Task 3: Monitoring Groundwater Impacts

Award Number: FWP 2012.02.00

Project Summary:

The goal of this project was to develop a suite of measurements and/or tools that can be used in groundwater to detect carbon dioxide (CO_2) and/or brine leakage and to evaluate the impact. In order to achieve the goal, researchers examined the utility of stable isotopes and metal isotopes to track migration of a CO_2 plume and the development of novel materials and sensors for in-situ monitoring. This project tested and validated the use of CO_2 monitoring devices under field conditions and worked to understand the natural variability in the background and better understand the physical-chemical-biological parameters impacting signals for geochemical tracers. Four types of geochemical monitoring tools were studied: (1) natural geochemical tracers in groundwater; (2) shallow continuous monitoring devices; (3) laser induced breakdown spectroscopy (LIBS) for in-situ measurement in groundwater; and (4) novel fiber-optic technologies for chemical sensing.

Prime Performer:
National Energy Technology Laboratory (NETL)

Key Performers:
Illinois State Geological Survey

Principal Investigator:
Angela Goodman

Project Duration:
10/1/2013 – 3/31/2018

Location:
Pittsburgh, Pennsylvania

Field Sites:
EOR Site – East Seminole, Texas
Illinois Basin – Decatur Project

Program:
Carbon Storage

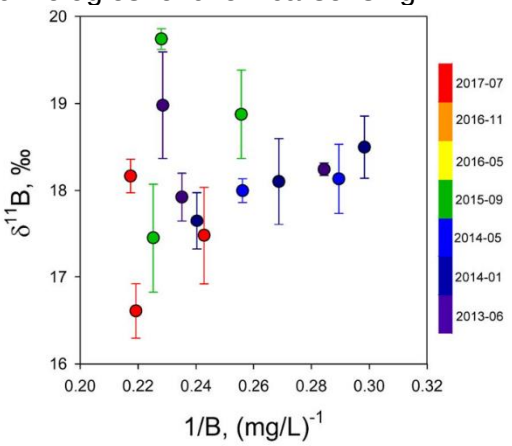

Figure 1: CO_2 injection does not affect the $\delta_{11}B$ values produced water from the target CO_2-EOR reservoir (San Andres formation, West Texas).

Project Outcomes:

Researchers successfully utilized stable isotopes for monitoring groundwater and soil gas at a coal-bed CO_2 sequestration site. Stable isotopes have been shown to be effective. Strontium (Sr), lithium (Li), boron (B), and uranium (U) metal isotopes were field tested; researchers found that Sr and Li isotopes are effective geochemical tracers of potential brine migration from the subsurface upward to shallow groundwater system, and that B isotope signals in groundwater/formation minerals may permanently record CO_2 plume interaction. The team has also used novel in-situ CO_2 field measurement techniques at surface conditions and has built a flow-through cell allowing for little-to-no atmospheric contact to test waters directly from a well. Researchers identified and eliminated hydrogen sulfide interference with measurements of CO_2 at EOR sites via volumetric techniques. In-situ laboratory measurements were successfully performed using LIBS, along with investigations of interferences and enhancements in groundwater LIBS sensing. Several classes of metal-organic frameworks-based materials have been developed for sensitive CO_2 sensing in CO_2 storage applications through integration with the optical fiber sensor platform. This project is ongoing under FWP-1022403.