

# Frio Brine Pilot: Lessons Learned and Questions Restated

Susan D. Hovorka, Bureau of Economic Geology, Jackson School of  
Geosciences, The University of Texas at Austin

Sally Benson and Larry Myer, GEO-SEQ Project, Lawrence Berkeley  
National Lab

## **Abstract**

An important product of this study is recommendations to the next generation of developers of geologic CO<sub>2</sub> injection pilot projects. We highlight the value of interactive modeling before and during project development. Numerical simulation of flow strongly guided site selection, well design, and tool selection, and was key in designing a successful project. The two-well design was effective in reaching project goals. We directly detected CO<sub>2</sub> breakthrough at the observation well, sampled formation waters as CO<sub>2</sub> interacted with rock and brine, and recovered tracers to quantify CO<sub>2</sub> saturations and CO<sub>2</sub> dissolution. We used two well hydrologic approaches for evaluating multi-phase flow parameters and cross-well EM and seismic imaging. The observation well provided access during injection for logging CO<sub>2</sub> saturation and “ground truthing” indirect geophysical methods for monitoring. Research team integration is critical but time and labor intensive and required vigorous e-mail communication, phone conferences, in-person meetings, and field coordination. Effective data exchange within the research team was challenging. Engineering designs and the experimental time-lines had to be redone to reduce conflicts between optimal conditions for each instrument, risk of failure, and cost. Redesign eliminated tools with low probability of success or those that could not be effectively implemented under experimental conditions, and substitute tools that would accomplish the required tasks. Even if cost was not an issue, it is impossible to create optimal conditions for each instrument in a single test; compromises must be made, and success is dependent on making thoughtful compromises.

## **Principle experimental results**

- (1) Field detection of a small volume of CO<sub>2</sub> using
  - U-Tube sampler and in-line gas analysis
  - Field geochemistry (pH, alkalinity, metals)
  - Stable isotopic signature
  - Introduced tracers
  - Neutron wireline log
  - VSP
  - Cross well seismic
  - Casedhole, cross-well EM
- (2) Good match between modeled and observed CO<sub>2</sub> distribution
- (3) Post injection retention by “two phase trapping” of CO<sub>2</sub> limits migration

## **Recommendations and lessons learned**

- (1) Numerical modeling strongly guided site selection, well design, and tool selection, and was key in designing a successful project.
- (2) Two-well design was effective in sampling a representative radius of the plume.
- (3) Research team integration is critical but time and labor intensive
- (4) Groundwater monitoring using a standard contaminated –site approach is effective in improving public acceptance
- (5) Interference between tests was significant and is an area where improvement of tools should be considered.