Developing & Investigating Subsurface Storage Potential And Technical Challenges for Hydrogen (DISSPATCH H_2)

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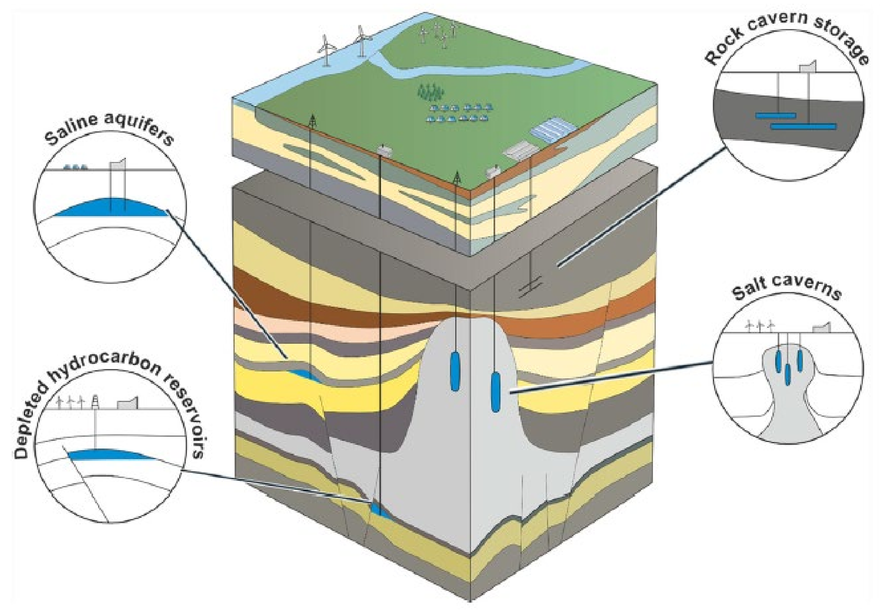
Underground Hydrogen Storage

- H_2 storage at scale is needed to enable broader end-use in energy markets.
- Geologic storage of H_2 is currently primarily in salt caverns, which are uncommon in most regions of North America.
- Depleted oil and gas reservoirs provide larger storage volumes than salt caverns and they are commonly found in the U.S.
- However, depleted oil and gas reservoirs have higher chances of H_2 contamination and loss due to the presence of residual hydrocarbons, and H_2 permeation through the subsurface minerals.



Miocic et al., *Geological Society, London*, **528** (2023) 73. https://doi.org/10.1144/SP528-2022-88

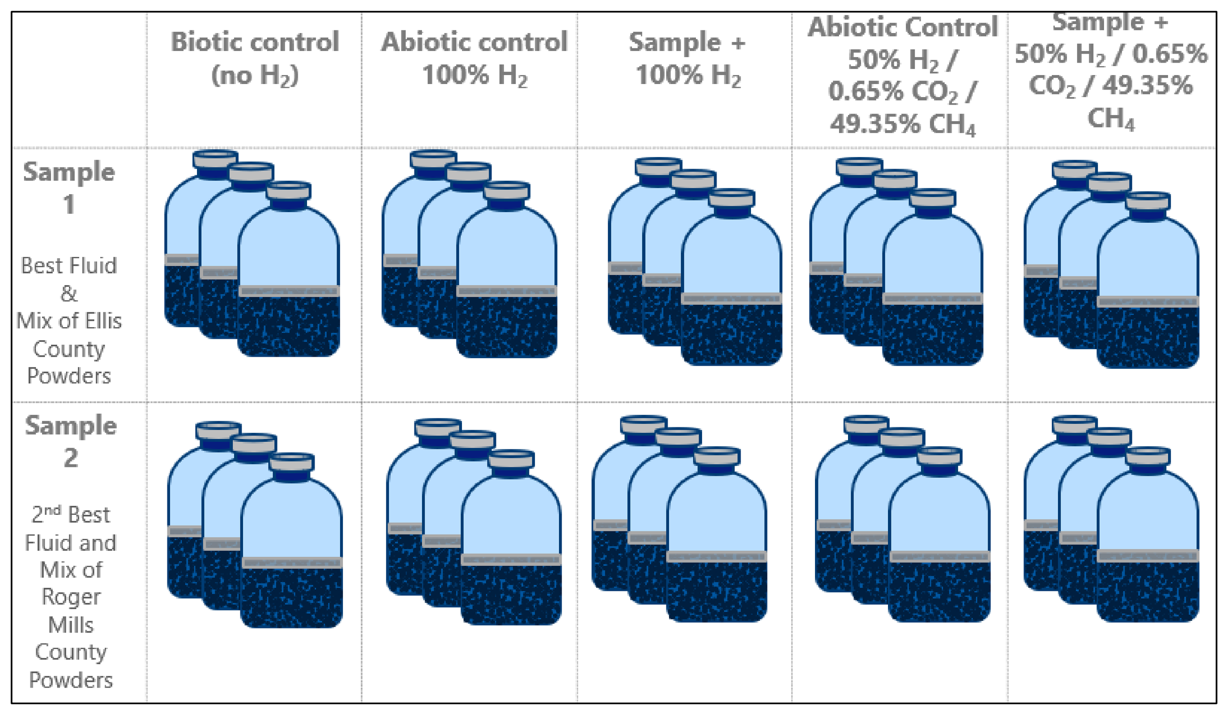
DISSPATCH H_2 Project Overview

- Determine the feasibility of using Oklahoma's prolific depleted oil and gas reservoirs in the Anadarko Basin to enable the transition to a carbon-free energy infrastructure.
- Characterize H_2 movement in representative reservoir and seal rocks in the presence of remnant reservoir fluid (containing hydrocarbons) and brine.
- Assess operational risks including storage underperformance due to geochemical or microbially-enabled processes or repeated storage-delivery cycles.
- Assess the technical and market potential of new commercial-scale underground storage sites for safely injecting, storing, and withdrawing H_2 from porous media in the region.
- Provide recommendations for a follow-on project focused on the field-scale testing and demonstration project including risk mitigation strategies

