

DOE-ARRA Geologic Sequestration
Training and Research
2011 Yearly Review Meeting

Project #: DE-FE0002028

**Title: Carbon Dioxide Sealing Capacity:
Textural or Compositional Controls?**

Brooklyn College of the City University of
New York

Presenter: Prof. Constantin Cranganu
Dept. of Earth and Environmental Sciences
February 24-26, 2011

Project Participants

- PI: Prof. Constantin Cranganu
- Sadiqua Azad, PhD student
- Kieva Watson, Undergraduate student

Introduction

- **Background of the project**

- We proposed to investigate the role of textural and compositional parameters that control the carbon dioxide (CO₂) sealing capacity of cap rocks.

- **Anticipated 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. Further, it will advance knowledge of the sealing capacity of rocks such as shales and anhydrites and, in turn, provide a better understanding of the processes that take place in geologic reservoirs that are subject to CO₂ injection.
- The research will also fill a gap that exists in the national database regarding the sealing capacity of caprocks, with special reference to existing and potential CCS targets.

Project Objectives

- **Major Objective**

- The major objective of this research is to test whether *textural parameters* (e.g., the pore-throat size, distribution, geometry, and sorting, grain size, etc.) or *compositional parameters* (e.g., compaction, mineralogical content, cementation, organic matter content, carbonate content, etc.) of cap rocks control their CO₂ sealing capacity.

- **Secondary Objectives**

- Advancing scientific discovery and understanding through proposed activity that will be intimately related to promoting teaching, training and learning activities at Brooklyn College. Prof. Cranganu teaches an upper tier core course, titled “Climate Change – Torn between Myth and Fact”. During course lectures and practice activities, undergraduate students from various departments will learn about the most important environmental issues raised by increased concentration of CO₂ in the atmosphere and the efforts taken by many countries, including USA, to reduce the amount of CO₂. One of the efforts, namely carbon dioxide sequestration, will be exemplified by our anticipated results.
- Students will also be trained in incorporating new data from our database in existing databases that will be provided to them during the course and practice activities.

Project Funding

- Total Project Cost: \$296,881
- DOE Share: \$296,881
- Non-DOE Cost Share: \$0
- Cost Share Provider: N/A

Highlights of Project to Date

- **Accomplishment 1:**

- A detailed project plan with duties for each student was created. A plan for constant monitoring and revision of the Project Plan was established to support the changes necessary as the results lead to new information

- **Accomplishment 2:**

- Project Kick-off Meeting was held on **March 3, 2010**

- **Accomplishment 3:**

- An Educational Program was instituted on **June 30, 2010**

- **Accomplishment 4:**

- Complete collection of 50 representative samples of cap rocks was done by **December 31, 2010**

Highlights of Project to Date

- **Accomplishment 4:**

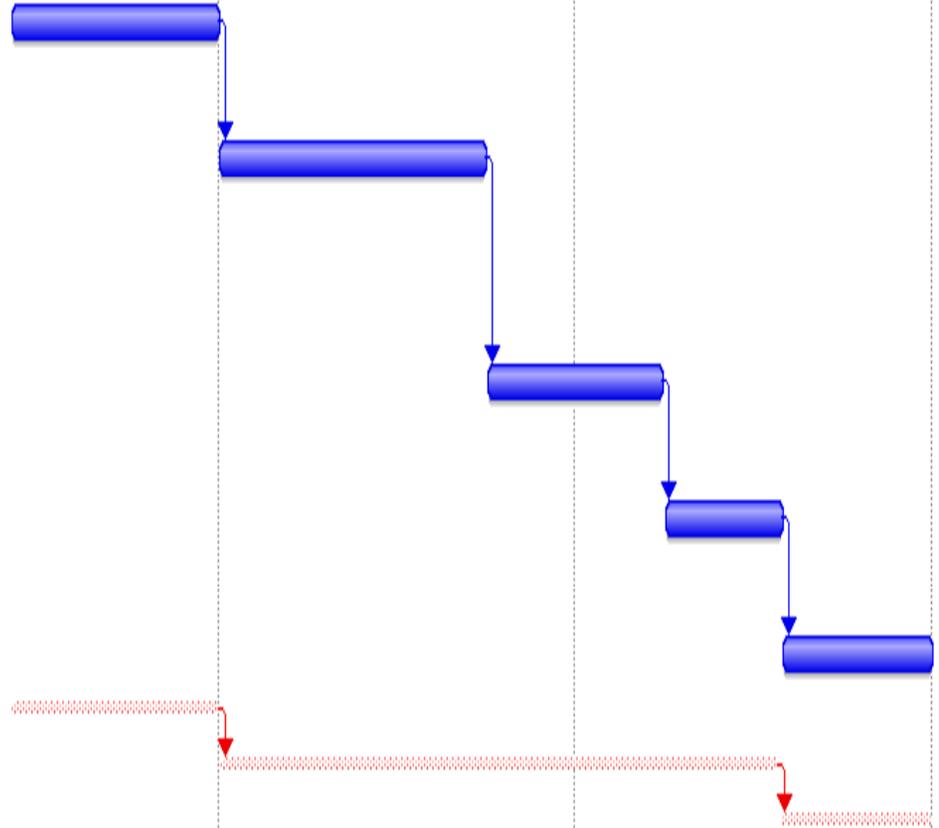
- The students working on this project have performed an intense and rigorous literature search;
- Have been trained in performing the measurements in the lab using our Autopore MIP, Particle Size Analyzer (Sedigraph) and Physisorption Analyzer (Gemini);
- Have been trained in using SEM/EDS equipment;
- Have been trained in using ORIGIN software

