

Simulation of Carbon Sequestration at Cranfield Incorporating New Physical Models

Scientific Achievement

Developed new computational tools to advance the capability to accurately simulate very large problems

Significance and Impact

Represent essential features of large-scale behavior that emerge from small-scale phenomena and build confidence in our predictions by validating models against field injection observations

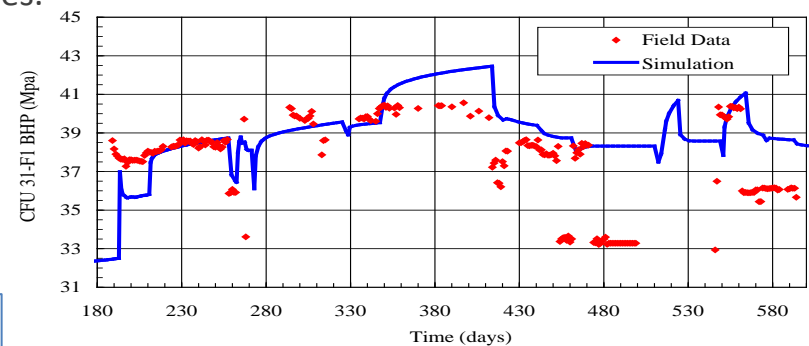
Research Details

- Developed and implemented models to include pressure, temperature, and salinity effects on CO₂ properties of solubility and interfacial tension (IFT). Modeled capillary pressure and relative permeability including IFT and contact angle.
- Set up a geomodel of Cranfield site using IPARS, history matched field observations, and simulated post injection.
- Demonstrated the significance of geomechanics for rock integrity.
- Demonstrated the importance of CO₂/brine relative permeabilities.

CO₂ Injection in Cranfield, Mississippi

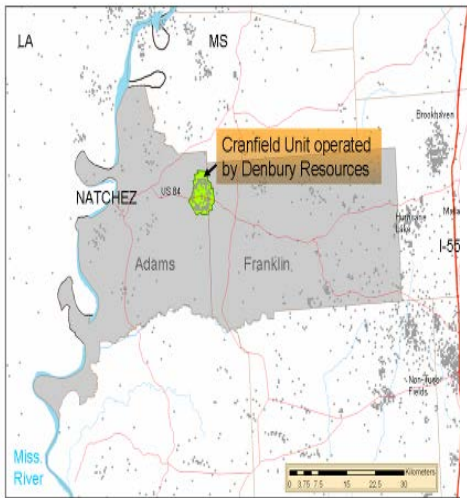


Delshad, Kong, Tavakoli, Hosseini, and Wheeler, "Modeling and Simulation of Carbon Sequestration at Cranfield Incorporating New Physical Models," International Journal of Greenhouse Gas Control, 10.1016/j.ijggc.2013.03.019

