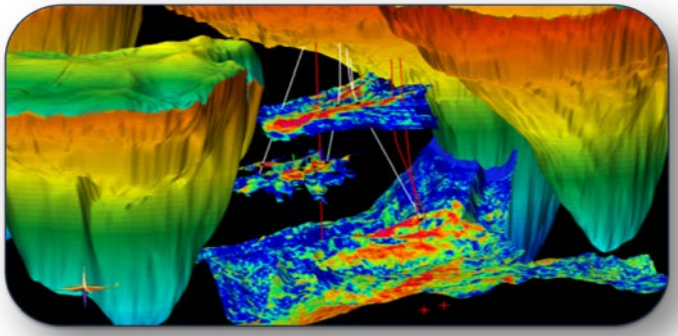
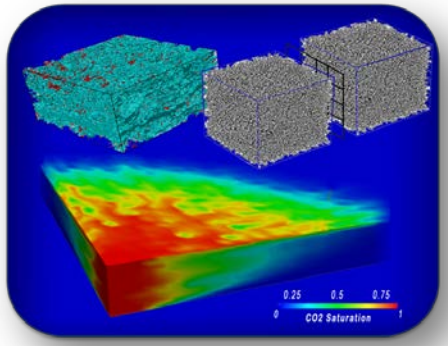
SAND2015-2726PE

Exceptional service in the national interest

Sandia National Laboratories





Brief History of Center for Frontiers of Subsurface Energy Security

Marianne C. Walck

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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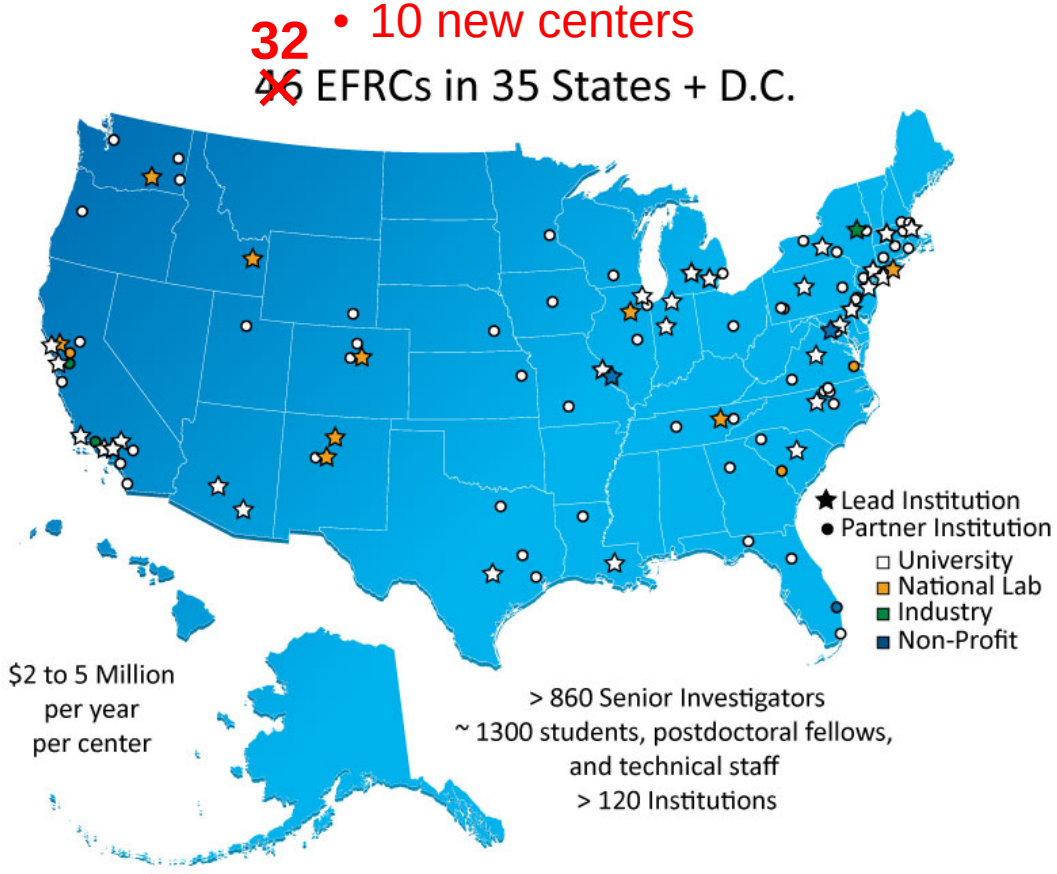
The Energy Frontier Research Centers Aim to Accelerate Discovery Science for Energy Technologies

