SUBSURFACE H_2 STORAGE

A WILLISTON BASIN COMMERCIAL-SCALE RESOURCE STUDY

EERC
UND UNIVERSITY OF NORTH DAKOTA

PROJECT OVERVIEW

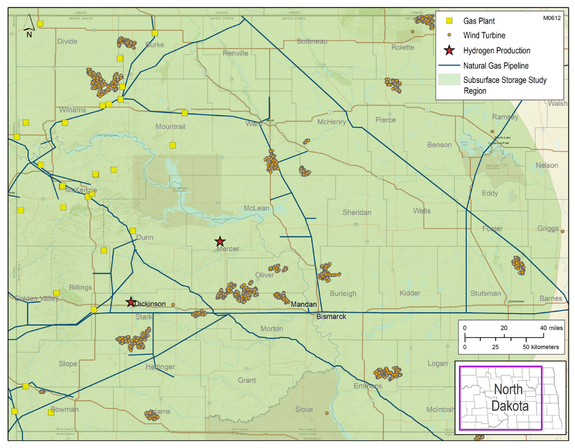
GOAL

Support the future commercialization of H_2 generation, storage, and use by assessing the potential for high-volume, secure subsurface H_2 storage with high recovery from geologic complexes in the North Dakota portion of the Williston Basin.

Period of performance:
October 1, 2023 – September 30, 2025

OBJECTIVES

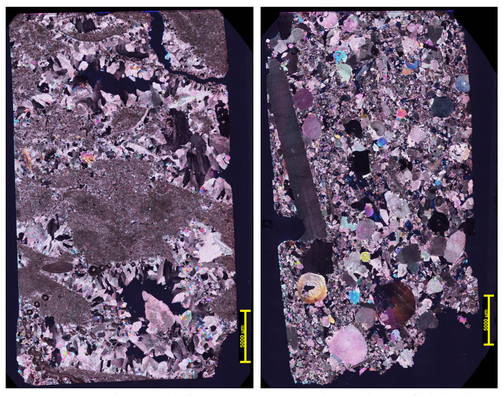
- Assess saline, depleted oil and gas, and salt formations for H_2 storage suitability.
- Characterize and assess effects of long-term H_2 storage use and exposure on formation fluids, storage and confining unit rocks, and wellbore materials.
- Basinwide estimation of geologic H_2 storage potential.



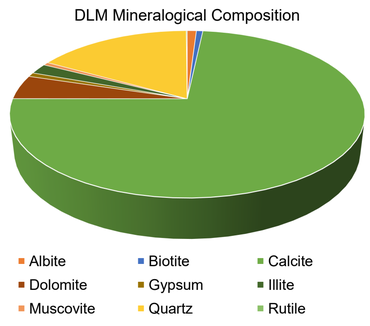
LABORATORY INVESTIGATION

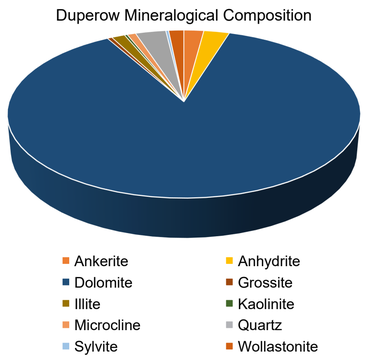
- Characterization analyses of select cores (ongoing)
  - Thin section and XRD/XRF
  - Porosity and permeability
  - Interfacial tension/contact angles
  - Minimum miscibility pressure
- Capillary pressure and relative permeability
- Geochemical effects of H_2 on rock and fluid samples
- Literature review of potential H_2 effects on well materials (ongoing)

Selected carbonate cores



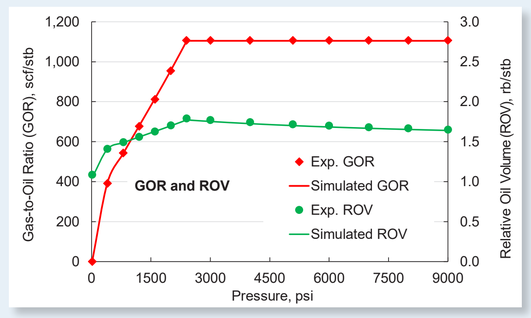
Carbonate wackestone (left). Larger open voids have been filled with calcite cement. Carbonate grainstone (right), mainly comprising crinoid fragments with other bioclasts. Particles have been cemented by medium-to-coarse calcite. Interparticle porosity is the main type of porosity.

