# Center for Frontiers of Subsurface Energy Security (CFSES)

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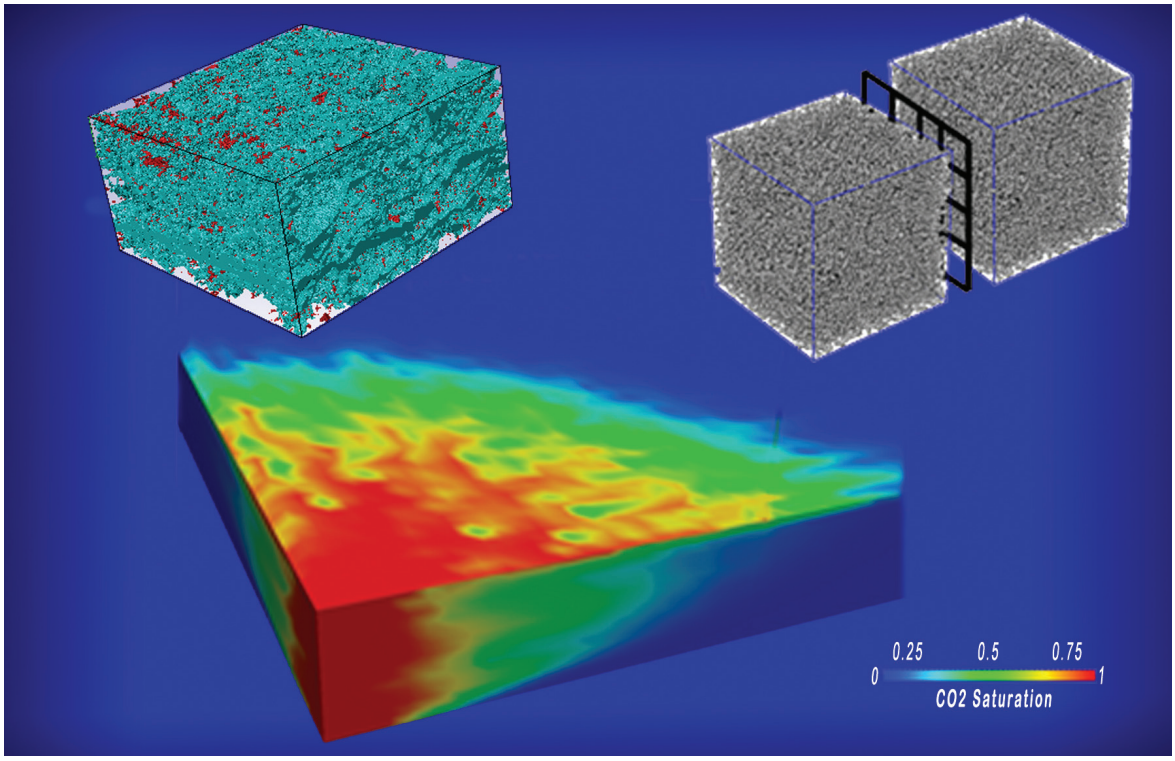
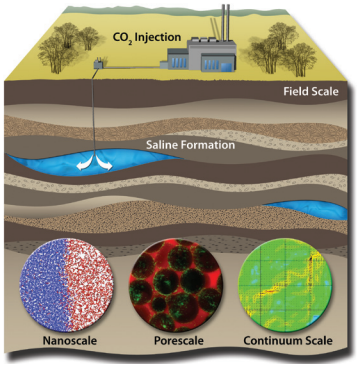
**Research Topics**
nuclear, extreme environment, high performance computing, carbon sequestration, interfaces, inorganic materials




**ABOVE:** CFSES addresses safe, secure and economical underground storage of CO2 by integrating multiple scientific disciplines to understand the various processes occurring from molecular to field scales.
**TOP:** CFSES combines experimental data (top left) with state-of-the-art simulations (top right) to create tools that will help determine what will happen when CO2 is injected underground (bottom).

## Mission

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

## Achievements

CFSES integrates experimental data with multi-scale modeling to create and validate new models to understand the geological complexity, variability and uncertainty of processes involved in the underground storage of $CO_2$. Researchers measured the rate of $CO_2$ dissolving inside a pore, the impact of mineral surfaces on bacterial survival, and the influence of biofilm formation on the movement of $CO_2$. In addition, they collected field data that demonstrated carbonate cementation obstructs permeability at the pore scale but not leakage pathways at the field scale. While building scientific leadership through the active involvement of students and post-docs, CFSES developed more accurate and quick modeling tools that incorporate detailed pore-scale information into multi-scale simulations, forecast fracture growth by coupling hydrological and mechanical processes in fractures, and predict large-scale $CO_2$ storage.