Abstract

The project goal is to identify potential saline aquifer reservoir sites for storage of >50 million tonnes of CO2, as part of the Integrated Carbon Capture and Storage (ICCS) for Kansas. An efficient, cost-effective saline aquifer storage concept is called for since commercial-scale CCS will require several billion tonnes of CO2. Storage reservoirs can be evaluated by: 1) field-scale studies, and 2) modeling high-resolution systems. The latter involves detailed mapping of potential storage sites (geologic, fluid, and permeability properties) and testing fluids and rocks through gas saturation, monitoring the change in pressure through time, and modeling CO2 plume migration in place.

Introduction

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Simulation of CO2 subsurface injection

A workflow (Figure 1) was developed to simulate injection of CO2 into a three-dimensional cellular model. The workflow (Figure 1) indicated that the Forest City Basin is likely not capable of storing >50 Mt of CO2. Model development and simulation results of the initial Forest City Basin targets (Figure, left) were used to evaluate the potential for induced seismicity. Here, we present 3-D cellular geologic models of the Vincennes Formation and Arbuckle Group target aquifers selected for long-term storage.

Background:

Geologic structure and isopach maps were generated in Petra™ and are used as isochore models to simulate CO2 plume migration in the Davis Ranch field structure. Simulations were used to determine the volume of CO2 stored, resulting rise in pore pressure and fluid saturation, and change in pressure through time.

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The Southwestern Kansas ‘North Hugoton’ Storage Complex

I. Location of four plausible storage sites within the North Hugoton Storage Complex. Map is the structure on the top of the Meramec (Mississippian). Patterson is the primary site and the others are alternative sites.

J. The Lakin and Pleasant Prairie top of Meramac (Mississippian) structure.

K. 3D cellular permeability model of the Lakin Field identifying key horizons.

L. 3D cellular permeability model of the Pleasant Prairie field identifying key structure and horizons.

M. A fence diagram of the Lakin Model centered at a key well. The well log is upscaled to the ‘fine grid’ which is upscaled to the ‘course grid’ prior to simulation.

N. A visualization of the well penetrations into the Pleasant Prairie model.

Lakin Model

Pleasant Prairie Model

John Creek Simulation

Pleasant Prairie Simulation

Davis Ranch Simulation

Rupp Simulation

Summary of Results:

Future Work:

This is an exciting time for CO2 storage research. Our team is well prepared with the technical evaluations at all five of the geologic sites. The upcoming steps include conducting a high-level technical analysis of the geologic storage complexes using NHM-MIPI-C and other tools for an integrated assessment. The geology and petrophysical properties of the rock and mineral volumes will be evaluated in terms of capacity, seal, faults, seismicity, pressure, and examination of existing wells, seepage, integrity, and injectivity. The sites in the North Hugoton Storage Complex have been designated as primary and alternative candidates for Phase II Storage. A recent CCS conference hosted in Kansas involved representatives from many diverse backgrounds including regulatory, political, oil and gas producers, CO2 producers, lawyers, geologic and engineering consultants, and researching academics. Kansas has assembled an excellent team to tackle the challenges ahead.