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

Project DE-FE0001790
Title: Monitoring and Numerical Modeling of Shallow CO2 Injection, Greene County, Missouri

Missouri State University

Presenter: Dr. Charles Rovey Department of Geography, Geology, and Planning

February 23, 2011

Project Participants

- Charles Rovey (PI)
- Doug Gouzie (PI)
- Rich Biagioni (PI)
  - David Butcher (RA)
  - Nathan Diaz (RA)
  - Nelson Rono (RA)

Introduction

- Background:

Follow up on a previous sequestration project: City Utilities (CU) Shallow Sequestration Program, Greene County, Missouri.

- Anticipated benefits:

Student training in multiphase flow simulation , chemical modeling, GIS techniques, and monitoring techniques related to CO2 sequestration.

Project Objectives

- Major Objective

  - Student Training

- Secondary Objectives

  - Multiphase flow model of CO2 injection.
  - Innovated instrumentation/monitoring techniques.
  - GIS database pore-fluid chemistry within and above potential injection zones in Missouri

Project Funding

- Total Project Cost: $293,118.
- DOE Share: $293,118.
- Non-DOE Cost Share: $0.0
- Cost Share Provider: (None)

Highlights of Project to Date

- Simulation of CO2-migration tutorial exercise in TOUGH2 documentation.
  - Conceptual model of proposed injection zone:
    - Bulk permeability & vertical distribution.
    - Bulk porosity.
    - Number of layers.
    - Medium compressablity.
    - Fractured medium, possibly dual porosity in upper few feet –Cannot be modeled as a simple porous medium!
- Design of innovative “U-tube” sampler that will be forward compatible with CU and DGLS projects.
- Completion of 3 (preliminary) GIS layers and chemical facies maps.

Tasks – Overview

(Include major tasks only)

Task No.	Task Description	Task Duration	Task Funding
1.0	Project Management and Planning	12/01/2009 – 12/31/2012	
2.0	Student Training in Numerical Modeling	1/1/10-12/31/2012	
3.0	Instrumentation and Monitoring	1/1/10-12/31/2012	
4.0	GIS Data Base	1/1/10-12/31-2012	

Project Schedule

YEAR	2010				2011				2012			
Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Task 1.0 Project Management and Planning												
Subtask 1.1 Project Management Plan												
Subtask 1.2 Project Management												
Task 2.0 Student Training in Numerical Modeling												
Subtask 2.1 Recruit Graduate RA												
Subtask 2.2 Literature Review Multiphase Flow												
Subtask 2.3 Acquire TOUGH2 Software												
Subtask 2.4 TOUGH2 Tutorials												
Subtask 2.5 TOUGH2 Calibration												
Subtask 2.6 Simulation of Trial CO2 Injection												
Subtask 2.7 RA Internship												
Subtask 2.8 Coupled Simulation & geochemical Reaction												
Subtask 2.8.1 Long-Term Simulation												
Task 3.0 Instrumentation and Monitoring												
Subtask 3.1 Recruit Graduate RA												
Subtask 3.2 Literature Review Tracers												
Subtask 3.3 Literature Review Monitoring												
Subtask 3.4 Tracer Selection												
Subtask 3.5 MO DNR Permit for Tracer												
Subtask 3.6 Initial Tracer Monitoring							?					
Subtask 3.7 Plan for Long-Term Monitoring												
Subtask 3.8 RA Internship												
Subtask 3.9 Implementation of Long-Term Monitoring Plan												
Task 4.0 GIS Data Base												
Subtask 4.1 Recruit Graduate RA												
Subtask 4.2 Literature Review Geochem. Data												
Subtask 4.3 Background Wells, Water Chem.												
Subtask 4.3.1 Select and Sort Wells by Stratigraphic Unit												
Subtask 4.3.2 Locate Additional monitoring and Water-Quality Data												
Subtask 4.4 GIS Data Base, Chemical Data												
Subtask 4.5 Chemical Facies Maps												
Subtask 4.6 RA Internship												

Discussion

- Task 2.0: Student Training in Numerical Modeling.
- Key Subtasks: 2.1: Graduate RA

  2.2: Literature Review Multiphase Flow
- Responsible parties: C. Rovey (PI), David Butcher (RA)
- Task Status: Initially completed, but see below.
- Major accomplishment(s)
- Major issues/problems: Graduate Research Assistant resigned; Fracture-dominated system means that we need more literature review on relative-permeability characteristics of nonporous media.

