PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Carbon Sequestration

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NETL

Stored CO_2 and Methane Leakage Risk Assessment and Monitoring Tool Development: CO_2 Capture Project Phase 2

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Background

Unmineable coal seams at depths beyond conventional recovery limits are potential storage reservoirs for carbon dioxide (CO_2) and enhanced coalbed methane (ECBM) recovery operations. This project supports the U.S. initiatives for reducing greenhouse gas intensity and improving domestic energy security by enhancing the potential for carbon sequestration in deep, unmineable coal seams with ECBM recovery. It addresses three critical topics that require further work to gain broad public acceptance for geological sequestration in methane coalbeds: (1) integrity of coalbed methane (CBM) CO_2 geologic storage systems, (2) optimization of the ECBM recovery and CO_2 storage processes, and (3) reliable monitoring of these operations. This project builds on past CO_2 Capture Project- (CCP) sponsored work in this area.

The program addresses optimization of ECBM recovery using CO_2, in addition to monitoring, verification, and risk assessment of CO_2 geologic sequestration in coalbeds. A numerical modeling study is using a state-of-the-art CBM simulator to define the physical and operational boundaries and tradeoffs for safe and effective CO_2 storage accompanying CO_2 ECBM recovery. An innovative geophysical approach is assessing the ability of non-seismic techniques to adequately monitor gas movement in coal beds under CO_2 flood with techniques that offer considerable cost savings over more conventional seismic techniques. An aerial remote-sensing approach is using cutting-edge thermal hyperspectral imagery to test the feasibility of monitoring large surface areas for CO_2 and methane seeps. If successful, it could eliminate the need for an extensive ground-based monitoring system and associated operational costs. The potential advances in optimization of ECBM recovery and CO_2 storage operations in coalbeds, along with advances in monitoring these processes, will provide assurance and the basis for public acceptance of geologic storage in coalbeds. The two gas monitoring technologies—non-seismic geophysical techniques and hyperspectral imagery—are innovative approaches that offer considerable cost savings over conventional techniques.

Primary Project Goal

The primary project goal is to develop and test tools for optimization of ECBM recovery and geologic storage of CO_2 in coalbeds, in addition to tools for monitoring CO_2 sequestration in coalbeds to support risk assessment. Three critical topics identified are (1) the integrity of coal bed methane geologic and engineered systems, (2) the optimization of the coal bed storage process, and (3) reliable monitoring and verification systems appropriate to the special conditions of CO_2 storage and flow in coals.

Objectives

The objectives of this project are:

- To establish CO_2 injection and methane production procedures in deep,

PARTNERS

CO_2 Capture Project
Phase 2/ BP America Inc.

Sproule Associates, Inc.

University of California –
Santa Cruz

Lawrence Berkeley National
Laboratory

PERIOD OF PERFORMANCE

03/09/2005 to 06/08/2008

COST

Total Project Value
$601,240

DOE/Non-DOE Share
$300,620 / $300,620

ADDRESS

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unmineable coals that will avoid CO_2 and methane leakage by using a state-of-the-art CBM simulator to define the physical and operational boundaries and tradeoffs for safe and effective CO_2 storage.

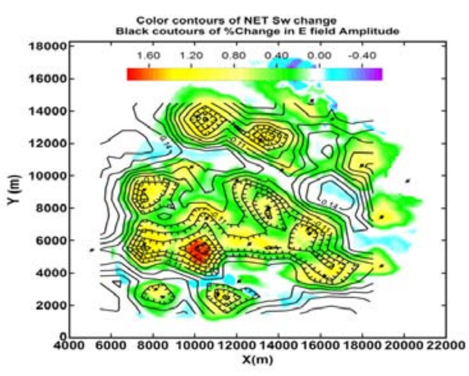
- To develop cost-effective technology to monitor the movement of CO_2 and methane (CH_4) in subsurface coals using an innovative geophysical approach based on electromagnetics (EM) and gravity at considerable cost savings over conventional seismic monitoring techniques.
- To develop technology for detecting CO_2 and CH_4 leakage at the surface using aerial imagery based on thermal hyperspectral monitoring that has the potential for evaluating large surface areas for seepage at considerable cost savings over ground-based surface monitoring systems.

Accomplishments

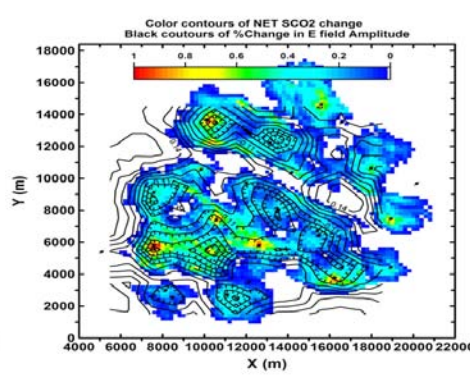
- Geologic and reservoir engineering data from a coalbed methane CO_2 storage pilot demonstration at the Deerlick Creek Field, Black Warrior Basin in Alabama were acquired, evaluated, and integrated into the reservoir simulation and geophysical study tasks.
- A ground-surface controlled leak experiment releasing CO2 and CH4 was conducted at the Naval Petroleum Reserve Site #3 in Wyoming in 2006. Aerial hyperspectral imagery based on MASTER technology was acquired and analyses of these data demonstrated that MASTER could identify CO_2 and CH_4 surface seeps at high concentrations.
- Based upon the Deerlick Creek Field, Black Warrior Basin pilot site in Alabama, sensitivity studies were conducted to model injection of CO_2 in coalbeds, and to compute resultant gravity and EM signals. Results of the sensitivity study indicate gravity and EM anomalies would result and could be detected by geophysical field surveys.

Benefits

Growing concern over the potential adverse effects of CO_2 buildup in the atmosphere leading to global climate change may require reductions in carbon emissions from industrial sources. One promising option is the capture of CO_2 from large point sources and subsequent sequestration in geologic formations. However, for this approach to achieve wide acceptance, there will need to be assurances that the sequestration projects can be monitored to ensure their safety. This work will advance optimization of CO_2 ECBM recovery and CO_2 coalbed storage operations and develop innovative technologies to monitor CO_2 in the reservoir and at the surface. These technologies will help expand the viable options for geologic storage of CO_2 emissions from coal-based energy and power.



Spectral monitoring equipment used to acquire aerial imagery during the CO_2 and CH_4 controlled surface leak experiment at the Naval Petroleum Reserve Site #3, Wyoming.



Electromagnetic surveying equipment and map showing electric field response to reservoir CO_2 saturation changes for a simulated field case study.