Quarterly Report

Grant No. DE-SC-0001761 **Report period:** From September 30, 2010 to December 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 CO_2 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 CO_2 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:**
Coordinating and managing data produced by multiple users is still a challenge to coordinate--with varying types of formatting needs, while still maintaining data integrity. Although this is an issue, experience is helping us overcome recurrent issues.

4) **Project problems, solutions and changes during the quarter**
(a) No significant problems occurred this quarter. However, when we reviewed our server log files, we saw that as we open our services to the world, we must increase our guard against malicious attacks to our server. Additional resources must be allocated to ensure that our server is secure and that our firewall is protective.

(b) We are experimenting with a bulletin board system as a solution for in-house discussion and documentation about data anomalies. Advantages to this resource tool include the ability for participants to express their thoughts and knowledge on a common topic at their own pace and leisure. Our goal is to encourage project collaboration, participant interaction, along with exchanging tips for data analysis *using specialized software.*

5) **Other topics of interest:** Please see attachments

5) **Status of project at end of period:** Project is on time and on budget to date.

Authors: David A. Barnes and William B. Harrison

Date: February 11, 2011

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—52 scanned and added to database
  - Wireline logs—inventoried 742 donated logs to be added to database
  - Cuttings—We have now inventoried about 65% of the State Geological Survey's cuttings collection, obtained during the last 80 years. We still estimate this inventory will be complete by next April.
- **Newly available data**
  - We were given several binders of geological engineering data from the estate of a man who worked in the Basin for more than 50 years. We have just begun to inventory and index these many volumes of reservoir data from the Prairie du Chien to incorporate in our reservoir studies.
- **Compiling all information into a digital atlas**
  - We continue to update our databases, resolving discrepancies where necessary. Major considerations include changes in well names, well identification, well ownership, and purpose (i.e. oil, gas, mineral) which may lead to multiple counts of a single well. This

process is time consuming because information from several sources must be coordinated to obtain the best history for any given well.
    - We continue to implement our digital asset management system (DAMS), working primarily with the State's cuttings collection.
    - Updating MichCarb's Web site—please see attachment 5.

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

- **Technical Research on CO2 Sequestration**
    - Dr. Barnes and Hampton continue to supervise geological characterization research activities conducted by graduate research assistants (Shannon Towne, Kate Pollard, Beth VandenBerg, and Steve Zdan), focusing on two important saline reservoir sequestration targets in Michigan:
        1. Cambrian Mount Simon Sandstone
        2. Devonian Sylvania Sandstone
- **Dr. Barnes also supervised digital well log data collection by undergraduate student assistants (Greg Sawatski, Brandon Vanderbeek, and Jessica Slagter).**
- Dr. Hampton recruited Beth VandenBerg, new Ph.D. student, to join our research group; advised Tony Clark and Amy Manley; and helped advise and review work from Kyle Patterson and Farsheed Rock.
    - See also Attachment 3 below.

Attachment 3 Report on *Conducting Geologic and Fluid Flow Modeling*

- **Dr. Hampton focused on three goals:**

1. Working with graduate students Tony Clark, Amy Manley, Kyle Patterson, and Farsheed Rock to help them accomplish project goals, including conceptual geologic model formulation, deployment of modeling software, such as STOMP, and general guidance and coordination.
2. Acquiring new modeling software: Petrel and Eclipse (obtained in September and installed on the MGREE server by Tony Clark). GEM was obtained from Computer Modeling Group, Ltd. and installed.
3. Dr. Hampton and Tony Clark conducted a "virtual 3-day modeling trip" to PNNL in early January 2011.

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**

1. Dr. Hampton attended meetings of the carbon sequestration research group; previewed and prepared Mike Celia's Webinar for that group; presented Webinar by colleague from U. Wyoming for that group.
2. Dr. Barnes met several times with colleagues from Consumers Energy to discuss potential CO2 sequestration.
3. Dr. Barnes had several conferences with personnel from Core Energy concerning on-going CO2 injection by that group in the Niagaran Reef trend.

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

- **Outreach to industry and the general public.**

Statistics for our MichCarb web site show that at least 983 visitors have accessed our resources during this quarter. Currently our site is indexed with Google and Yahoo. We continue to monitor and update our pages and will be submitting our site for indexing with other major search engines. Unfortunately, upon reviewing the log files, it has become evident that as we open our services to the world, we must

increase our guard against malicious attacks to our server. Additional resources must be allocated to ensure that our server is secure and that our firewall is protective.

- **Outreach to industry**—see Attachment 4 above
- **Outreach to the K-12 and higher education community**

MGRRE's K-12 Outreach Program, CoreKids, continued to welcome school groups to MGRRE and to make visits to public schools, primarily in southwestern Michigan.

A new interactive module for secondary students was introduced so the students could "behave" as carbon atoms and move from rocks to machines, to animals, to water systems and to the atmosphere. This demonstrates how so much CO2 is in the atmosphere.

Dr. Hampton taught GEOS 6120, Advanced Hydrogeology, during Fall 2010, with considerable content aimed at helping students understand multiphase flow and modeling, essential content for carbon sequestration research.

Papers on carbon sequestration were presented in Western Michigan University's GEOS 6120 by Kate Pollard and Beth VandenBerg; Tony Clark and Amy Manley also presented papers on carbon sequestration modeling this class.