

Quarterly Report

Grant No. DE-SC-0001761

Report period: From March 31, 2010 to June 30, 2010

1) Project activity during this quarter

(a) Planned activities

1. Development of data archive and resource center
 - Create statewide digital databases for samples and well records for Michigan's geological formations relevant to CO₂ storage, containment and potential for enhanced oil recovery
 - Accumulate data with which to construct maps and tables of physical properties
 - Implement internal data share (intranet) to facilitate compilation of information into a digital atlas
2. Conduct technical research on CO₂ sequestration:
 - Conduct basic and applied research to characterize Michigan saline reservoirs for CO₂ storage potential volume, injectivity and containment
 - Integrate any new data from wells drilled primarily by the oil and gas industry.
3. Data acquisition and software implementation to conduct geologic and fluid flow modeling to address specific predictive uses of CO₂ storage and enhanced oil recovery, including:
 - Compile data for geological and fluid flow models
 - Formulate models, integrate data, and run the models
 - Apply models to specific predictive uses of CO₂ storage and enhanced oil recovery
4. Establish effective technology transfer to members of industry and governmental agencies by:
 - Establish an Internet Website at which all data, reports and results will be accessible (site usage statistics will be maintained)
 - Introduce MICHCARB programs at industry and governmental workshops and meetings
5. Create and deploy educational materials for public outreach
 - Construct physical demonstration models and displays that can be used in outreach and other educational events
 - Work with partners in Michigan geo-resource industries, energy utility companies, State and local governments, K-12 classrooms and teachers and public groups

(b) Actual activities: All planned activities were conducted and good progress was made as described in detail in attachments.

2) Results achieved on the project during this QPR time period

(a) Results planned consisted mainly of:

- See *Planned Activities* 1) (a) 1-5, above.

(b) Results consisted of:

- See Attachments 1-5, *Reports on Planned Activities and Press Release*

- 3) **Activities which went better or worse than expected:**
 - (a) After we received three 70-foot truckloads of cuttings from the State Geological Survey, we added three more student positions to begin inventorying these and to implement our Digital Asset Management System. This is proving to be a very time-consuming project given the volume of material (representing over 10,450 wells), the condition of the material (not well labeled) and the lack of a comprehensive list of wells represented. We will not be able to complete the inventory for many more months.
 - (b) Implement the DAMS systems was a challenge, which we overcame with the manufacturer's help.
- 4) **Project problems, solutions and changes during the quarter--**No significant problems occurred this quarter. Implementing the digital asset management system was a change, and one which will foster our interrelational datasets.
- 5) **Other topics of interest:** Please see attachments
- 6) **Status of project at end of period:** Project is on time and on budget to date.

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Date: August 2, 2010

Please see following Attachments 1-5.

Attachment 1 Report on *Establishing the Resource Center at MGRRE*

- **Developing statewide and site-specific digital research databases—Data added this quarter:**
 - Core analysis data (largely porosity and permeability data)—hand entered from paper records 34 wells
 - Mudlogs—56 scanned and added to database
 - Wireline logs—inventoried 780 donated logs to be added to database
 - Cuttings—received three 70-foot truckloads of unmounted cuttings, representing about 10,450 wells. These are the State Geological Survey's cuttings collection, obtained during the last 80 years. Only a partial listing of wells was available, so we have begun inventorying each box. This is an enormous collection which will require many months to inventory completion.

- **Compiling all information into a digital atlas**

A. This quarter Linda Harrison, Lolita Krievs and student workers implemented a digital asset management system (DAMS). Initially designed to locate and inventory the State's cuttings collection, this system will eventually include every data asset type at MGRRE. Using a digital bar coding system, we are entering asset location, type, and description are being entered in datasets. We have established asset categories for all our materials and intend to complete these datasets in the next few years using this system.