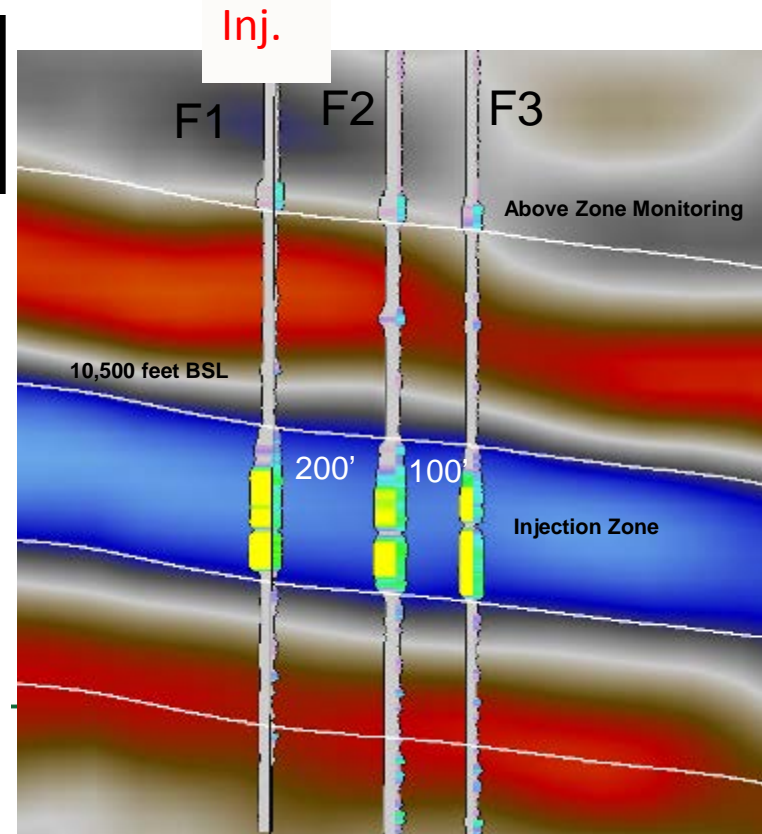
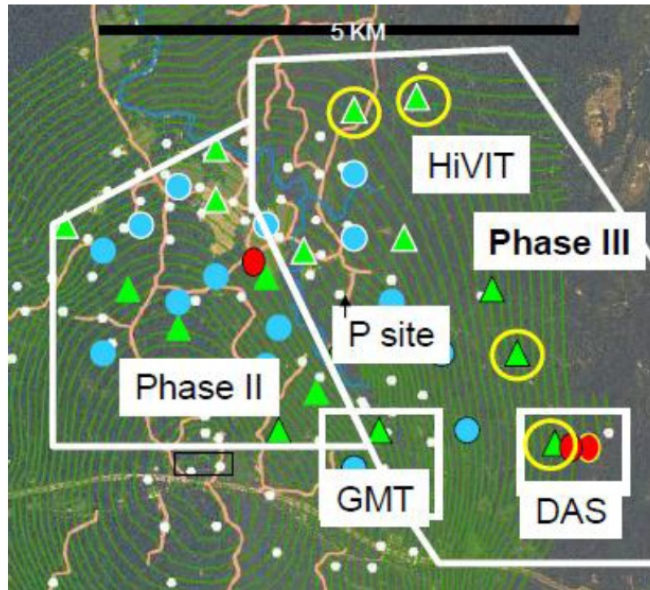


