the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Risk Assessment and Monitoring of Stored CO_2 in Organic Rock under Non-Equilibrium Conditions

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 Southern Illinois University (SIU) to undertake a comprehensive study to understand the potential interactions between organic rocks and CO_2. Interactions between various ranked coals (lignite, sub-bituminous, bituminous, and anthracite) or organic shale with CO_2 are complex and not well understood. The fact that potential risks associated with their storage are seldom evaluated under plausible but extreme transient conditions poses a concern. Most risk assessments are typically accomplished under equilibrium conditions. However, under extreme non-equilibrium conditions (whether natural, seismic, or manmade) there are potential situations that could lead to the re-emission of CO_2 stored in organic rocks. The possible interactions

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

Vivak Malhotra
Principal Investigator
Southern Illinois University
Neckers 483A
Mailcode: 4401
Carbondale, IL 62901
618-453-2643
Fax: 618-453-1056
vmalhotra@physics.siu.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
$459,856

DOE/Non-DOE Share
$300,000 / $159,856

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

have not yet been studied in detail. In addition, SIU will attempt to evaluate how potential pressure and temperature variations, typically encountered under natural seismic conditions, can control the emission, adsorption, and absorption behavior of sequestered CO_2.

Goals/Objectives

Project objectives include:

1. Collecting coal cores from various ranked coal seams including Illinois Basin bituminous coal (depth 700 to 1,200 ft) and Western sub-bituminous coal (depth 3,000 to 3,500 ft).
2. Determining how various air, nitrogen (N_2), methane (CH_4), and CO_2 gas environments influence the flexural, compressive, and tensile strength of coal.
3. Establishing how air, N_2, CH_4, and CO_2 gas environments affect the structural, thermal, and thermomechanical properties of gas-saturated coal seams.
4. Designing and developing an experimental laboratory arrangement where various seismic pressure waves can be generated in cores saturated with CO_2 and gas mixtures. The experimental setup will be capable of in situ monitoring of potential gas emission even at a parts-per-million (ppm) range.
5. Monitoring the interactions between CO_2 and organic rocks under extreme non-equilibrium conditions as simulated primary-, secondary-, and Rayleigh-waves are established in cores. In particular, the emphasis will focus on the potential for local organic rock reservoir collapse and massive re-emission of stored CO_2.
6. Analyzing the leachable or extractable chemical constituents of organic rock samples that are to be subjected to experimentation in Objective 5.

Benefits

Under seismic conditions, whether natural or manmade, equilibrium condition monitoring may not provide adequate information to evaluate the potential for CO_2 re-emission. This research will provide the framework to understand and determine:

- How the interactions between organic rocks and CO_2 affect the strength of the rocks, and whether these interactions pose a potential for rock collapse under overburden stresses and pore pressures.
- Whether CO_2-saturated organic rocks may indicate leakage of CO_2 over time when placed under typical overburden stresses.
- How shock pressure waves in CO_2-saturated organic rocks control the interactions between adsorbed and/or absorbed CO_2 and rock; how these interactions are modified, and if there is cause for concern due to significant CO_2 leakage.
- Whether CO_2-saturated organic rocks placed under typical overburden stresses could potentially leak CO_2 when subjected to shock-induced variations in hydrostatic pressure.