We identified 23 primary asset types with associated datasets for inclusion in the master MGRRE digital asset management system (DAMS). Some of these data are proprietary and available to researchers at MGRRE only through our in-house data share. Several of these datasets are "inherited", showing variable fields and different structures. These datasets will require reformatting for compatibility. Some data records are incomplete and will require searching for missing values.

In designing our DAMS, we continue to explore new methods and techniques which help us discover and define unacceptable errors so that corrective action can be taken. We are also preparing qualitative descriptors for the datasets to help end users interpret the degree of acceptability or utility

of such data. This includes any needed context setting information required to identify the origin, conditions of use, interpretation, or understanding of the information being exchanged. This also helps us to ensure that the data generated is of proven and known quality meeting the needs of the end user. Other factors which we are taking into consideration include future data perspectives, diversity of the user community, organizational requirements, timeliness, consistency, and user interface issues.

As we continue developing of our database, and new data files are incorporated into our internal data share, it is essential that we maintain flexibility, be able to adapt to new issues, and modify processes as needed to design a solution which is robust, usable, and can stand the test of time.

B. Continuing our extensive work on MGRRE datasets, we are reformatting and checking data for two primary in-house database: Core analyses and Wireline Logs. We are checking and verifying several fields for accuracy and data continuity. We are standardizing API numbers, using the Stat of Michigan DNRRE database to fill in missing values, and removing extraneous characters from data fields. The goal is to provide for a clean and efficient workflow from spreadsheet to data share to web.

Definitions, ranges and rules for variables are being created for basic data entry to ensure consistency and reduce "outliers". Variable definitions will carry through all data files with new definitions being created as needed. The end result should provide for a means by which a "relational database" can be conceptualized.

1. About 90% of the core analysis database has been updated. About 40% of the wireline logs have been updated and reformatted.
2. We are beginning to update and reformat another critical dataset: our core collection.

C. We are reviewing models for searchable and sortable html tables to reduce dataset file size so they will download more quickly.

Attachment 2 Report on Technical Research on CO2 Sequestration and Enhanced Oil Recovery

- **Technical Research on CO2 Sequestration**

- Dr. Barnes and Hampton supervised geological characterization research activities that were conducted by graduate research assistants (Farsheed Rock and Kyle Patterson) with a focus on 2 important saline reservoir sequestration targets in Michigan:
 1. Cambrian Mount Simon Sandstone
 2. Devonian Sylvania Sandstone
- Dr. Barnes supervised Farsheed Rock who is preparing a poster on the new unconventional play of Michigan: Collingwood Member of Trenton Formation for the upcoming fall AAPG-Eastern Section Conference in Kalamazoo. This poster will address stratigraphy, subsurface distribution, core description and petrophysical evaluation.
- Dr. Hampton supervised Kyle Patterson and Farsheed Rock to analyzed pressure falloff tests for EPA class I injection wells in Michigan in the Sylvania and Mt. Simon formations.

Attachment 3 Report on Conducting Geologic and Fluid Flow Modeling

- **Compile data for geological and fluid flow models**

Dr. Hampton continues to supervise three students, Kyle Patterson, Tony Clark, Farsheed Rock Amy Manley and Rachel Salim. Clark and Rock are working on modeling using Stomp software. He also:

- Worked with Farsheed Rock who calculate the location for 12,687 mineral wells from footage and/or location descriptions given by Township, Range, Section, and quarter location, adding that data to the MRCSP Master Project.
- Worked with Farsheed Rock who hyperlinked spreadsheets of 1964 core analyses to the Master Project for easy access . The same method will be used to hyperlink MGRRE's and DEQ's digital data such as scanned well files, s mudlogs, core photographs, and thin section images.
- Taught a directed study on groundwater modeling to Amy Manley and Rachel Salim.

