fractures and pores at the macro-, micro-, and nanoscale levels; identified potential correlations between fracture characteristics and other rock properties of tight oil formations, correlated core characterization data with well log data to better calibrate geocellular models; and evaluated CO_2 permeation and oil extraction rates and mechanisms. This project also generated data to further understand the roles that shale members play with respect to CO_2 storage, containment, and/or EOR.

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

Principal Investigator:
James A. Sorensen

Project Duration:
11/1/2014 – 10/31/2017

Performer Location:
Grand Forks, North Dakota

Program:
Carbon Transport & Storage

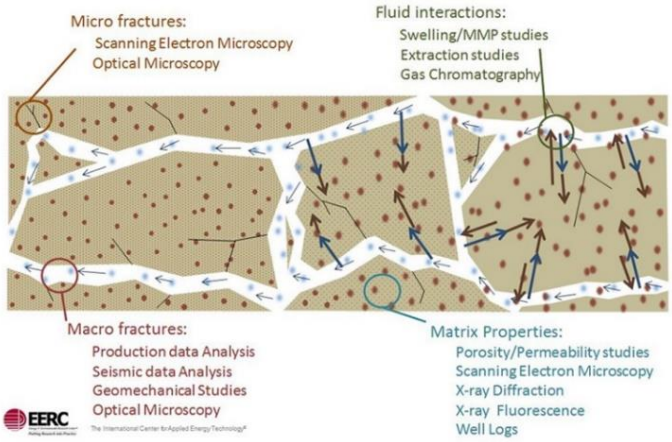

Figure 1: An illustration depicting the variety of ways in which CO_2 interacts with a tight oil reservoir and the technique that can be applied to evaluate those interactions.

Project Outcomes:

A combination of standard and advanced petrophysical characterization techniques were applied to characterize samples of Bakken Formation shales and tight reservoir rock from multiple wells. Techniques including advanced computer tomography (CT) imaging, scanning electron microscopy (SEM), whole-core and micro x-ray CT imaging, field emission SEM, and focused ion beam SEM were used to provide insight into nanoscale fracture properties, pore throat mineralogy and connectivity, and rock matrix characteristics, mineralogy, and organic content. Laboratory experiments demonstrated that CO_2 can permeate the tight matrix of Bakken shale and non-shale reservoir samples and mobilize oil from those samples. Geologic models were created at scales ranging from the core plug to the reservoir, and dynamic simulations were conducted. Simulation results suggest the use of CO_2 for EOR in the Bakken petroleum system may yield 1.8 billion to 16 billion barrels of incremental oil and have a CO_2 storage resource of between 169 million tons and 1.5 billion tons.

Presentations, Papers, and Publications

Final Report: **Improved Characterization and Modeling of Tight Oil Formations for CO_2 Enhanced Oil Recovery Potential and Storage Capacity Estimation** (March 2018) James Sorenson, Steven Smith, Bethany Kurz, Steven Hawthorne, Lu Jin, Nicholas Bosshart, Jose Torres, Carolyn Nyberg, Loreal Heebink, John Hurley