- Over 200 proposal submitted
- 22 of 46 renewed centers
- 10 new centers

- Center started August 2009
- 5 year program
- $15M ($7M to SNL)
- **CFSES is one of 2 geosciences related EFRCs**

- Renewal starts August 2014
- 4 year program
- $12M ($5.6M to SNL)
- **CFSES is one of 3 geosciences related EFRCs**



Reviews Made it Difficult for DOE to Reject The Renewal Proposal

Seven reviewers → Five "Excellents" → One "Very Good"

- "***Outstanding*** proposal that is well conceptualized."
- "This proposal is a ***winner***."
- "I suspect that this EFRC many have the ***most cohesive team of researchers*** among all the proposals submitted for this FOA …."
- "… the ***results will be important*** for a number of fundamental problems in subsurface fluid-rock-chemistry-geomechanics that are much broader than the issues related to CO_2 sequestration that are described in this proposal."
- "It is ***extremely well-written*** and concise."
- "I would recommend that the succinctly written Section 1.2 be ***used as a model*** for future EFRC proposals if this program continues. It is very well written."
- "The management plan clearly describes mechanisms to encourage synergy among the investigators through discussions and decision-making about progress at all levels of activities in the EFRC."
- "It has a solid, proven management and research team that will move the science forward."

CFSES I

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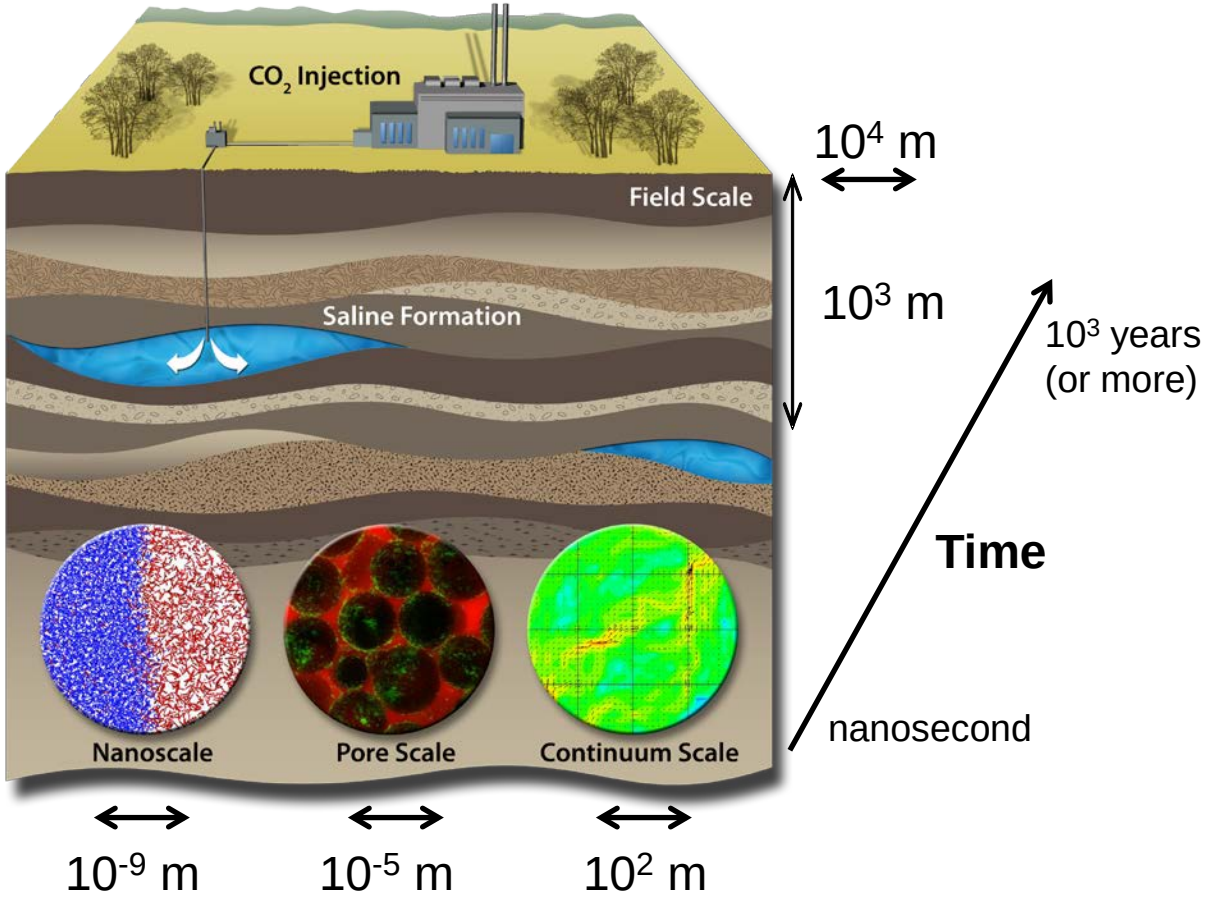
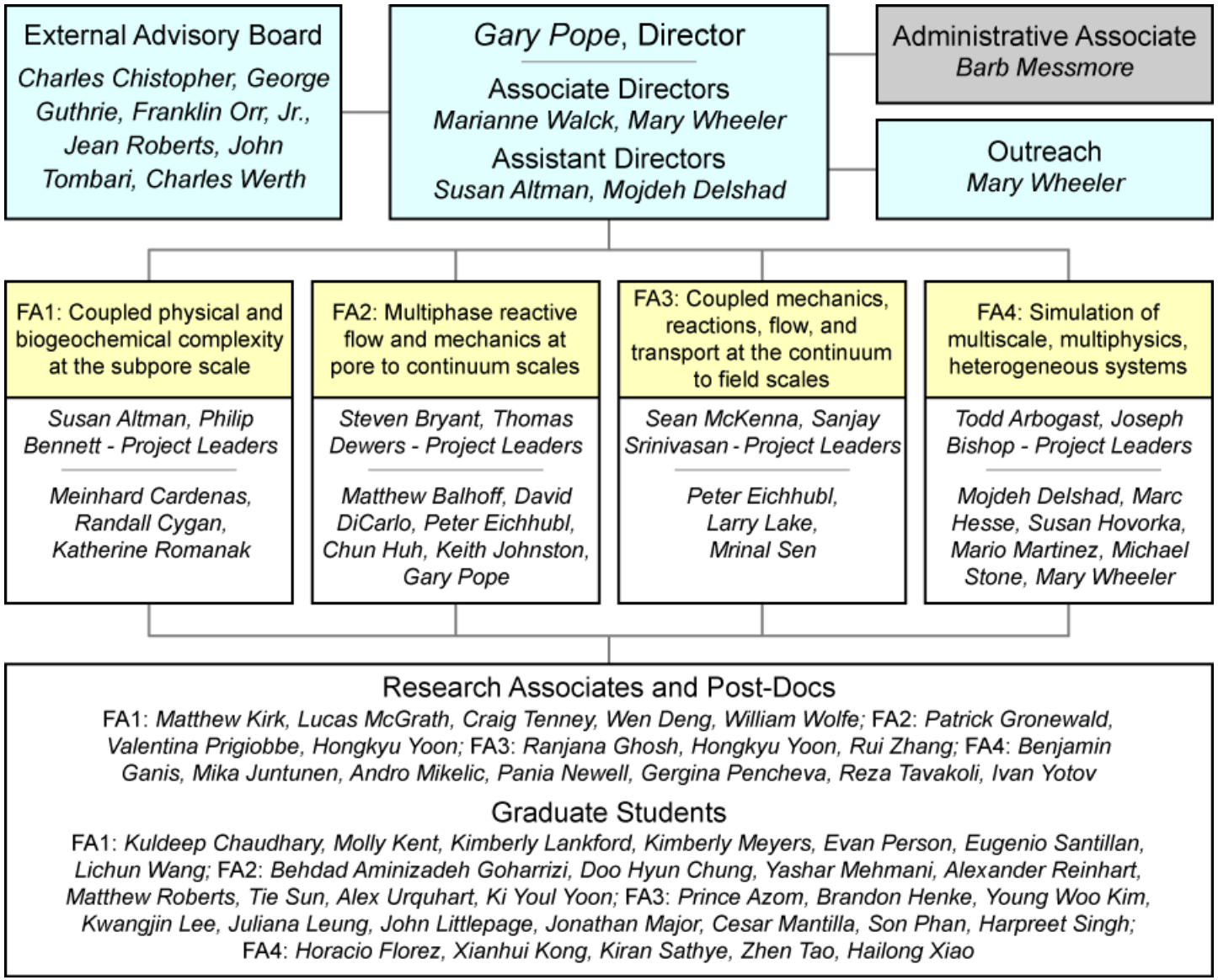
A Multi-scale, Multi-physics Approach is Needed to Study Underground CO_2 Storage

