

FEATURED PROJECT

A new approach to quantitative CO₂ injection monitoring with geo-electrical methods



Developing techniques for better tracking

The key goal of this project is to develop better ways to monitor CO₂ once it's been injected deep underground.

Mainstream monitoring techniques using seismic tools track where CO₂ is going after it's been injected by measuring seismic waves, but the injection process changes the fluid and pressure in the rock and that consequently affects the seismic properties. That means there is some ambiguity in current monitoring techniques and scientists aren't sure how to attribute seismic measurements to changes in pressure or fluid caused by the injection of CO₂.

This research project will explore new methods to track injected CO₂ by filling gaps in knowledge about the electrical properties of CO₂ as well as the relationships between seismic and electric properties. It is one of the first to study the cross-property relationships between electrical conductivity and seismic properties of CO₂/brine/rock mixtures.

Researchers will use two sites, one in Quebec and one in Saskatchewan, for field tests to better understand how to measure electrical properties underground. Project investigators will also develop numerical models that will help assess the data that's gathered.

Research Grant:

\$450,000/3 years; awarded 2012

Research Team:

Dr. Bernard Giroux, Institut national de la recherche scientifique (INRS)
 Klaus Spitzer, TU Bergakademie Freiberg Institute of Geophysics and Geoscience Informatics, Germany
 Douglas Schmitt, University of Alberta, Department of Physics
 Cornelia Schmidt-Hattenberger, Centre for CO₂ Storage, Potsdam, Germany
 Don White, Geological Survey of Canada



Bernard Giroux, Lead PI

Benefits to Canada and beyond

The aim of this project is to develop a new approach that will improve quantitative monitoring and contribute to the deployment of CCS at scales significant for climate change mitigation.

Researchers want to provide the tools that can indicate where "every drop" of CO₂ is going after injection, therefore increasing the safety and public acceptance of sequestering operations.

Industrial applications

The project will allow scientists to monitor changes in electrical properties with more robust tools, opening the possibility to track changes in two complementary geophysical properties (electric and elastic). This will reduce the ambiguity in seismic data interpretation and lead to improved quantitative monitoring.

By eliminating the need for installation of potential (measurement) electrodes, the proposed methodology will reduce installation and maintenance costs of monitoring systems. This will also improve the longevity and reliability of the monitoring infrastructure by avoiding problems related to electrode corrosion and improving the repeatability of the measurements.

Industrial Project Partners

Junex, a junior exploration company with oil and gas exploration permits in the Bécancour area in Quebec, is giving researchers access to 18 wells and 30 2D seismic lines.

The project is aligned with planned work by the Geological Survey of Canada at the Aquistore CO₂ storage site in Saskatchewan. Logistical support is being provided by Aquistore project managers – the Petroleum Technology Research Center.

Project Description

Goal

This project will develop an effective downhole geoelectrical technique that will complement current seismic methods used to monitor injected CO₂.

Investigators will draw on two techniques that have not been applied to CO₂ monitoring – magnetometric resistivity (MMR) and time-domain electromagnetics (TEM). MMR measures magnetic fields instead of electric fields. However, MMR does not provide absolute values; instead it offers contrasts in resistivity. TEM, on the other hand, does yield absolute values of conductivity and it does so without the use of electrodes, which can be difficult and costly to install and maintain. Also tested will be electrical resistivity tomography (ERT) which uses electrodes to measure electrical fields. The use of ERTs to measure CO₂ in saline aquifers is problematic because measurements are noisy and the equipment is difficult to install and maintain.

Data gathered through these three techniques (MMR, TEM and ERT) will be studied and compared to determine the limitations and advantages of each. The technology will be tested in the lab and then in the field, leading to improved interpretation of monitoring data.

Activities:

There are three components to this research project.

In the lab, the researchers will explore the relationship between fluid nature, pressure changes, and temperature changes to improve the fundamental understanding of how CO₂ affects the electrical properties underground.

Using a saline aquifer in Saskatchewan and a reservoir in Quebec, researchers will test different methods of measuring electrical properties underground. More specifically, the team will test how measuring the magnetic field instead of the electric field (as done usually) can be used to infer the electric conductivity of the rock.

The project will also develop numerical models that will help assess all the data gathered.

Milestones:

At the time of this writing, the project was in its early stages and researchers are working toward the following milestones:

- Electrical resistivity and seismic velocity measurements
- Analysis of lab measurements
- Analysis of the geophysical logs and scanning of the cores
- Development of the 3D forward modeling code
- Determination of optimal field acquisition parameters
- Development of a time-lapse MMR/TEM inversion code
- Determination of optimal field acquisition parameters
- Field tests in Québec and Saskatchewan

For additional information

Dr. Bernard Giroux
INRS-ETE
Quebec City, QC, Canada
T: +1 418 654-2624
E: Bernard.giroux@ete.inrs.ca

For CMC program information

Richard Adamson
Managing Director
Carbon Management Canada
2500 University Drive
Calgary, AB, Canada T2N 1N4
T: +1 403 210-7767
E: Richard.Adamson@cmc-nce.ca
W: www.cmc-nce.ca

About Carbon Management Canada

Carbon Management Canada (CMC) is a national network that funds research and promotes the transfer to practice of knowledge and technologies to reduce CO₂ emissions in the fossil energy industry and other large stationary emitters. CMC has over 160 investigators, network agreements with 27 Canadian universities, and has invested \$22 million in 44 research projects.



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