Tasks – Overview

Task No.	Task Description	Task Duration	Task Funding
1	Project Management and Planning -Complete collection of 50 representative samples of cap rock ; -kick-off meeting; -educational program instituted.	12/01/2009 – 12/31/2010	\$131,834.54
2	Data Collecting -Complete construction of capillary-pressure curves -Complete other textural measurements, including specific surface area, preferred orientation of matrix clay minerals, and orientation and aspect of ratio of organic particles.	01/01/2011 – 12/31/2011	\$
3	Data Interpretation and Hypotheses Testing -Complete compositional measurements, including EDS, TOC, and microscopy; -Use data collected to test either hypothesis; -Establish relationships between sealing capacity of cap rocks and both textural and compositional parameters.; -Produce the final report of the research .	01/01/2012- 30/11/2012	\$

Project Schedule

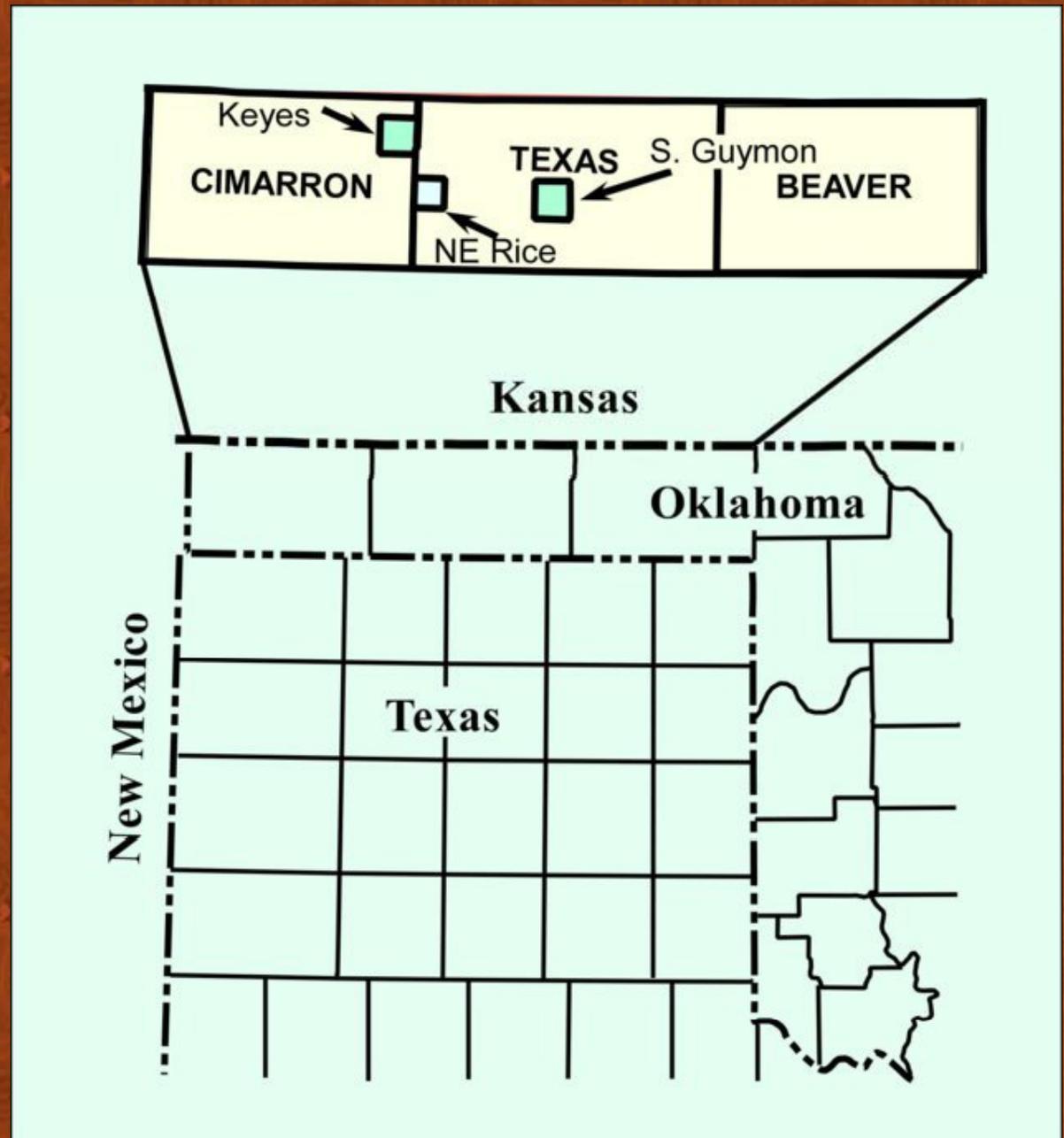
ID	Task Name	Duration	Start	Finish	Predecessor	Resource Names	2010				2011				2012				2013
							Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
1	1.1. Project Management and Planning - Sample Collection	7.7 mons	Tue 6/1/10	Fri 12/31/10															
2	2.1 Data Collecting - MIP measurements	197 days?	Sat 1/1/11	Fri 9/30/11															
3	2.2 Data Collecting - Conduct other textural measurements	130 days?	Mon 10/3/11	Fri 3/30/12															
4	2.3. Data Collecting - Conduct compositional measurements	87 days?	Mon 4/2/12	Tue 7/31/12															
5	3.3 Testing Hypotheses	109 days?	Wed 8/1/12	Mon 12/31/12															
6	Milestone - Phase I	154 days?	Tue 6/1/10	Fri 12/31/10															
7	Milestone - Phase II	412 days?	Sat 1/1/11	Fri 7/27/12															
8	Milestone - Phase III	111 days?	Mon 7/30/12	Mon 12/31/12															



