the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Understanding the Impact of CO_2 Injection on the Subsurface Microbial Community in an Illinois Basin CCS Reservoir: Integrated Student Training in Geoscience & Geomicrobiology

Background

Increased attention is being placed on research into technologies that capture and store carbon dioxide (CO_2). Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and, in turn, mitigating global climate change without adversely influencing energy use or hindering economic growth.

Deploying these technologies in commercial-scale applications requires a significantly expanded workforce trained in various CCS specialties that are currently under-represented in the United States. Education and training activities are needed to develop a future generation of geologists, scientists, and engineers who possess the skills required for implementing and deploying CCS technologies.

The U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) has selected 43 projects to receive more than $12.7 million in funding, the majority of which is provided by the American Recovery and Reinvestment Act (ARRA) of 2009, to conduct geologic sequestration training and support fundamental research projects for graduate and undergraduate students throughout the United States. These projects will include such critical topics as simulation and risk assessment; monitoring, verification, and accounting (MVA); geological related analytical tools; methods to interpret geophysical models; well completion and integrity for long-term CO_2 storage; and CO_2 capture.

Project Description

NETL is partnering with the University of Illinois Urbana-Champaign (UIUC) to provide cross-disciplinary training and research opportunities for undergraduate and graduate students in CCS. This will be accomplished through a joint effort involving faculty and staff in the Department of Geology, the Institute of Genomic Biology, and the Midwest Geological Sequestration Consortium (MGSC) led by the Illinois State Geological Survey (ISGS). The research aspect of the project will take advantage of the unique opportunity provided by the drilling of CCS injection and monitoring wells as part of the NETL's Regional Carbon Sequestration Program (RCSP) at the Illinois Basin—Decatur sequestration site near Decatur, Illinois, under the supervision of the ISGS.

CONTACTS

Sean Plasynski
Sequestration Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-4867
sean.plasynski@netl.doe.gov

Darin Damiani
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507
304-285-4398
darin.damiani@netl.doe.gov

Bruce Fouke
Principal Investigator
University of Illinois
1301 W.Green
Urbana, IL 61801
217-244-6323
Fax: 217-244-4996
fouke@illinois.edu

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Fairbanks, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

PROJECT DURATION

Start Date
12/01/2009

End Date
11/30/2012

COST

Total Project Value
$299,338

DOE/Non-DOE Share
$299,338 / $0

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

During the project, students and staff from UIUC will collect and identify microbes in subsurface samples from the Mt. Simon Sandstone (a candidate CCS reservoir) both before and after injection of CO_2, to observe how CO_2 injection impacts the subsurface microbial community (Figure 1). ISGS researchers are already committed to analyzing the environmental conditions (pressure and temperature) in the wells, and the chemical composition of pore fluids. The total set of observations will permit characterization of the subsurface microbial community in a CCS reservoir in the context of the local reservoir environmental conditions, sedimentary substrate, and pore-water environment. Subsurface microbes constitute over 50 percent of the biomass on this planet, so it is important to know whether large-scale injection has the potential to disrupt or alter subsurface ecosystems.

In addition to analyzing microbes, students will obtain rock sidewall cores from the drilled wells. These cores will be analyzed petrographically (describing and classifying rocks) using a variety of techniques in order to characterize the evolution of cements and other diagenetic features (i.e., the paragenesis—the order in which closely associated minerals in rocks have formed) of the Mt. Simon Sandstone. Using micro-drilling techniques, samples of different cements will be obtained for elemental and isotopic analysis. This aspect of the study will set a baseline for the paragenetic status of the rock, allowing for future CCS impact studies to determine how CO_2 injection affects cementation and permeability. To ensure that a broad group of students and staff gain insight into CCS-related geosciences issues, the project's Principal Investigator (PI) will mentor graduate and undergraduate students, and will develop CCS-focused classroom and field courses, and seminars.

