the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Geological and Geotechnical Site Investigations for the Design of a CO_2 Rich Flue Gas Direct Injection and Storage Facility in an Underground Mine in the Keweenaw Basalts

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 University of Alaska Fairbanks to conduct research and training to develop a methodology for the geologic and geotechnical site characterization of mafic rocks through field work and simulation. Mafic rocks are dark igneous rocks with a high magnesium and ferrous iron content. Basalt is the most common mafic rock (Figure 1). Basalt formations have a unique chemical makeup that could potentially convert all of the injected CO_2 to a solid mineral form, permanently isolating it from the atmosphere. The methodology will attempt to define the parameters that enhance rock carbonation and permanent sequestration

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PROJECT DURATION

Start Date

12/01/2009

End Date

11/30/2012

COST

Total Project Value

$299,762

DOE/Non-DOE Share

$299,762 / $0

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

by directly injecting CO_2 enriched flue gas streams into large underground cavities in basaltic and gabbroic rocks. A small demonstration project will be conducted in which 100 tons of CO_2 will be injected. Project site selection will be determined following a thorough characterization effort of two candidate mine sites.

Mine tailings (the materials left over after coal and mineral ore extraction) will be examined, sampled, and tested throughout the 100 mile long by three mile wide Keweenaw Copper Belt to estimate the extent of carbonation as a consequence of exposure to atmospheric CO_2 resulting from 100 plus years of mine operations. The focus of this effort will be on characterizing secondary carbonate minerals that have precipitated on the mine tailings following exposure to atmospheric CO_2. These samples will be used as comparative analogs to assess the physical and chemical property changes expected following CO_2 injection into mafic rock within the region. Based on these characterizations, a volume of naturally sequestered atmospheric CO_2 will be estimated to provide a minimum estimate of the potential for carbonation of the basalts at the higher temperature, pressure, and chemical partitioning of CO_2 from flue gas streams. Instrumentation techniques will be developed based on the results of the mine and tailings site characterization work, to monitor injection direction and determine the CO_2 storage capacity of the basalts. Finally, design and cost estimates will be developed for a direct injection and storage demonstration project at the selected mine site.

Goals/Objectives

The objective of this project is to provide an opportunity for graduate and undergraduate students to participate in research to develop a methodology for the geologic and geotechnical site characterization of mafic rocks via simulations, field work, and analysis of existing data. Research will ultimately be used to compile an economic analysis for using mafic rocks as a CO_2 sequestration option.

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 and will provide insight to further the understanding of CCS in mafic rocks.

Figure 1. Keweenaw Basalt, Chippewa Falls, near Batchawana Bay, Ontario