

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY



GEOLOGIC SEQUESTRATION CORE FLOW LABORATORY

Background

Sequestration of CO₂ and production of coalbed methane (CBM) can affect the strata in various ways. For example, coal can swell or shrink, depending on the specific adsorbed/absorbed gas. In turn, this can affect permeability and porosity (flow properties), depending on the amount of sorption/desorption. If the geological formations of interest are deep and have high lithostatic pressures, high laboratory confining pressures are needed to realistically simulate in situ conditions in the lab. Deep formations also have elevated formation temperatures; hence, temperature control of laboratory test equipment is required. The same parameter evaluations are required for assessment of overburden/underburden strata sealing ability for preventing fugitive emissions from target sequestration strata.

CONTACTS

Sean I. Plasynski

Sequestration Technology Manager
National Energy Technology
Laboratory
626 Cochran Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4867
sean.plasynski@netl.doe.gov

T. Robert McLendon

Geosciences Division
National Energy Technology
Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507
304-285-5749
t.mclendon@netl.doe.gov

Bob Kleinmann

Division Director
Geosciences Division
National Energy Technology
Laboratory
P.O. Box 10940
626 Cochran Mill Road
Pittsburgh, PA 15236
412-386-6555
robert.kleinmann@netl.doe.gov

Description

The National Energy Technology Laboratory's (NETL) Geological Sequestration Core Flow Laboratory (GSCFL) was established to evaluate rock-fluid interactions at depth and to determine how a particular stratum will be affected by adsorption/desorption of gas at various temperatures, pressures, and degree of saturation. It can be used to measure porosity, permeability, Young's Modulus, Poisson's ratio, and stress and strain. However, complete evaluation of a core, particularly coal, which swells/shrinks upon sorption/desorption of a fluid and can change permeability and effective molecular weight during testing, requires additional evaluation. The GSCFL work complements the examination of cores using NETL's CT Scanner, which can be used to see inside a core while it is being tested; this enables one to evaluate fluid flow in a core in real time. These results can then be compared with those predicted by modeling experiments and then used to improve the models. Closely linking the laboratory, field, and modeling activities in an iterative relationship will ensure accurate results and optimize progress. In addition, independent reactors are used to test fluid/mineral interactions at high pressures and temperatures.

Primary Project Goal

The goal is to be able to simulate the conditions found in all of the major potential geological sequestration sites including oil and gas fields, unmineable deep coal seams, brine formations, and natural gas hydrates. The data obtained from laboratory tests of various rock types under a variety of controlled conditions and environments will provide information on the geotechnical effects and chemical interactions that occur when CO₂ is injected into natural rock. The data will also be used to predict potential problems that might be encountered in field-scale investigations.



PERFORMANCE PERIOD

10/1/2007 to 9/30/2008

COST

Total Project Value
\$400,000

DOE/Non-DOE Share
\$400,000 / \$0

ADDRESS

**National Energy
Technology Laboratory**
1450 Queen Avenue SW
Albany, OR 97321-2198
541-967-5892

2175 University Avenue South
Suite 201
Fairbanks, AK 99709
907-452-2559

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

626 Cochran's Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

One West Third Street, Suite 1400
Tulsa, OK 74103-3519
918-699-2000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

Objectives

- Obtain representative strata samples per program/project constraints, working cooperatively with Regional Carbon Sequestration Partnerships (RCSP).
- Prepare cores for testing to desired physical specifications and determine initial porosity and permeability.
- Use AutoLab testing instrument or high pressure reactors to simulate specified conditions of confining pressures, temperature, and pore pressures and determine porosity, permeability, Young's Modulus, Poisson's ratio, and stress and strain; coordinate appropriate tests with CT scanning evaluation of the same core samples.
- Use sensors installed on the AutoLab testing equipment to collect initial P-wave velocity structure of core samples at appropriate pressure and temperature conditions.
- Present test results to modelers at NETL and to the relevant regional partners; publish technical papers.

Benefits

The type of information that can be determined in the GSCFL is essential to realistic evaluation of the potential of CO₂ geologic sequestration, as well as CBM production. Much of this data is not currently available.

Accomplishments

The NER AutoLab 1500 unit, which is used to measure permeability and geo-mechanical property measurements at elevated pressure and temperature conditions, has been mechanically modified to reduce the time required for measurements. It is also being equipped with sensors that will allow researchers to assess seismic velocities in a particular core, which will improve the ability of NETL and the RCSPs to evaluate seismic investigations of potential field sites.



NER AutoLab 1500 unit