Comparison of simulated injection BHP with field data

CO₂ Injection in Cranfield, Mississippi



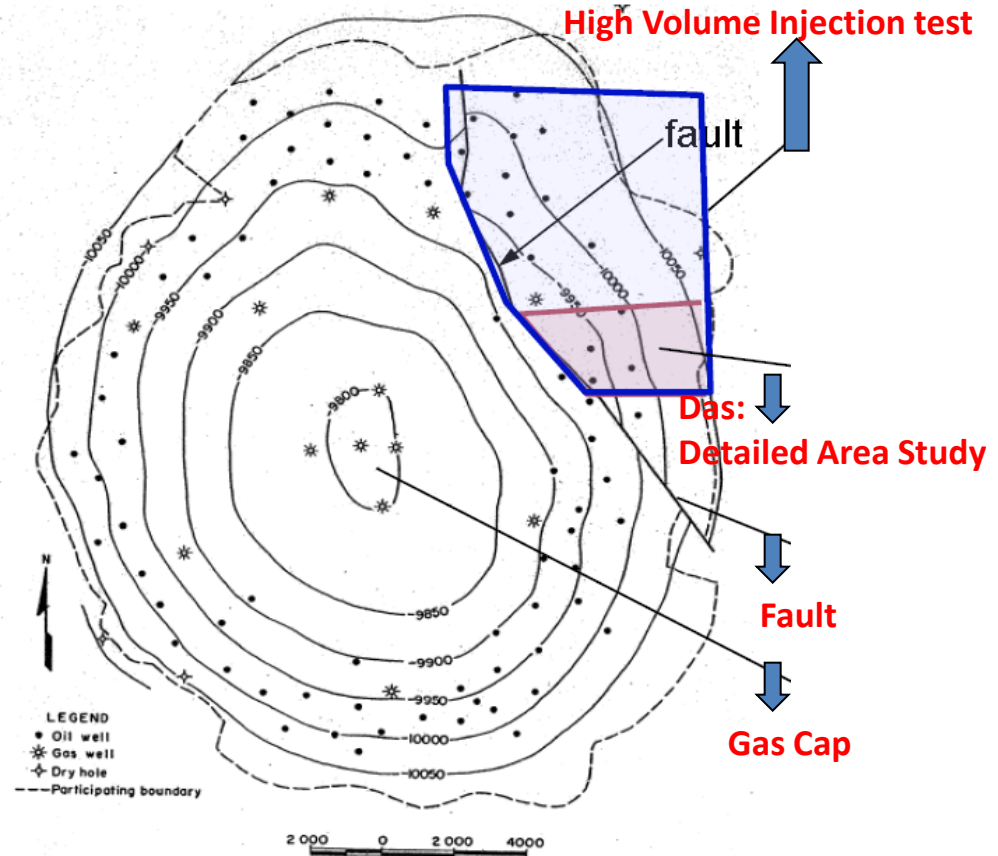
3,000 m deep
Inj. Rates of 5-10 MMSCFD
Started in December 2009



**Gulf Coast
Carbon Center**

Cranfield Pilot CO₂ Injection Test

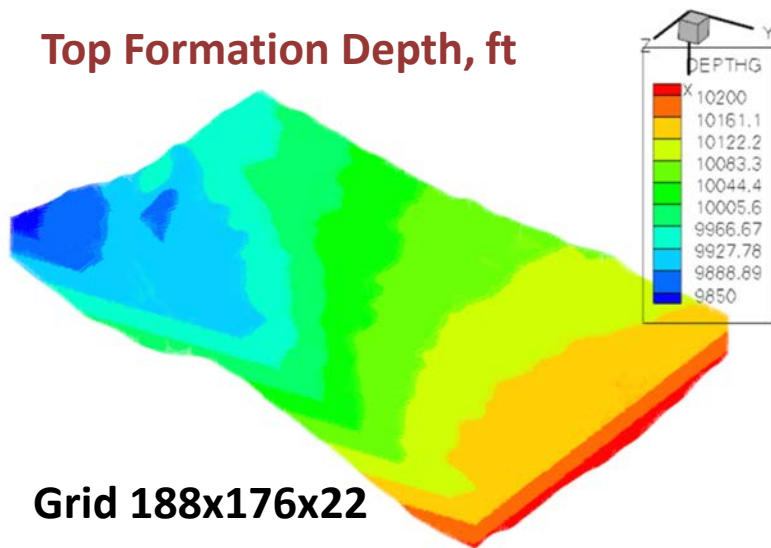
- Lower Tuscaloosa ~9800 ft (3000 m) deep
- Thickness: 80~100 ft
- Porosity : 0.20-0.30
- Permeability: 50 - 1000 md
- Temperature and Pressure: 257 F, 4650 psi
- Brine salinity: > 150,000 ppm
- CO₂ injection started in July 2008
- 1 million metric ton/year rate
- Total 1.5 M metric tonnes injected in 1.5 years



