Development of Geomechanical Screening Tools to Identify Risk: An Experimental and Modeling Approach

Award Number: DE-FE0023314

Project Summary:

The goal of this project was to develop screening tools for improved understanding of reservoir geomechanical processes and conditions related to carbon dioxide (CO_2) storage including faults, fractures, and caprock flaws. Specifically, this project was conducting laboratory experiments to study petrophysical and hydro-mechanical properties of rocks under CO_2 storage conditions and using the findings from this effort to develop a simulator that can model two CO_2 storage field studies; the Frio pilot injection study in Texas and the Southeast Regional Carbon Sequestration Partnership (SECARB) Cranfield large-scale injection project in Mississippi. The results of these experimental and computational methods can be integrated to generate geomechanical screening tools that can be used for assessment of future CO_2 storage operations.

Prime Performer:
University of Texas at Austin

Principal Investigator:
Mary Wheeler

Project Duration:
9/1/2014 – 8/31/2017

Performer Location:
Austin, Texas

Program:
Carbon Storage

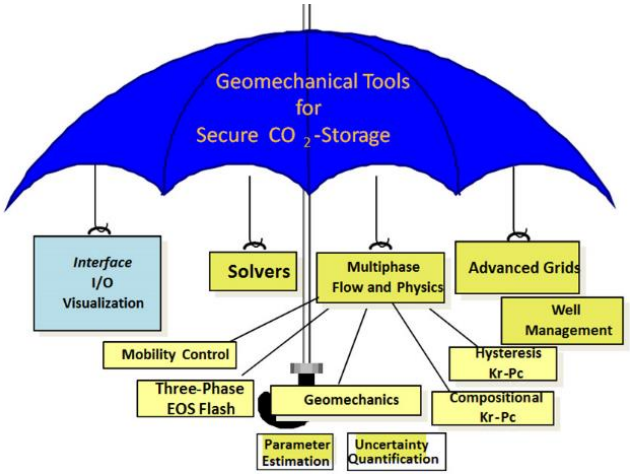

Figure 1. Depiction of the geomechanical tools that are part of the computational framework developed as part of this project.

Project Outcomes:

This project developed a coupled mathematical modeling and experimental framework that took into account the effect of rock heterogeneity on effective mechanical properties of the rock in contact with CO_2 (Figure 1). Accurate laboratory experiments were performed to determine the changes in rock mechanical properties due to mineral dissolution in the presence of carbonic acid generated by CO_2 injection. A two-scale adaptive homogenization framework was then developed to consistently upscale petrophysical and geomechanical properties to the field scale. The numerical model was then used to study field scale CO_2 sequestration problems for the two selected field sites: (1) the Frio formation and (2) the Cranfield site. Robust schemes were developed for field data assimilation and model calibration such that the residual uncertainty at the end of the data assimilation procedures can be faithfully represented while taking into account the coupled geochemical and geomechanical processes.

Presentations, Papers, and Publications

Final Report: Development of Geomechanical Screening Tools to Identify Risk: An Experimental and Modeling Approach for Secure CO_2 Storage Final Technical Report (December 2017) Mary Wheeler, Sanjay Srinivasan, David Espinoza