the ENERGY lab

PROJECT FACTS

Carbon Sequestration

CO_2 Geological Storage: Coupled Hydro-Chemo-Thermo-Mechanical Phenomena—From Pore-Scale Processes to Macroscale Implications

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

DOE is partnering with the Georgia Institute of Technology (GT) to explore the consequences of coupled hydro-chemo-thermo-mechanical (HCTM) processes related to the injection of CO_2 into the subsurface (Figure 1). This work will expand the results from a previous study on the interactions of groundwater acidification and dissolution of minerals and precipitation on pore-scale processes. This research will include the study on the interactions between pressure, temperature, pore fluid chemistry, mineral, and surface conditions (wet or oil wet) that are relevant to CCS projects in various geological settings. The data GT will collect include surface tension, contact angle, diffusion, time-dependent fluid-rock chemical reactions, percolations, and

CONTACTS

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

Brian Dressel
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-7313
brian.dressel@netl.doe.gov

J. Carlos Santamarina
Principal Investigator
Georgia Institute of Technology
790 Atlantic Drive
Atlanta, GA 30332-0355
404-894-7605
jcs@gatech.edu

PARTNERS

None

PROJECT DURATION

Start Date
12/01/2009

End Date
11/30/2012

COST

Total Project Value
$300,000

DOE/Non-DOE Share
$300,000/$0

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

residual saturation. The scope of research will:

- Combine unique pore and particle-scale experimental studies.
- Numerically evaluate the experimental studies and upscale the pore- and particle-scale processes.
- Utilize the data to develop a, fully coupled, macroscale numerical HCTM model.

Goals/Objectives

A goal of this project is to gain a better understanding of the fundamental processes and couplings that may either hinder or enhance the long-term geological storage of CO_2. To reach this goal GT will explore the consequences of HCTM processes on geological storage, identify emergent phenomena, and bound the parameter-domain for the efficient injection and safe long-term sequestration of CO_2 in underground reservoirs.

Benefits

Overall the project will make a vital contribution to the scientific, technical, and institutional knowledge necessary to establish frameworks for the development of commercial-scale CCS. The research will deliver unprecedented particle and pore-scale data, up-scaled implications, emergent phenomena, injection strategies and storage performance.

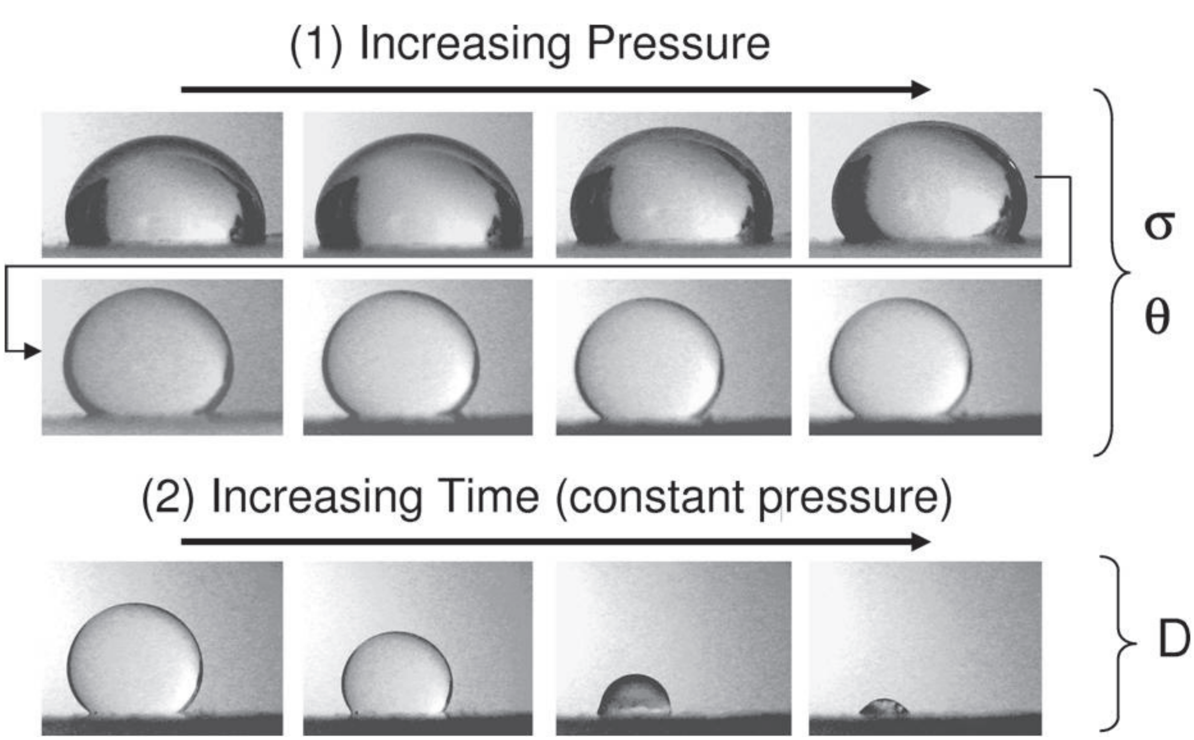

Figure 1. A water droplet on polytetrafluoroethylene (PTFE) substrate surrounded by CO_2. (1) Changes in interfacial tension and contact angle as CO_2 pressure increases from 0.1 to 18.5 MPa. (2) droplet size reduction as water diffuses into the surrounding liquid CO_2 (Duration ~400 min).