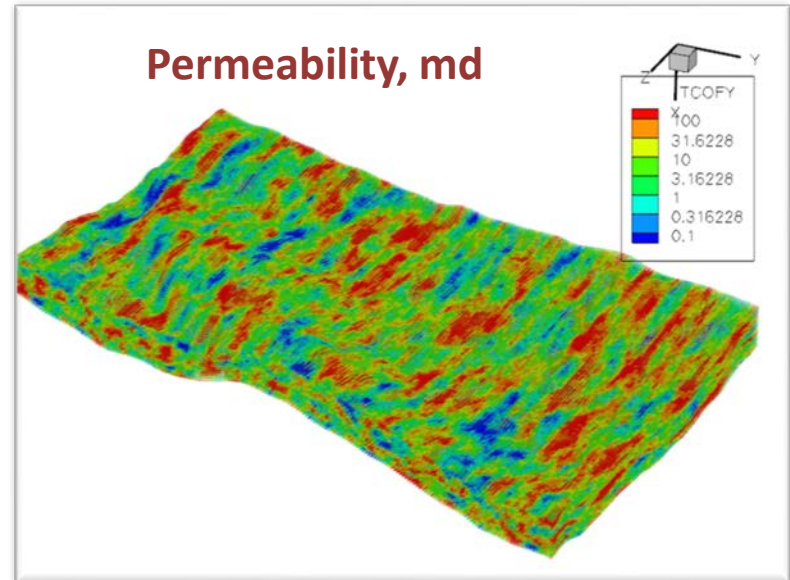
- Field data, 18 million grid
 - depth variation, K , Φ , K_p , P_c , etc

Cranfield Model in IPARS

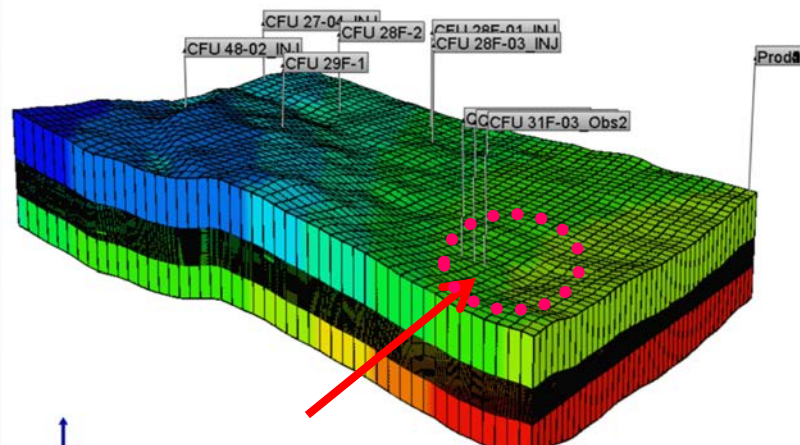
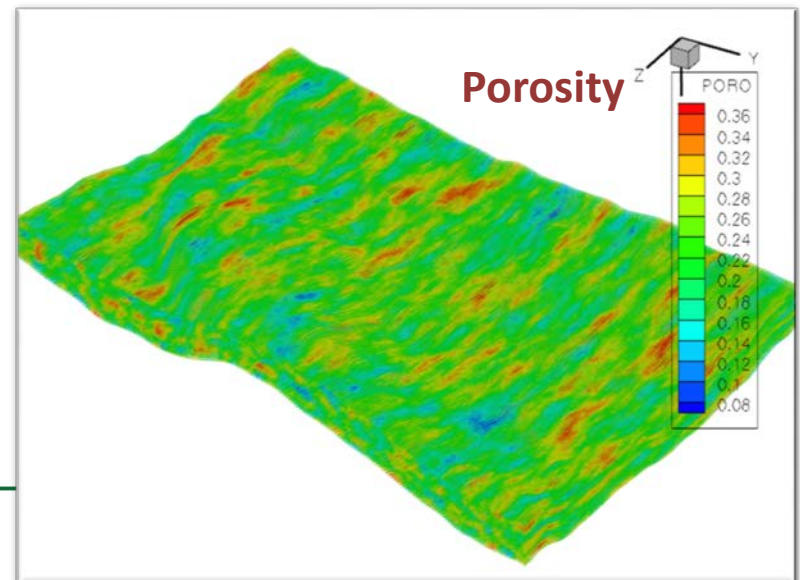
Top Formation Depth, ft