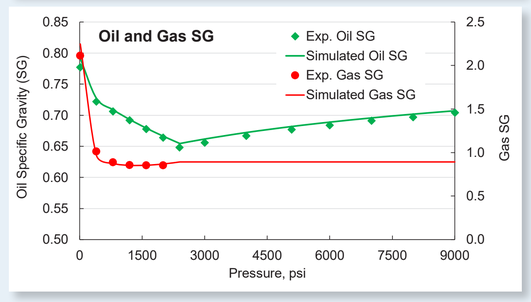




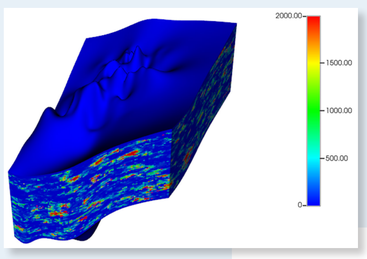
ENGINEERING ASSESSMENT

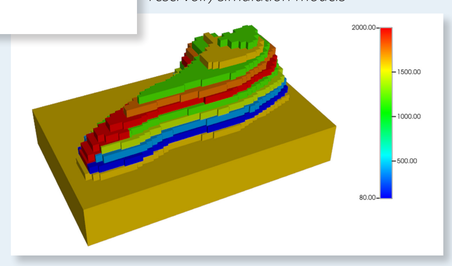
- **Reservoir simulation** models to predict H_2 flow behavior
- **Evaluate** H_2 plume distribution, surface injection pressure, and extraction recovery rates (ongoing)
- **Evaluate** potential geochemical and microbial interactions and related risks during and after H_2 storage
- **Design** case matrix to identify the most important parameters that control H_2 storage performance (ongoing)
- **Investigate** a variety of completion and production scenarios to maximize predicted H_2 recovery factor



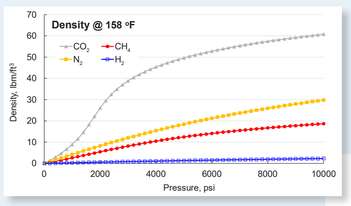


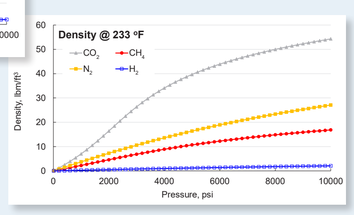
The DLM equation of state (EOS) has been tuned based on the pressure-volume-temperature experimental data. The EOS matches the experimental data satisfactorily.





Permeability distributions of the Broom Creek (saline formation) and Dickinson Lodgepole Mound (DLM, the depleted oil reservoir) simulation models

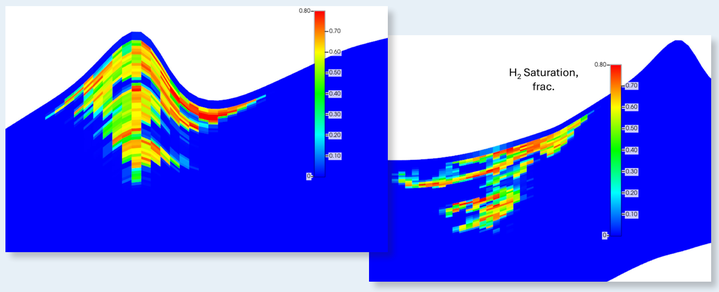




The phase behavior of different gases at 158°F and 233°F (Broom Creek and DLM reservoir temperatures). H_2 has the lowest density under a wide range of pressure in both formations.

INITIAL H_2 STORAGE SIMULATION IN SALINE FORMATION (BROOM CREEK)

- Different well locations: 1) a dome structure and 2) a flat spot.
- Quarterly on-off schedule: 3 months injection, then 3 months shut-in; 10 years of operation.
- Target injection rate: 200 tonnes/day.
- Maximum injection pressure: 4800 psi.
- More H_2 can be injected in the dome spot because of its higher permeability.



BASINWIDE EVALUATION

- H_2 storage characterization database
  - Storage and confining unit properties
  - Structural features suited for H_2 storage and recovery
- Extrapolation of field-scale simulation results to basin scale
- Volumetric storage potential across the Williston Basin
- Database of existing H_2 production and use facilities

DEIA PLAN

DIVERSITY, EQUITY, INCLUSION, AND ACCESSIBILITY

Increase awareness of H_2 industry's potential

- T4 Summit in western North Dakota (September 2024)

Increase inclusion of disadvantaged communities and groups underserved in STEM (science, technology, engineering, and math)

- Participate in a STEM event (TBD)

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