the ENERGY lab

R&D FACTS

RESEARCH & INNOVATION CENTER

Geological & Environmental Systems

Geologic Storage Core Flow Laboratory

Background

The storage of CO_2 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 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 storage strata.

Description

The National Energy Technology Laboratory's (NETL) Geological Storage Core Flow Laboratory (GSCFL) was established to evaluate rock-fluid interactions at depth and determine how a particular stratum will be affected by adsorption/desorption of gas at various temperatures, pressures, and degrees of saturation. The GSCFL 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) can change permeability; therefore, effective molecular weight during testing requires additional evaluation.

The GSCFL work complements core examination using NETL's computed tomography (CT) scanner, which can be used to see inside a core, enabling the real-time evaluation of fluid flow in a core. These results can then be compared with those predicted by modeling experiments 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 can be used to test fluid/mineral interactions at high pressures and temperatures.

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Primary Goal

The goal is 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 CO_2 is injected into natural rock. The data will also be used to predict potential problems that might be encountered in field-scale investigations.

Objectives

- Obtain representative strata samples per program/project constraints, working cooperatively with Regional Carbon Sequestration Partnerships (RCSPs)
- Prepare cores for testing to desired physical specifications and determine initial porosity and permeability
- Use the 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 relevant partners and publish technical papers

Benefits

The type of information that can be determined in the GSCFL is essential to realistic evaluation of the potential of CO_2 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