Goal

Advance scientific understanding of subsurface biological, chemical and physical phenomena related to the storage of energy byproducts using an integrated experimental and modeling approach



CFSES I Structure



Structure Designed to Integrate Between Focus Areas and Institutions

- Mix of PI's from each institution
- Multidisciplinary backgrounds
- Multidisciplinary integrated team

THE UNIVERSITY OF TEXAS AT AUSTIN

Sandia National Laboratories

FA-1: Molecular – Pore Scale


Susan Altman


Philip Bennett


Bayani Cardenas


Randy Cygan

FA-2: Pore – Continuum Scale


Matthew Balhoff


Steven Bryant


Thomas Dewers


David DiCarlo


Chun Huh


Keith Johnston

FA-3: Continuum – Field Scale


Peter Eichhubl


Larry Lake


Sean McKenna


Mrinal Sen


Sanjay Srinivasan

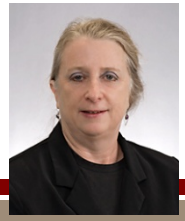
FA-4: Model Development and Simulation


Todd Arbogast


Joe Bishop


Mojdeh Delshad


Marc Hesse


Susan Hovorka

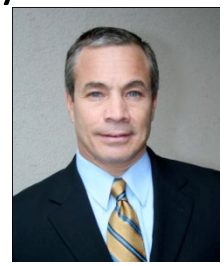

Mario Martinez


