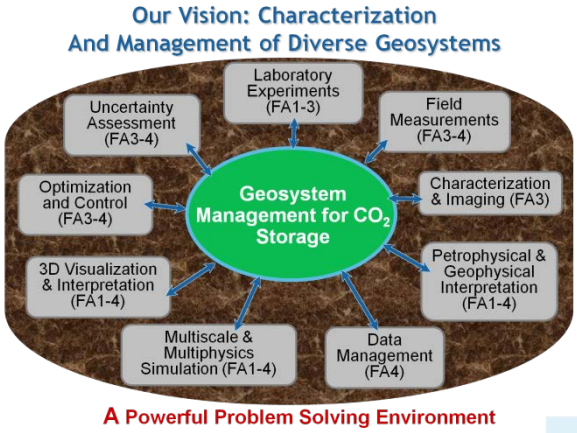
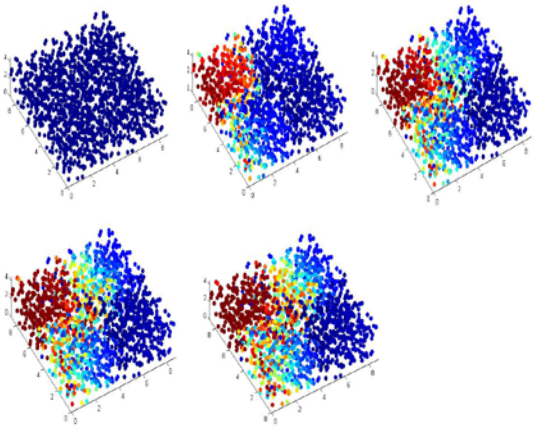
Center for Frontiers of Subsurface Energy Security (CFSES)
EFRC Director: Steven Bryant
Lead Institution: The University of Texas Austin

Mission Statement: *To pursue the scientific understanding of multiscale, multiphysics processes and to ensure safe and economically feasible storage of carbon dioxide and other byproducts of energy production without harming the environment.*



The secure sequestration of energy byproducts, such as CO_2, requires improved scientific understanding from the nano to pore to field scales.



Concentration field in four coupled pore-scale models

Project Description:
The subsurface disposal or storage of energy production waste materials entails time spans that are short compared to those of geological processes. The result is a highly perturbed system in which the chemical, biological, and physical reactions are significantly different from those observed in the natural state. Therefore, any comprehensive research program attempting to understand those processes must consider the coupled multiphysics driving active subsurface processes over broad spatial and temporal scales. CFSES seeks to gain the necessary scientific understanding through a comprehensive and integrated research program focused on key coupled processes at different scales progressing from the molecular to field scale. The research conducted at CFSES capitalizes on the partnership of two world-class research institutions: The University of Texas Austin and Sandia National Laboratories. The research benefits from the unique resources, research capabilities, and facilities at both institutions.

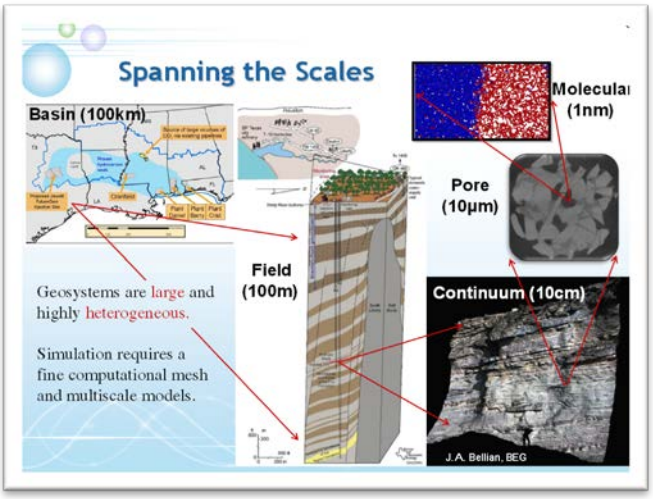
Numerical tools are being developed to:

- Conduct relevant molecular dynamics simulations
- Model fluid flow and reactive transport at the pore scale
- Model flow in faults and fractures
- Upscale pore-scale features to large heterogeneous network models
- Make long term predictions of flow and transport at the reservoir scale
- Develop cutting edge techniques for coupling critical phenomena across scales
- Validate the models using laboratory and field observations

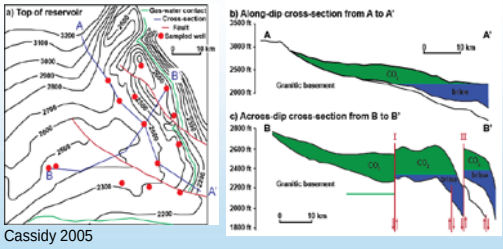
This research leverages information from natural analogs, such as the Crystal Geyser, Bravo Dome, and CO_2 injection experiments at the Cranfield, Frio, and in Salah sites.

The research emphasizes the multiphysics at multiscales to understand:

- **the interface between CO_2 and H_2O and other mineral surfaces**
- **the impact of CO_2 and pH change on biomass distribution and flow properties**
- **coupled mechanics, multiphase flow, and reactive transport**



Bravo Dome CO_2 field

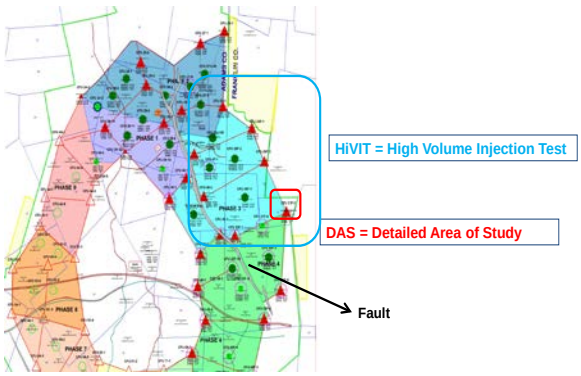


Cassidy 2005

Magmatic CO_2 injected approx. 10,000 years ago.

What is the time integrated rate of CO_2 dissolution?

Cranfield CO_2 Injection Test



Center for Frontiers of Subsurface Energy Security (CFSES)	
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