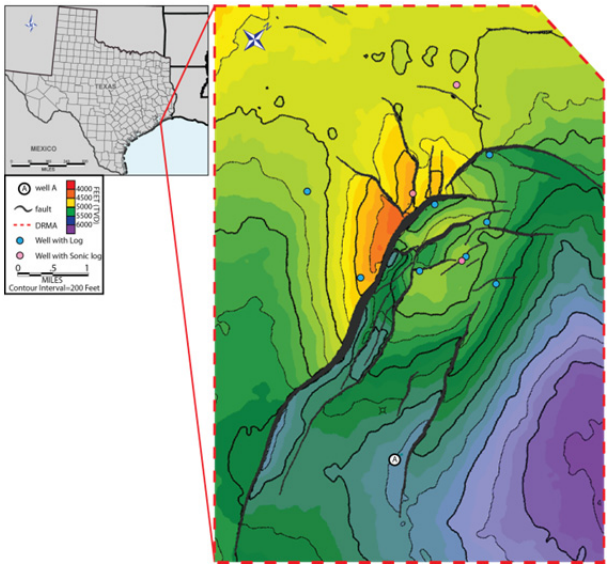
Theme Overview: Reliable Capacity Estimation

2011–14 Goal

Improve techniques for estimating storage capacity to account for the major impact of the interaction of multiphase flow, boundary conditions, maximum pressure, and geomechanics. Capacity estimation is one of GCCC's strengths, and we have continued to strive to develop more sophisticated and accurate methods of estimation, as appropriate, for various storage environments.



Structure map of the top of model interval

Accomplishments

- Generated southern Georgia, Permian Basin, and upper Texas coast Miocene static regional capacity estimates.
- Used data from the petroleum system of the Gulf of Mexico as inputs for modeling engineered, anthropogenic CO_2 and dynamic capacity.
- Validated geomechanical models using dense datasets from above-zone monitoring intervals (AZMI).
- Generated code (EASiTool) that incorporates multiphase flow, boundary conditions, and geomechanics.
- Evaluated the confining system (top seal and fault seal) of the upper Texas coast Miocene section.
- Collected three high-resolution 3D (HR3D) shallow seismic (aka "P-Cable") datasets to evaluate the overburden section of future potential geosequestration sites in the upper Texas coastal Miocene section.

Impacts

- Geomechanical models were validated using Cranfield AZMI data.
- Use of natural analogs (petroleum system) provided realistic inputs to dynamic models and indicated that pressure is the dominant boundary condition parameter.
- EASiTool provides a science-based yet fast and reliable tool for storage capacity estimation.
- A confining unit in the Lower Miocene was mapped; its distribution and thickness suggest that it could provide a good regional seal for geosequestration.
- Initial results suggest that gas chimneys are present and resolvable on HR3D seismic from Texas coastal waters.

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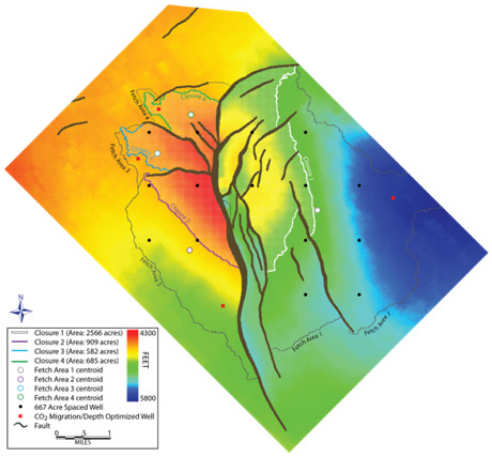
Geographic Area

- Gulf of Mexico Basin
  - Mississippi Salt Basin (Cranfield)
  - Texas State waters, adjacent land areas and Federal waters
- Southern Georgia and adjacent offshore Atlantic waters
- Permian Basin



Closure and fetch area polygons plotted with subsurface structure of the top of the model interval

Reliable Capacity Estimation Subthemes

- **Natural analogs, data, and models.** The petroleum system of the Gulf of Mexico (GoM) was considered as a natural analog for future engineered, anthropogenic CO_2 storage developments. The Miocene-age section of Texas State waters was selected as a most promising subset.
- **Regional capacity.** Most CO_2 storage is likely to occur as volumetric trapping (capacity in available pore volume at in situ reservoir conditions) in deep saline formations in regions having favorable source-sink relationships. Our goal was to provide static CO_2 storage capacity estimates in such regions.
- **EASiTool.** This novel software package produces a fast, reliable estimate of storage capacity for geologic formations.
- **Geomechanical implications of CO_2 injection.** We developed fully coupled analytical formulation and numerical simulation methods for the reliable estimate of pressure limit to maximize storage capacity while avoiding geomechanical failures.
- **Confining systems.** Mudrock units in two Lower Miocene cores were evaluated as to mineralogy, petrography, pore distribution, and fabric alignment.

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