Los Alamos National Laboratory
Carbon Storage Activities

Award Numbers: FWP-FE-10-001; FWP-FE-452-14-FY15; FWP-FE-715-16-FY17; FE-819-17-FY17; FWP-FE-890-18-FY18; FWP-FE-1122-19-FY19; FWP-FE-1209-20-FY20

Project Summary:

This award consisted of multiple tasks focusing on enabling science that supports large-scale deployment of geologic carbon dioxide (CO_2) storage technology as part of the U.S. Department of Energy's program to mitigate anthropogenic emission of CO_2. This effort has involved multiple tasks over the years that focus on specific areas of research in the near-surface and subsurface:

- Wellbore and Seal Integrity
- Measurement, Verification and Accounting (MVA) Tools
- Systems Modeling and Science for Geologic Storage
- Monitoring for Faults at a Critical State of Stress
- Storage and Trapping of CO_2 in Multiphase Systems
- Novel Methods to Detect Small Leaks over Large Areas
- CO_2-Water-Rock Interactions

Project Outcomes:

Ongoing work at LANL is focused on the above areas. Outcomes that occurring from this work over the project time include:

- Novel reconstruction method (i.e., modified total-variation [MTV] regularization) to solve non-linear and ill-posed inverse problems in seismic imaging. The following algorithms were enhanced to improve velocity estimation, inversion accuracy, and reduce image artifacts:
    - Acoustic- and elastic-waveform inversion method (AEWI).
    - Double-difference acoustic- and elastic-waveform inversion method (Double-difference AEWI).
    - Least-squares reverse-time migration method (LSRTM).
- New inversion algorithms that improve velocity models for microseismic imaging. The location precision of microseismic events can be improved using a new method.
- **Storage and Trapping of CO_2 in Multiphase Systems Containing both Brine and Hydrocarbon:** Intermediate scale experiments (1D column, 2D tank) were used to understand the process of gas exsolution, gas phase expansion, and CO_2 migration to characterize the impacts of CO_2 and CO_2-dissolved water leakage in groundwater aquifers. Key findings include:
    - Permeability contrast (heterogeneity) affects CO_2 migration.
    - Background flow affects the existence of free-phase CO_2:
        - Dissolved CO_2 plume primarily remains at the bottom.
        - CO_2 remains in the water (primarily dissolved) well after leakage stops.
- **Wellbore and Seal Integrity:** Portland cement is a carbonic cement with self-sealing properties; it is far more resilient than originally thought.

Prime Performer:
Los Alamos National Laboratory (LANL)

Principal Investigator:
Rajesh Pawar

Project Duration:
10/1/2014 – Present

Performer Location:
Los Alamos, New Mexico

Field Sites:
Mammoth Springs, California

Valles Caldera, New Mexico

Sevilleta Long Term Ecological Research, New Mexico

Farmington, New Mexico

Soda Springs, Utah

LANL Juniper-Pinion Field Site

ZERT, MSU, Bozeman, Montana

Southwest Regional Partnership, Kansas

Program:
Carbon Transport & Storage