the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Web-based CO_2 Subsurface Modeling

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

NETL is partnering with San Diego State University (SDSU) to develop a user-friendly Rich Internet Application (RIA) using cutting-edge Asynchronous JavaScript and XML (AJAX) Web technologies to run existing geologic sequestration simulation software modules on a network accessible cluster of machines. This Internet simulator will include comprehensive chemical and physical processes relevant for modeling CO_2 sequestration systems. The modeling will include capabilities to simulate diffusive, advective, tortuous, and dispersive mass-transfer, and include a comprehensive database of solid-phase and aqueous species properties with support for both kinetic and equilibrium reactions. The interface will allow users to graphically define a computational domain, specify boundary conditions, specify relevant reaction mechanisms, define mineral properties, and investigate the long term fate of sequestered CO_2 in saline reservoirs and geologic formations. The Web-based simulator will use existing codes donated by Sienna Geodynamics. SDSU will develop a graduate-level course based around learning and implementing the codes. The overall project effort to develop the Internet-capable interface will include:

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PARTNERS

Sienna Geodynamics and Consulting, Inc.

PROJECT DURATION

Start Date
12/01/2009

End Date
11/30/2012

COST

Total Project Value
$299,993

DOE/Non-DOE Share
$299,993/$0

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

- Creating a Graphical User Interface (GUI) with Web-Service capabilities for simulator input to existing codes that model water/rock chemical reactions in a fractured CO_2 sequestration environment.
- Developing a cross-disciplinary class available over the Internet using data from existing and proposed sites as model inputs.
- Investigating a way of adapting other codes (finite difference and finite element) to examine geomechanical and potential surface deformation effects of injected CO_2.

Goals/Objectives

The overall objective of the project is to create a Web-based simulator with chemical and physical processes relevant for modeling CO_2 sequestration systems and to then use the simulator as part of a course on CO_2 sequestration and modeling. The goal is to make the Web-based simulator easily accessible, user-friendly, and fully applicable to real-world CCS projects. This research will provide an opportunity at SDSU to further develop existing industry-supported, multidisciplinary, applied computational sciences programs and well-trained personnel for the CCS industry.

Benefits

Overall the results of 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, particularly in the simulation and modeling of the fate of injected CO_2 in subsurface geologic systems. The resulting simulation package will provide a new, flexible, user-friendly, and innovative foundation for CO_2 modeling.

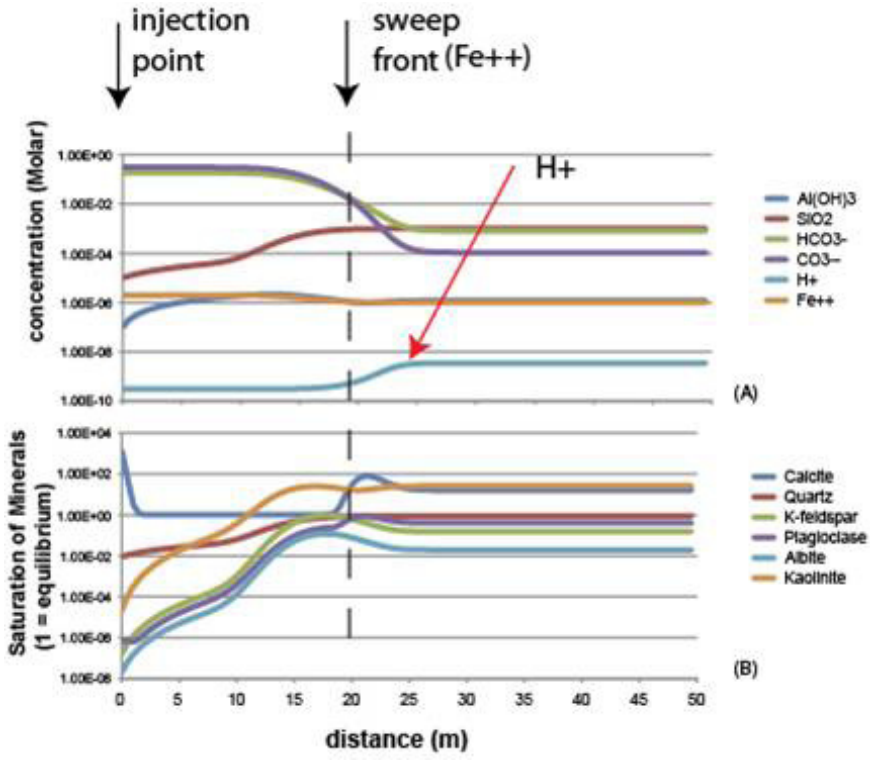

Figure 1. Example of chemical-based simulation and modeling as a function of distance from the injection wellbore. Web-based simulations, as shown, were taken from modeling of the CO_2 injection in the Frio Formation.