the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Simulation Framework for Regional Geologic CO_2 Storage Infrastructure Along Arches Province of Midwest United States

Description

Through its core research and development program administered by the National Energy Technology Laboratory (NETL), the U.S. Department of Energy (DOE) emphasizes monitoring, verification, and accounting (MVA), as well as computer simulation, of possible carbon dioxide (CO_2) leakage at CO_2 sequestration sites, along with risk assessment of those sites. MVA efforts focus on the development and deployment of technologies that can provide an accurate account of stored CO_2, with a high level of confidence that the CO_2 will remain permanently sequestered. Effective application of these MVA technologies will ensure the safety of sequestration projects with respect to both human health and the environment, and provide the basis for establishing carbon credit trading markets for sequestered CO_2. Risk assessment research focuses on identifying and quantifying potential risks to humans and the environment associated with CO_2 sequestration, and helping to ensure that these risks remain low.

This three-year project—performed by Battelle Memorial Institute (Battelle) in partnership with the Ohio Coal Development Office of the Ohio Air Quality Development Authority; Ohio, Indiana, and Kentucky Geological Surveys; Western Michigan University; and Battelle's Pacific Northwest Division—will develop a simulation framework for regional geologic CO_2 storage along the U.S. Arches geologic province (areas of Indiana, Kentucky, Michigan, and Ohio) by using a strong set of field data to build a geologic model and completing reservoir simulations necessary for large-scale CO_2 storage. A key part of this effort will be integration of the project data from geologic mapping, waste injection wells, and field demonstrations in the western part of the Midwestern Regional Carbon Sequestration Partnership (MRCSP) study area.

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PARTNERS

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COST

Total Project Value
$2,065,064

DOE/Non-DOE Share
$1,518,225 / $546,839

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U.S. DEPARTMENT OF ENERGY

This work represents the "next step" in simulation of CO_2 storage—its widespread application along a major regional geologic structure in an area of the country having a dense concentration of large CO_2 sources. The Arches province in the Midwest—the uplifted Cincinnati, Findlay, and Kankakee arches region separating the Illinois, Michigan, and Appalachian basins — has been identified as a major target for CO_2 sequestration because of the intersection of reservoir thickness and permeability along the province. The province includes areas of Indiana, Kentucky, Michigan, and Ohio along several regional geologic structures (Figure 1) that extend across more than 50,000 square miles. The main injection target in the province is the Mt. Simon sandstone formation, which is the major CO_2 sequestration target in the Midwest. The area also is adjacent to coal-fired power plants along the Ohio River Valley corridor, making it feasible to access the area with a CO_2 pipeline network.

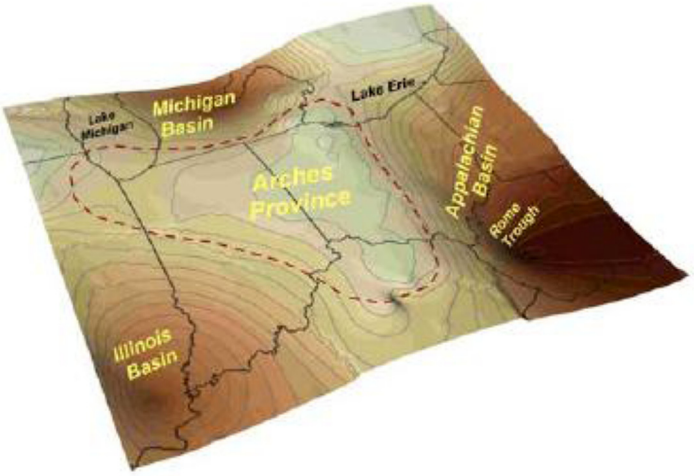

Figure 1. The Arches province of the Midwestern United States offers abundant opportunities for geologic sequestration of carbon.

Primary Project Goal

The primary goal of this project is to develop an advanced simulation framework for evaluating regional geologic CO_2 storage deployment along the Arches province. The project team will achieve this goal by building a geologic model and advanced reservoir simulations for the province to determine the infrastructure necessary to implement large-scale CO_2 storage. The focus of the work is to improve methods to mathematically simulate the placement, storage, and movement of CO_2 in geologic formations. Coupled geochemical, geomechanical, heat, and fluid flow processes are included in the simulation program. These processes will require development of new computer simulation methods to meet computational challenges.

Accomplishments

This project was awarded on October 1, 2009. Anticipated accomplishments related to the work include development of a regional geologic framework (conceptual model) for the Mt. Simon sandstone and immediate overlying containment layers in the Arches province. Initial project activity includes compilation of geologic maps and hydrogeologic data to develop modeling grids. Data from a number of Class I and II injection well sites, oil and gas exploration wells, and core analysis will be collected. The conceptual model will be used initially to develop baseline hydrodynamic models that represent effects of brine density and chemical composition variations. Multiphase simulations with equations of state will be used to simulate injection and containment of CO_2 in the Mt. Simon sandstone. The analyses will include sensitivity analysis, calibration with injection well observations, assessment of regional deployment scenarios, and estimates of storage capacity constrained by both pore space volume and pressure increase.

Benefits

Evaluating the feasibility of CO_2 storage on a regional scale will help develop a basis for guidelines that will ensure optimal utilization of this increasingly valuable underground repository. It will allow the energy industry to prove the viability of an evolving technology and allow power plants and industries they serve to mitigate carbon emissions as the nation develops a strategy to deal with the buildup of greenhouse gases in the atmosphere. Ultimately it will help strengthen these industries and preserve the economic infrastructure of the Midwestern region, which is heavily dependent on the affordable energy supplied by fossil fuels.

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