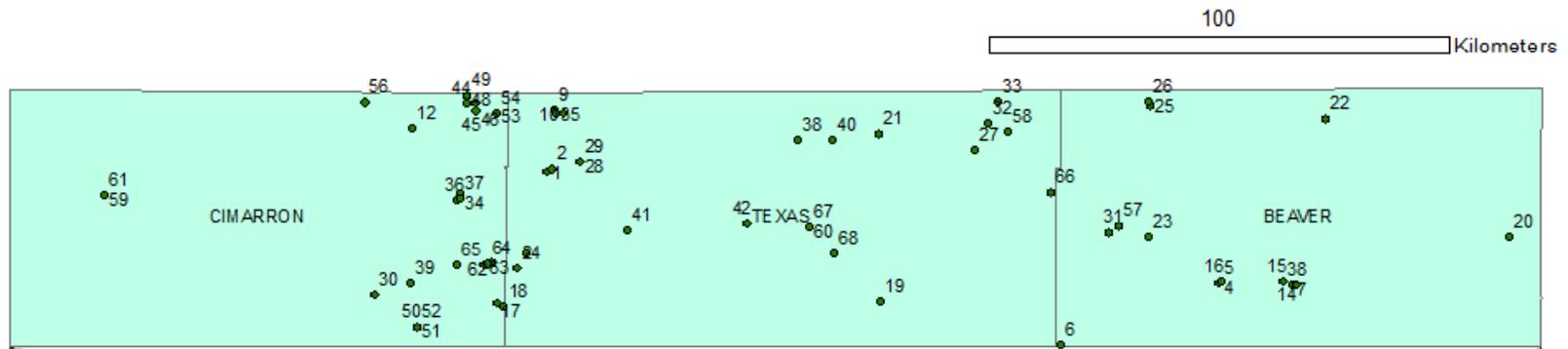
Task Discussion

- Task Name/Goal
 - Project Management and Planning
- Key Subtasks
 - Complete collection of 50 representative samples of caprocks
- Responsible parties (including students)
- Task Status (100 % complete)
- Major accomplishment(s) –see next

The three gas fields (Keys, NE Rice, and S. Guymon) to be investigated in this project