- Worked to obtain carbon sequestration software, including GEM from CMG in Calgary, Canada, and Petrel and ECLIPSE from Schlumberger, June, 2010, and beyond. He submitted associated paperwork to WMU's legal counsel and Office of Information Technology.
- Worked with Tony Clark to configure new hardware acquisition requests for additional research workstations and internal server to support research efforts
- Attended a partners' meeting for MRCSP in June at Columbus, Ohio; he also attended the Geologic Carbon Sequestration Site Integrity: Characterization and Monitoring Science and Technology Conference in June at Columbus, Ohio.
- **Formulation of models, integrating data, and running the models**

Dr. Hampton:

- Taught directed Kyle Patterson in a directed study on analyzing pressure falloff tests for class I injection wells in Michigan in the Sylvania and Mt. Simon formations.
- Worked with Tony Clark to produce various analytical injectivity simulation models for the Sylvania Sandstone Formation in Michigan.
- Attended a STOMP Workshop with Tony Clark in association with the Arches Simulation Project in June at Columbus, Ohio, where they ran STOMP example problems provided by Pacific Northwest National Laboratory staff.
- Co-presented a poster with Farsheed Rock and Tony Clark on Reservoir Characterization and CO₂ flow modeling of Sylvania Sandstone at 9th Annual Conference on Carbon Capture and Sequestration, in May at Pittsburgh, Pennsylvania.

Attachment 4 Report on Technology Transfer to Members of Industry and Governmental Agencies

- **Disseminating information about MICHCARB/accelerating the deployment of CC&GS in Michigan**

Dr. Barnes:

- Participated in discussions with Oakland Co. Road Commission staff Engineers (Darryl Heid) concerning piggy-back drilling opportunities with Road Commission Brine wells, May 4.
- Presented Spatial Variability of Reservoir Properties in a Stratigraphically Complex Geological Sequestration Target: The Devonian Sylvania Sandstone, Michigan Basin USA at the Rocky Mountain Section, American Association of Petroleum Geologists Annual Meeting, Durango, CO, June 14.

Attachment 5 Report on Outreach to Industry, the General Public and K-12 Community

- **Outreach to industry and the general public.** Dr. Barnes was an invited speaker at:
 - Glen Oaks Community College Science Department, Centreville, MI, April 15, along with Jerry Barkley and Sarah Simmons, Faculty hosts: Addressing Climate Change through Carbon Capture and Geological Sequestration in Michigan
 - Kellogg Go-Green Event, Monday, April 19th, Kellogg Corporation Headquarters, Battle Creek MI, Terra Mickolatcher, organizer: Addressing Climate Change through Carbon Capture and Geological Sequestration in Michigan
 - "Climate Change Vulnerabilities and Opportunities: Michigan and Beyond", a symposium sponsored by Michigan Agricultural and Experimental Station, Bioeconomy and Global Climate Change Institute, April 26, Lansing MI, Maya Fischhoff, host. Revisiting the Michigan Climate Action Plan: Carbon Capture and Geological Sequestration in Michigan

Dr. Barnes also participated in discussions with:

- Richard Hinkley, President and CEO, Dart Energy, June 21, concerning CO₂/Enhanced Oil Recovery opportunities in Richfield (Devonian) oilfields in the Michigan basin.
- Other Members of the Organizing Committee for an American Association of Petroleum Geologists Geosciences Technology Workshop: "Carbon Capture and Sequestration -- New Developments and Applications, Case Studies, Lessons Learned", Scheduled for

August 10-12, Golden CO. He was Session Co-Chair and presenter, SESSION 1: Geological Characterization & Analog, A Reservoir Geologist's Approach to Characterization of Geological Sequestration Targets.

Dr. Barnes supervised student Stephanie Ewald and staff member Lolita Krievs who are

- Compiling an annotated bibliography of references related to geological carbon sequestration and climate change. These articles are now categorized subject and likely stakeholder users. For example, an MRCSP document that explains the Midwest Regional Carbon Sequestration Partnership has a general subject of geological carbon sequestration and could be useful to stakeholders such as local leaders, the public, and government officials.
- Writing and illustrating content for several MichCarb Web pages, including the home page, the "About MichCarb" page, and the "Mission" page.