

Drilling Fluid Design and Execution for Carbon Capture Wells

February 22, 2024

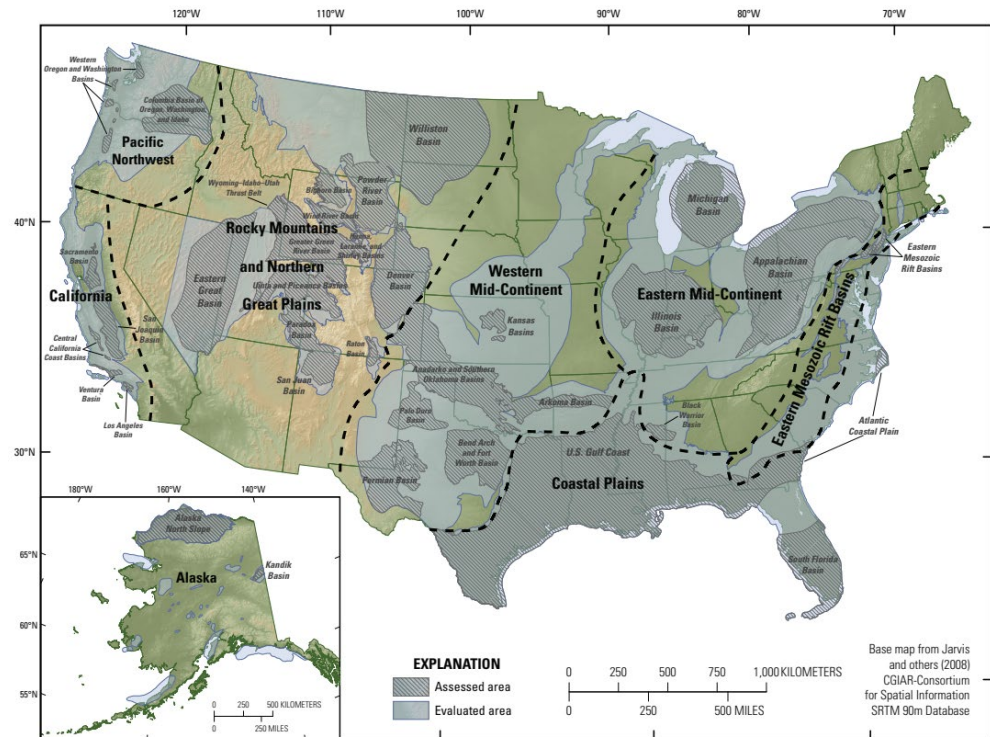
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Agenda

- **Introduction**
- **Carbon capture and storage (CCS) activities**
- **Drilling fluid design considerations**
 - **Formation evaluation**
 - **Isolation/cementing**
 - **Coring**
- **Execution**
- **Summary and conclusions**

Introduction

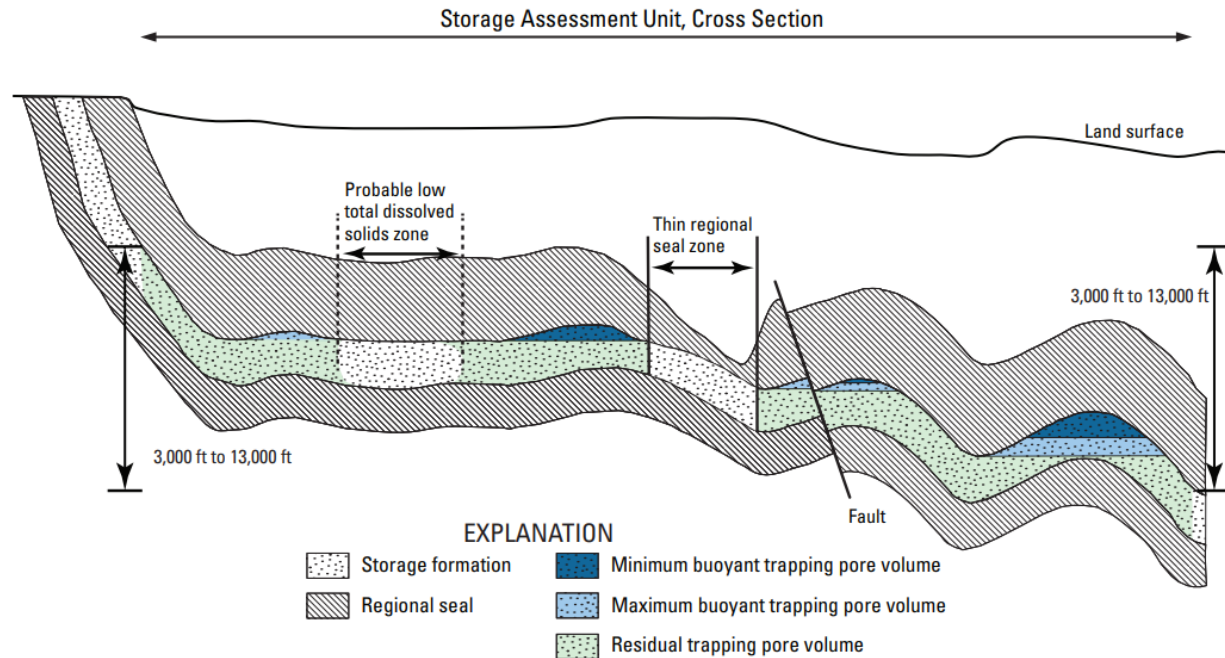
- **Coastal Plains have the most potential for CO₂ storage followed by Eastern Mid-Continent and Western Mid-Continent**
- **US estimated capacity of 3,000 metric gigaton**
- **Estimated that US generates 5.5 metric gigatons/year**