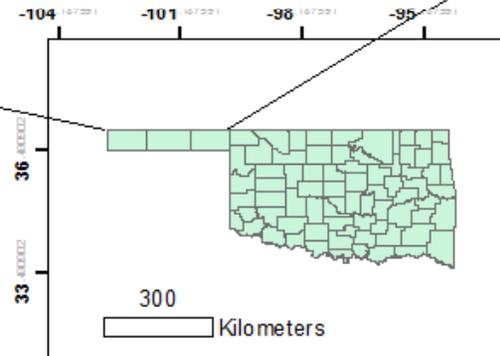


Location Of Samples In the Oklahoma Panhandle



Legend

- Sample_Locations
- County_Oklahoma



ID #	FILE #	COUNTY	Formation	Top (ft)	Bottom (ft)	Lat	Long	Sample Image	Sample Description
1	120	TEXAS	Morrowan	4419	4466	36.84006	-101.94854	Pic	Gray medium grained quartz sandstone
2	163	TEXAS	Morrowan	4410	4459	36.84413	-101.93947	pic	Light brown medium to coarse grained sandstone
3	239	BEAVER	Marmaton	6720	6839	36.61827	-100.4896	Pic	Black fine grained lime mudstone
4	269	BEAVER	Des Moinesian	6430	6533	36.62177	-100.63258	Pic	Black fine grained lime mudstone
5	328	BEAVER	Permian	866	1030	36.50206	-100.94257	pic	reddish waxy anhydrite
6	334	BEAVER	Marmaton	6646	6676	36.61827	-100.4896	Pic	Black fine grained lime mudstone
7	868	TEXAS	Purdy	4524	4547	36.95927	-101.93526	Pic	Black fine grained Fissile shale
8	874	TEXAS	Morrowan	4559	4569	36.95239	-101.91719	pic	dark gray fine grained limestone
9	878	TEXAS	Cherokee	4524	4600	36.6806	-101.98941	Pic	Black fine grained lime mudstone
10	900	CIMARRON	Morrowan	4496	4557	36.92432	-102.21267	Pic	Light brown fine grained quartz sandstone
11	946	BEAVER	Marmaton	6627	6741	36.61796	-100.48026	pic	Black fine grained mudstone
12	953	BEAVER	Marmaton	6403	6462	36.62537	-100.50748	pic	Black fine grained mudstone
13	3152	CIMARRON	Morrowan	4817	4916	36.53576	-102.20474	Pic	Black fine grained layered calcareous shale

3952-5 (6781-6784)

Black Mudstone



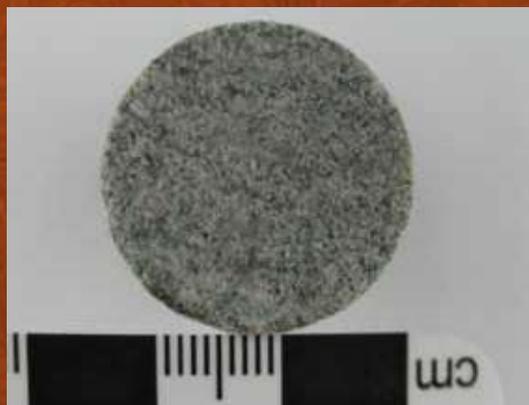
239-C-19 (6974-6977)

Black Limestone (Fine Grained)



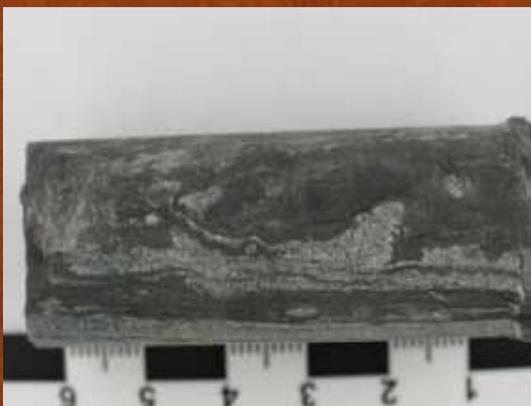
3115-4 (6544-6547)

Dark Gray Limestone (Medium-Coarse Grained)



3979-3(6472-6483)

- Black Shale (Fine Grained)



4210-8 (4536-4559)

- Dark Grey Shale (fine grained)



Major issues/problems

- One instrument (Gemini Physisorption Analyzer) suffered a power surge during a violent summer storm (during student training).
- It was sent to the manufacturer for repairs. It was recently returned and will have to check its functionality and calibration.
- Since this instrument was a floor sample when purchased, the manufacturer said no warranty is implied if does not work in specs.

Major issues/problems

- Another instrument (Sedigraph grain size analyzer) requires samples to be milled below $0.065\ \mu\text{m}$.
- We tried to use agate ball machine, but our samples are too hard to be crushed and milled by agate balls.
- Suggestion was made to purchase a jar and balls made of zircon oxide (with a hardness close to 9), but these supplies are very expensive (\$4,500+)
- A cost analysis shows it might be worth it to outsource the measurements performed by those two instruments.

Major issues/problems

- The PhD student has expressed consideration of moving out of the country;
- The undergraduate student will be graduating this May;
- This creates personnel problems and I will have to advertise the positions to hire other students as research assistants

Anticipated Efforts for the Coming Year

- **Activity 1:** Complete construction of capillary-pressure curves
- **Activity 2:** Complete other textural measurements, including specific surface area, preferred orientation of matrix clay minerals, and orientation and aspect of ratio of organic particles

PI Contact Information

- If you have any questions or would be interested in collaboration please contact
- cranganu@brooklyn.cuny.edu