Mary Wheeler

CFSES I External Advisory Board

- Franklin “Lynn” Orr, Jr.
  - Stanford University

- George Guthrie
  - National Energy Technologies Laboratory



- John Tombari
  - Schlumberger

- Jean Roberts
  - Paris-Rocquencourt research center of INRIA

- Charles Werth
  - University of Illinois

- Charles Christopher
  - Retired Consultant for BP

Change in CFSES Leadership

Gary Pope
July 31, 2009 – July 1, 2013

Steven Bryant
July 1, 2013 – July 31, 2014

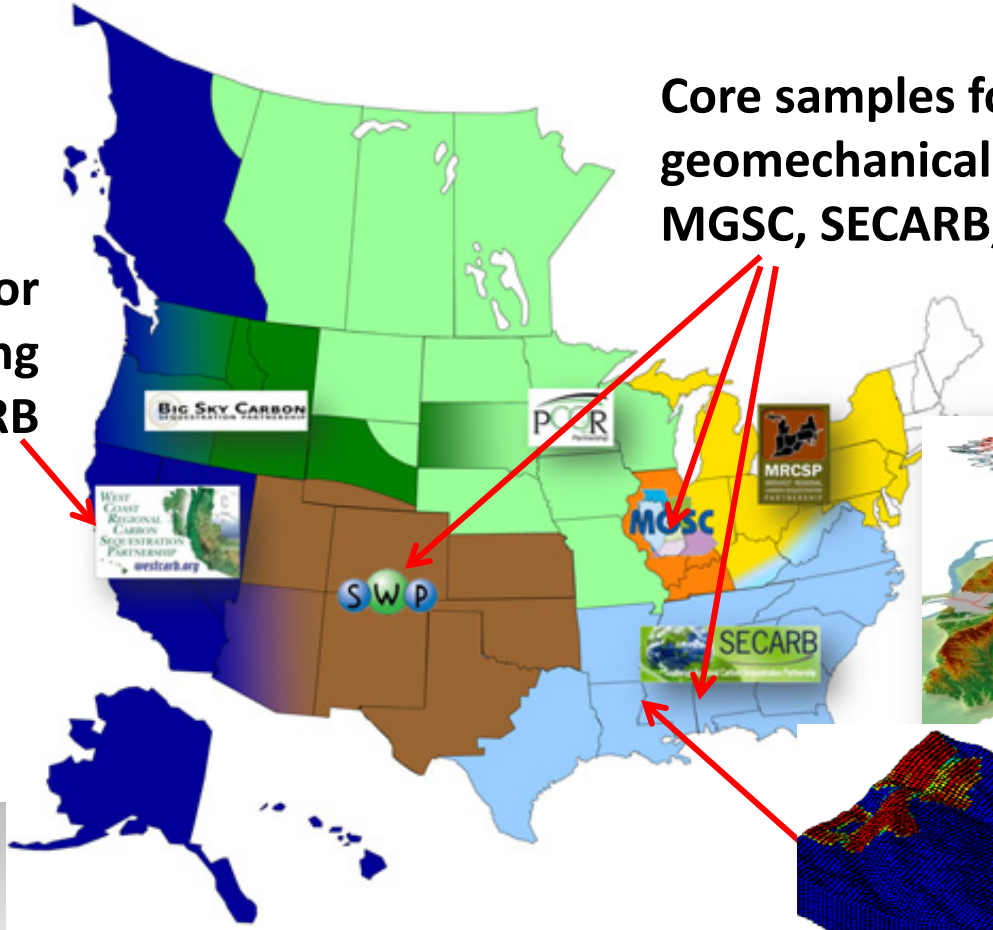
Larry Lake
CFSES 2

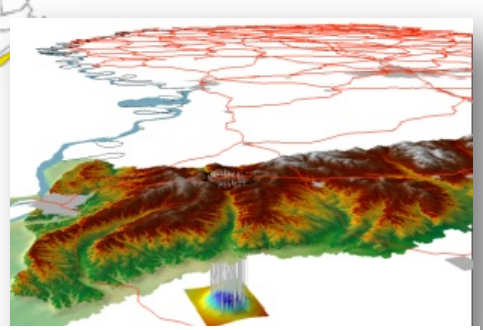
Integrating with NETL Partnerships and UT-Bureau of Economic Geology

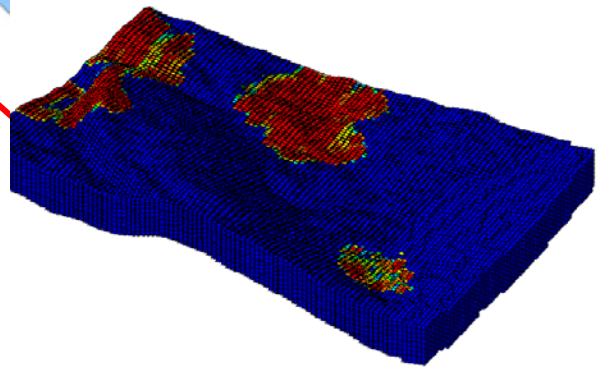
Sandia National Laboratories

Core samples for geomechanical testing from MGSC, SECARB, and SWP

Samples for microbiological testing from WESTCARB



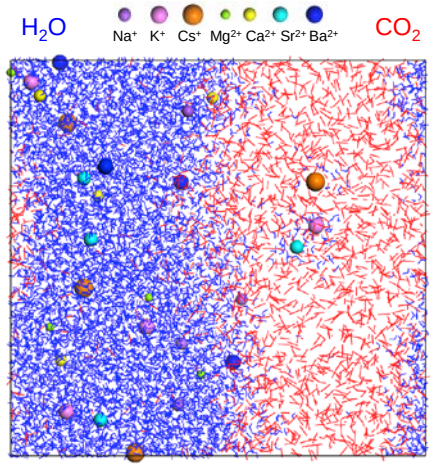


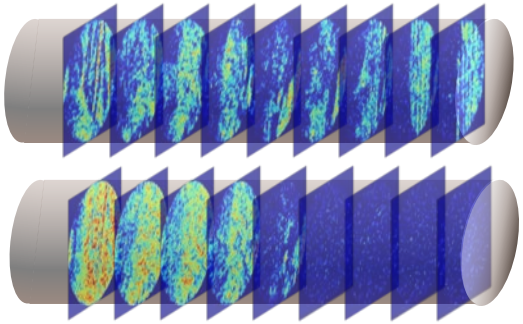


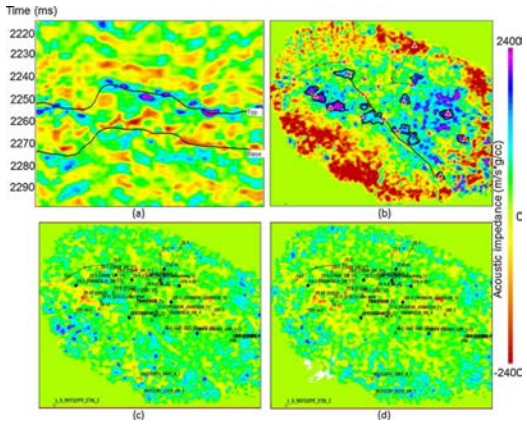
3D simulation of Cranfield demonstration project