Goals/Objectives

The objectives of the project include:

- Identifying sets of microbes to characterize the subsurface biosphere ecology at a CO_2 sequestration site, and to determine the potential impact of CO_2 injection and storage on this ecology.
- Correlating metabolic biomarkers with present environmental conditions (temperature, host rock composition, and fluid composition).
- Characterizing the paragenesis of the Mt. Simon Sandstone at the drill site so as to establish a baseline for future studies of the impact of sequestration on cements and permeability in the Mt. Simon.
- Developing course materials for undergraduate/graduate-level courses that address CCS geological and geomicrobial issues, and CCS technology in general.
- Developing a seminar series to address CCS-related issues.

Benefits

Overall the project will make a vital contribution to the scientific, technical, and institutional knowledge needed to establish frameworks for the development of commercial-scale CCS. Specifically, the project will advance the knowledge of subsurface microbial ecology, and will provide insight into how large-scale carbon sequestration may impact this ecology. Further, it will provide a baseline for determining if carbon sequestration, and its possible impact on microbial communities, can effect cementation and permeability of a proposed CCS reservoir unit. Additionally, students assigned to this project will develop an understanding of CCS geological and geomicrobiological issues, as well as of CCS technology and strategy in general. Lastly, the work will create a sample collection relevant to CCS studies at UIUC.

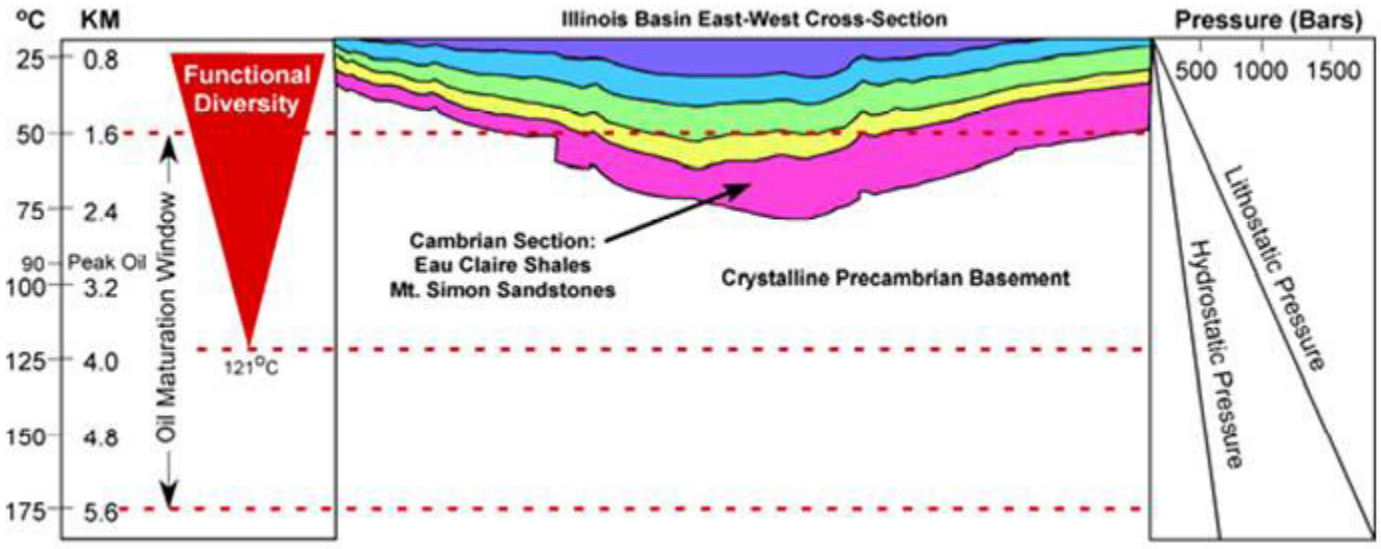

Figure 1. Simplified cross section of the Mt. Simon Sandstones of the Illinois Basin.

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