Characterizing and Interpreting the In Situ Strain Tensor During CO_2 Injection

Award Number: DE-FE0023313

Project Summary:

This project evaluated how subsurface strain measurements can be used to improve the assessment of geomechanical properties and advance an understanding of geomechanical processes that may present risks to subsurface carbon dioxide (CO_2) storage systems. Clemson University designed and built instrumentation for measuring the in-situ strain and evaluated its performance characteristics relative to the existing state-of-the-art instrumentation. Data acquired was used to develop analyses for characterizing the strain field associated with injection near the well and in the vicinity of critical features such as contacts and faults.

Prime Performer:
Clemson University

Principal Investigator:
Dr. Larry Murdoch

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

Performer Location:
Clemson, South Carolina

Program:
Carbon Transport & Storage

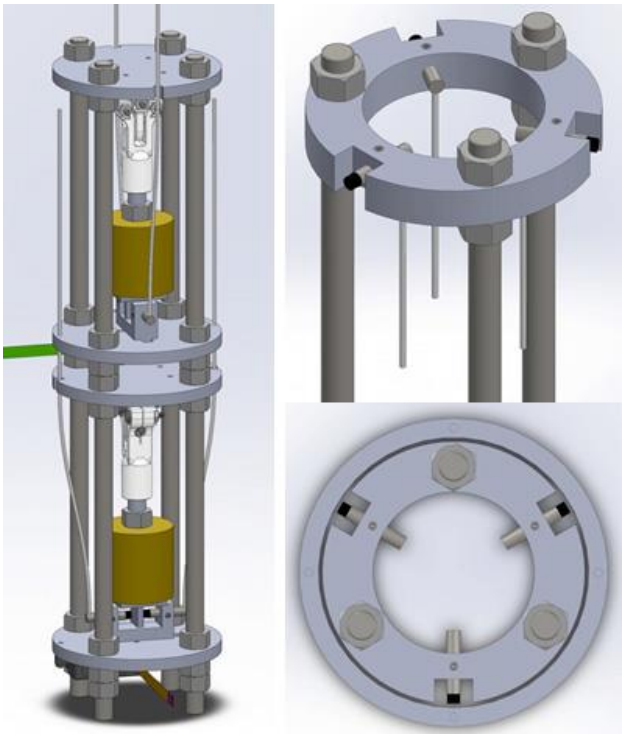

Figure 1: Depiction of the in-situ strain sensor that was developed as part of this project. The sensor was designed, tested, and evaluated for cost.

Project Outcomes:

This project demonstrated the feasibility of measuring the strain tensor at a depth of 30 meters (m) caused by injection into a reservoir at 530 m depth. An injection rate of 10 to 15 gallons per minute caused a strain rate of tens of nanostrain per day. Two new strainmeters were field demonstrated. A new optical strainmeter was particularly promising because it performed better than the current state-of-the-art strainmeter, and it could be constructed and deployed at a modest cost. The strain signals measured during a field test were similar to results from theoretical analyses of an idealized reservoir. Four different analyses were used to interpret the strain signal and the results were consistent with each other and independent measurements. These results are a proof-of-concept demonstration that the slow strain caused by injection can be measured and interpreted to obtain useful information.

Presentations, Papers, and Publications

Final Report: Characterizing and Interpreting the In Situ Strain Tensor During CO_2 Injection (June 2018) – Lawrence C. Murdoch, Scott DeWolf, Leonid N. Germanovich, Alexander Hanna, Robert Moak, Stephen Moysey