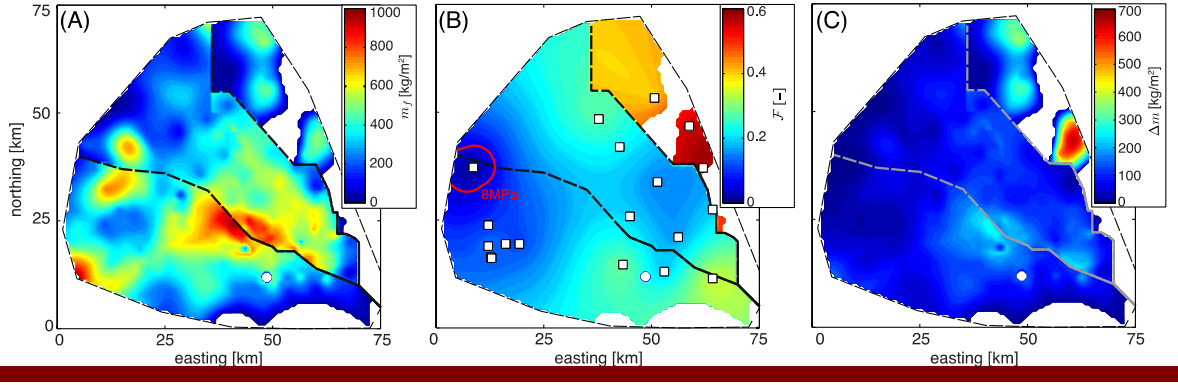
Six Accomplishments from CFSES I

- CO_2-Mediated Geochemistry and Caprock Integrity
- Controlling CO_2 movement with surface-treated nanoparticles
- Geomechanics of Geologic Carbon Storage: Long Term Sealing, Hazards, and Storage Security
- Time Lapse Monitoring of CO_2 Plume using a High-Resolution Seismic Inversion Technique
- Constraints on magnitude, rate and mechanism of CO_2 dissolution at Bravo Dome natural CO_2 reservoir
- Cement precipitation at the Crystal Geyser CO_2 field analog site: observations and reactive transport









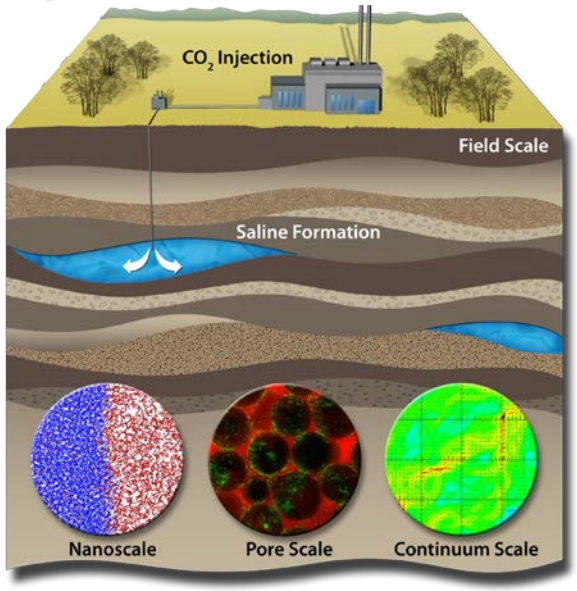
CFSES II

Sandia National Laboratories

Injection For Geologic CO_2 Storage Will Drive Natural Systems Far From Equilibrium

Goal

To understand and control emergent behavior arising from coupled physics and chemistry associated with carbon sequestration in heterogeneous geomaterials.



RESEARCH PLAN

CFSES will pursue scientific advances to understand chemico-mechanical coupling between supercritical CO_2 and clay minerals, understand and predict modes and fluxes of reactive CO_2 migration, and design, develop and apply novel materials that will alter fluid-assisted perturbations in heterogeneous geomaterials.