Permeability, md

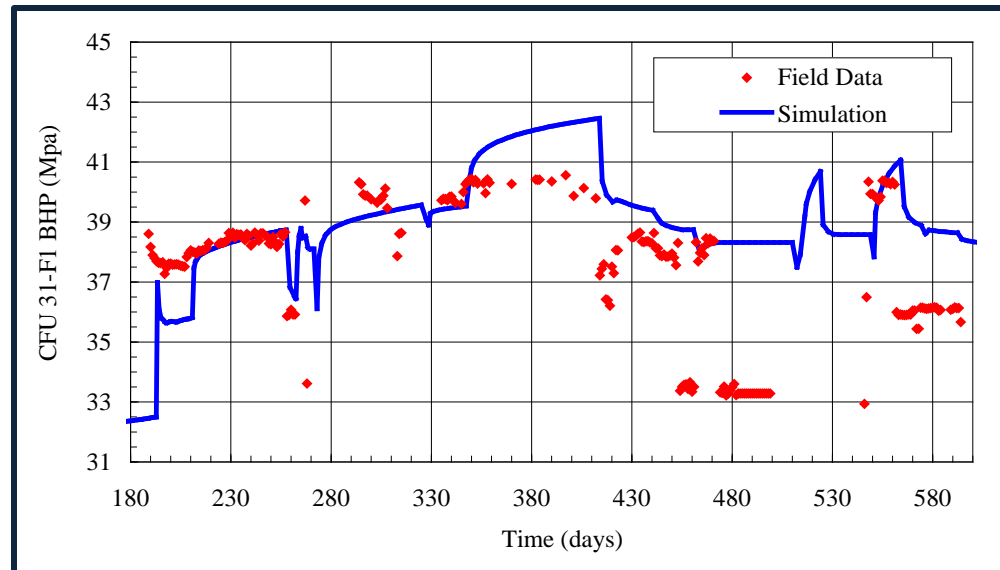
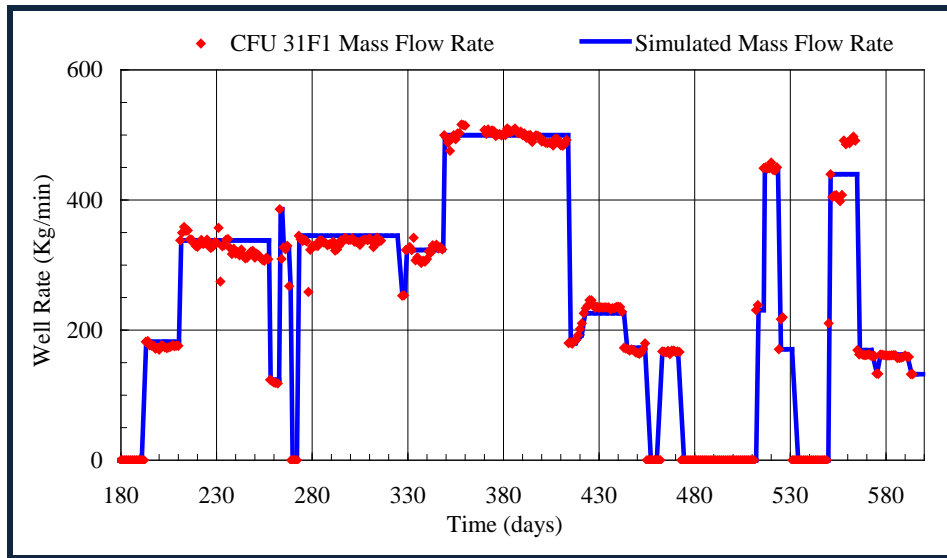


Porosity



Detailed area of study (DAS)

Injection Rate and Bottomhole Pressure



Effect of Relative Permeability on Injection Pressure