Discussion

- Task 2.0: Student Training in Numerical Modeling.
- Key Subtasks: 2.3: Acquire TOUGH@ Software

  2.4: TOUGH2 Tutorials

Responsible parties: C. Rovey (PI), David Butcher (RA)-Resigned

- Task Status: Software acquire and then reacquired. (Task 2.4 ~20%)
- Major accomplishment(s): Tutorial 1 completed.
- Major issues/problems: (1)Compatibility issues with TOUGH2 (source) code. (2)Need to replace RA.

Discussion

- Task 3.0: Instrumentation and Monitoring.
- Key Subtasks: 3.1: Graduate RA

  3.2: Literature Review Tracers

  3.3: Literature Review Monitoring

Responsible parties: R. Biagioni (PI), Nelson Rono (RA)

Task Status: Complete

- Major accomplishment(s):
- Major issues/problems:

Discussion

- Task 3.0: Instrumentation and Monitoring.
- Key Subtasks: 3.4 Tracer Selection

Responsible parties: R. Biagioni (PI), Nelson Rono (RA)

Task Status: Complete

- Major accomplishment(s): Sulfur Hexaflouride (SF_6)
- Major issues/problems:

Discussion

- Task 3.0: Instrumentation and Monitoring.
- Key Subtasks: 3.5: MO DNR Permit for Tracer

Responsible parties: R. Biagioni (PI), Nelson Rono (RA)

Task Status: On Hold.

Major accomplishment(s):

Major issues/problems: City Utilities will probably not seek injection permit for the Greene County site due to low TDS values within planned injection zone.

Opportunity: The water chemistry seems to imply a very effective regional isolation between Missouri's lowest sandstones and overlying aquifers. RA Rono is beginning geochemical modeling to assess recharge scenarios and their implications.

Discussion

- Task 3.0: Instrumentation and Monitoring.
- Key Subtasks: 3.6: Initial Tracer Monitoring

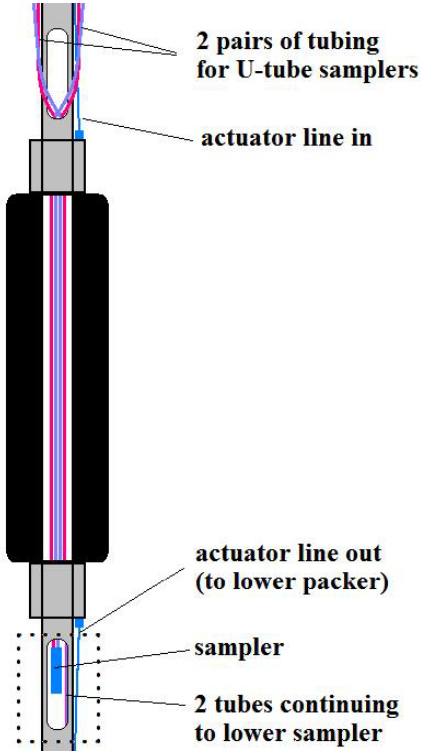
Responsible parties: R. Biagioni (PI), Nelson Rono (RA)

Task Status: Ongoing.

Major accomplishment(s): Designed a combination Straddle-Packer/U-tube sampler to sample and monitor pore-fluids under *in situ* pressure.

Major issues/problems: City Utilities will probably not seek injection permit for the Greene County site.

Opportunities: Device will be employed with RAs During summer internship with DGLS.



Discussion

- Task 4.0: GIS Data Base
- Key Subtasks: 4.1: Graduate RA
- 4.2: Literature Review

Responsible parties: D. Gouzie (PI), Nate Diaz (RA)

Task Status: Complete.

Major accomplishment(s): Confirmed existence of much unpublished data.

Major issues/problems: Confirmed that most data bases of pore-fluid chemistry do not directly control for stratigraphic interval.

Discussion

- Task 4.0: GIS Data Base
- Key Subtasks: 4.3 Background Wells.

Responsible parties: D. Gouzie (PI), Nate Diaz (RA)

Task Status: Ongoing. (~5% complete)

Major accomplishment(s):

Major issues/problems:

Discussion

- Task 4.0: GIS Data Base
- Key Subtasks: 4.4 GIS Data Base, Chemical Data.
- 4.5 Chemical Facies Maps.