From “National Assessment of Geologic Carbon Dioxide Storage Resources – Results”
Circular 1386 – Version 1.1, September 2013

CO₂ Storage Formations

- Targeted storage formation depths from 3,000 ft to 13,000 ft
- Largest storage resource is in rock with permeabilities between 1 mD and 1 D



From "National Assessment of Geologic Carbon Dioxide Storage Resources – Results"
Circular 1386 – Version 1.1, September 2013

Current Activities

- Wells to date have focused on obtaining stratigraphic information with secondary objectives of conversion to CO₂ injection or for monitoring purposes
- To date have completed 2 wells
 - Vernon Parish, LA – water based
 - Ascension Parish, LA – oil based
- Active wells
 - Sabine Parish, LA – water based
 - Liberty County, TX – 3 wells, oil-based and water-based

Design considerations

- **Multiple logging runs**
 - Every hole section including surface
- **Gauge hole**
 - Optimal for cement placement
- **Coring**
 - Recovery and core bit performance

Logging

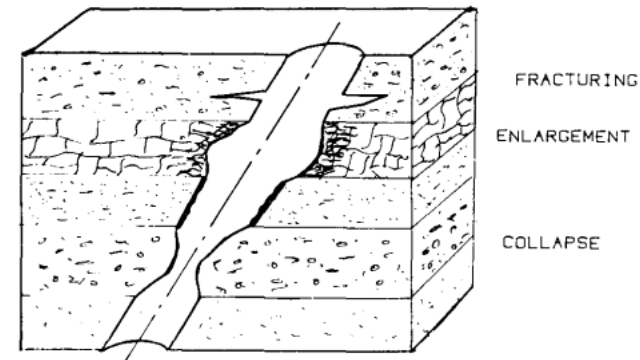
- **Optimize hole cleaning to remove all cuttings**
- **Viscosity to prevent solids settling resulting in fill and bridges**
- **Controlled filtration properties with thin filter cake**



Baker-Hughes GeoXplorer
Imaging tool

Gauge hole

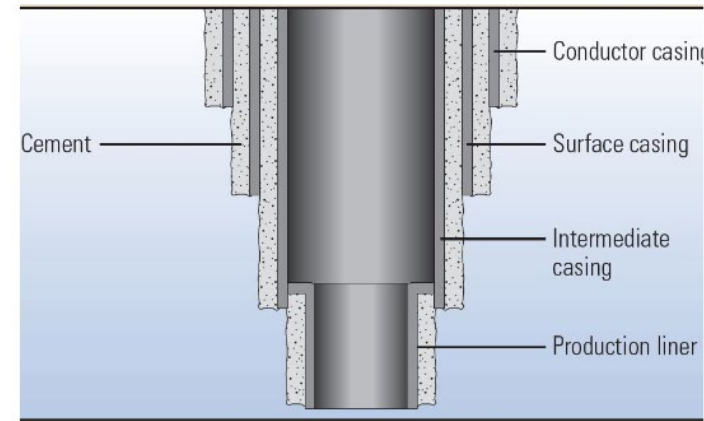
- **Water based fluids**
 - Utilize polymers and avoid dispersing agents
 - Multi-function polymer available that provides benefits compared to conventional xanthan, PAC, and PHPA
 - Control pH in lower range (less than 9 pH typical)
 - Add 3 vol% of liquid sulfonated asphalt product
 - Shallow sands require bridging and sealing agents with sufficient hydrostatic pressure
- **Oil based fluids**
 - Balance formation water activity
 - Fluid density required to prevent formation instability
 - Filter cake quality on porous media (not filter paper)



Types of wellbore instabilities
(after Bradley)

Cementing

- **Determine desired properties for optimal cement placement**
- **Provide representative samples for cement and spacer compatibility testing**
- **Determine any materials needed to prepare spacers or cement**
- **Circulate casing and hole sufficiently**
- **Document fluid properties for cementing**



Typical casing program
(from SLB)

Coring operations

- **Prepare wellbore for coring operations**
 - Optimize hole cleaning prior to coring
 - Maintain filtration properties
- **Monitor surge/swab for tripping**
 - Model for optimized tripping speeds
- **Determine if core bit will be prone to balling**
 - Anti balling agents
 - Optimize circulating rate
 - Drilling parameters to avoid balling



Core from Vernon Parish CCS well

Execution results

- **Vernon Parish, LA**
 - Met all requirements for formation evaluation
 - Core recovery over 98%
 - Logging tool stuck and recovered
 - Casing set as potential injection well
- **Ascension Parish, LA**
 - Met all requirements for formation evaluation
 - Complete core recovery
 - Well plugged and abandoned



Summary and conclusions

- **Wells for Carbon Capture and Storage require careful planning**
- **Most critical to well success are:**
 - Formation evaluation
 - Gauge hole
 - Cementing
 - Coring
- **Preparation and execution**

Acknowledgements

- **Our customers**
 - Capture Point
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 - US Coring
 - Brammer Engineering
 - Precision Drilling



Questions?