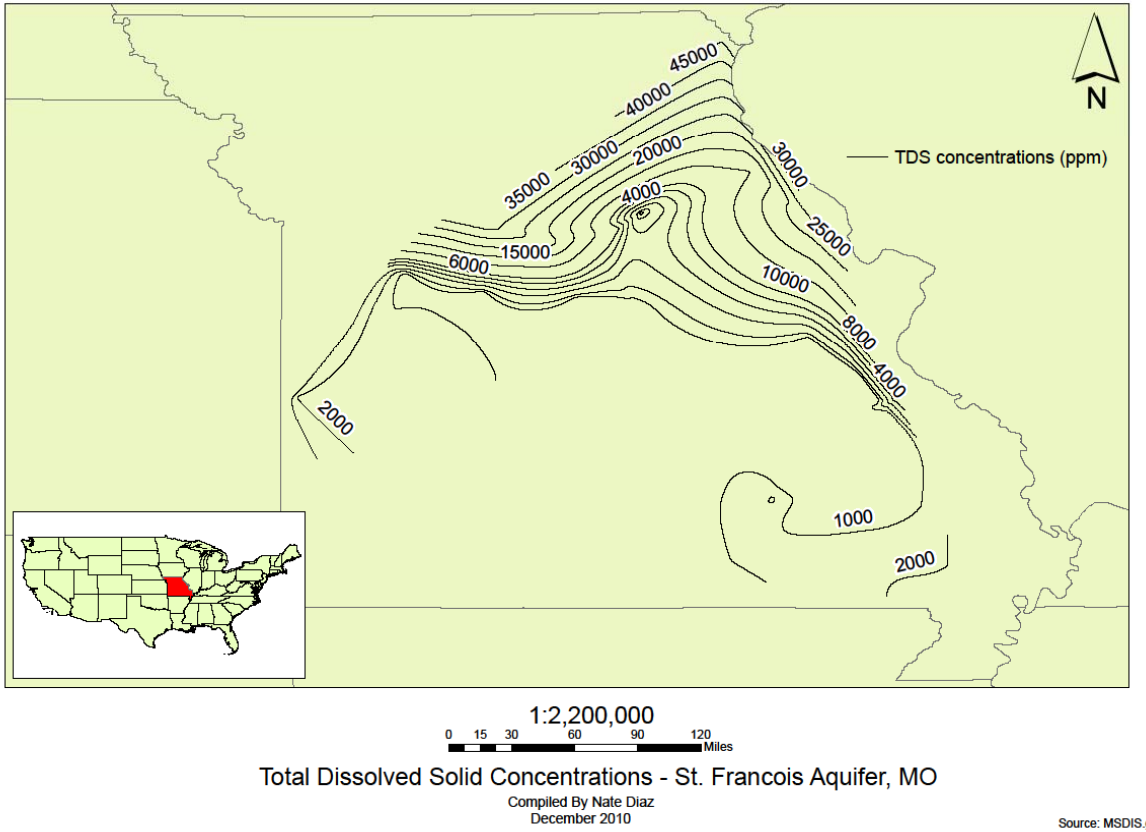
Responsible parties: D. Gouzie (PI), Nate Diaz (RA)

Task Status: Ongoing (~ 5% complete; ahead of schedule).

Major accomplishment(s): First (preliminary layers and maps complete.

Major issues/problems:

Discussion

- Task 4.0: GIS Data Base
- Key Subtasks: 4.4 GIS Data Base, Chemical Data.
- 

Total Dissolved Solid Concentrations - St. Francois Aquifer, MO

Compiled By Nate Diaz
December 2010

Source: MSDIS.gov

Project Milestones

(Include HQ and project milestones)

Milestone	Planned Completion Date	Actual Completion Date
Project Kick-off Meeting	3/31/10	2/24/2010
Educational Program Instituted	6/30/10	4/22/2010
MO DNR permit for tracer	9/30/10	On Hold
Semi-Annual Progress Report	9/30/10	10/6/2010
Complete TOUGH2 tutorials	12/31/10	

Project Milestones

(Include HQ and project milestones)

Milestone	Planned Completion Date	Actual Completion Date
Initial monitoring for tracer injection	2/1/2011	On hold
Yearly Review Meeting	3/31/2011	2/23/2011
TOUGH2 calibration	7/15/2011	
RA internships at DGLS	8/31/2011	
GIS database	1/15/2012	

Project Milestones

(Include HQ and project milestones)

Milestone	Planned Completion Date	Actual Completion Date
Yearly Review Meeting	3/30/2012	
Long-term monitoring plan	8/1/2012	On hold
Simulation of long-term CO2 injection	12/1/2012	
Chemical facies maps	12/1/2012	

Anticipated Efforts for the Coming Year

Effort	Task
Update PMP	
Complete TOUGH2 tutorials	(2.4)
TOUGH2 “calibration”	(2.5)
U-tube fabrication	(3.6)
(Continue) with water chemistry	(4.3-4.5)
GIS data base, & chemical facies maps	
RA internships at DGLS	(3.8, 4.6)

PI Contact Information

- If you have any questions or would be interested in collaboration please contact

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