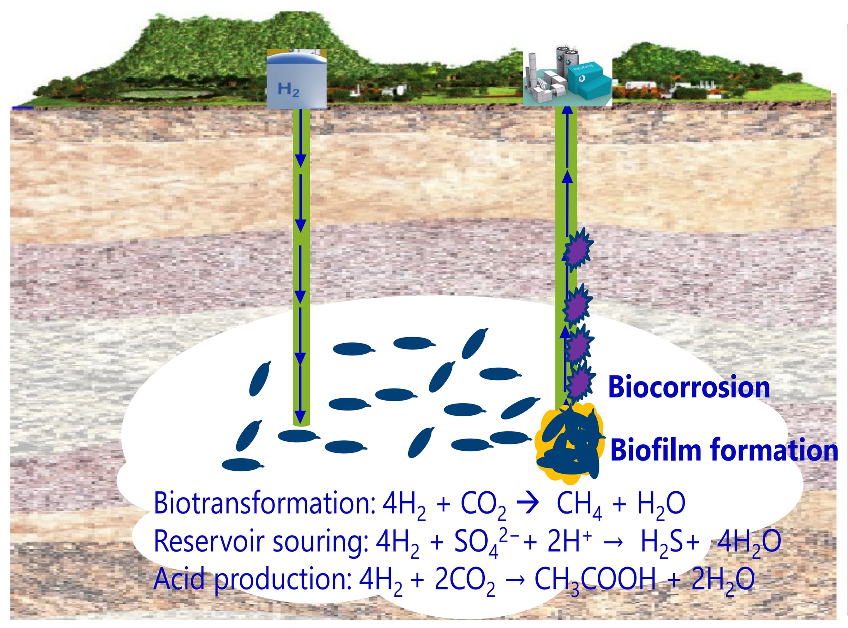
Bench-Scale Testing

Microbial Testing
- Changes in gas composition
- Fluid/wet chemistry analysis
- MIC gene monitoring
- Changes in microbial community

H_2 Injection Experiments
- Rock characterization
- Fluid flow behavior
- Operational performance

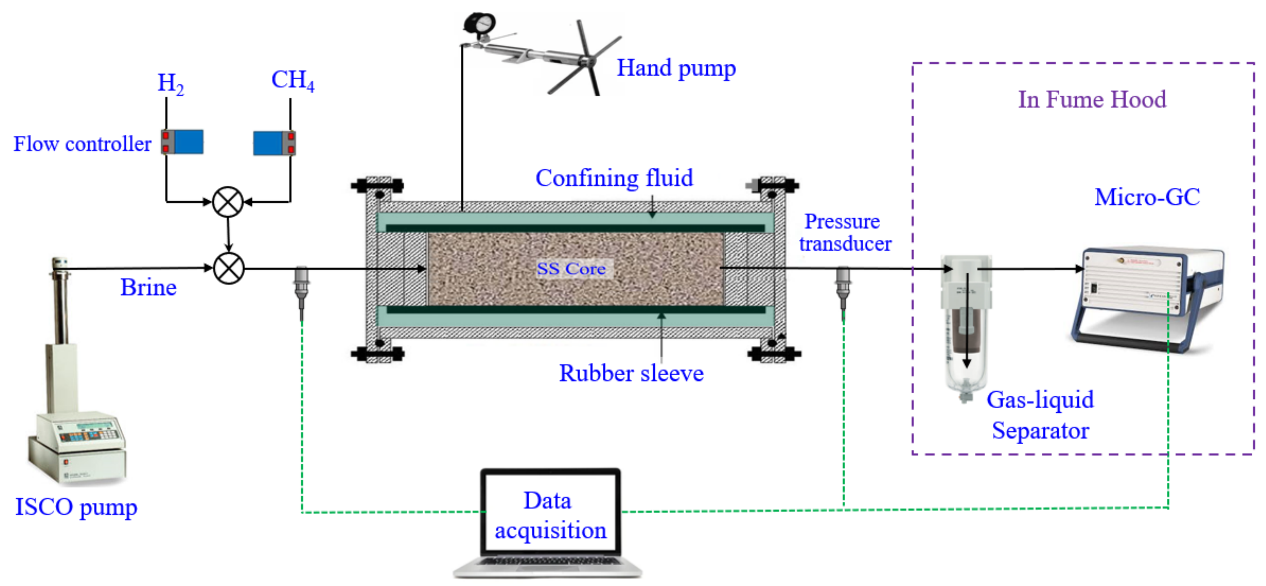


Microbial testing conditions



Consequences
- Hydrogen consumption and purity reduction
- Corrosion
- Compromised infrastructure integrity and safety
- Increased technical and financial requirements to cleanup product to meet hydrogen end-use requirements.

Possible subsurface reactions and consequences



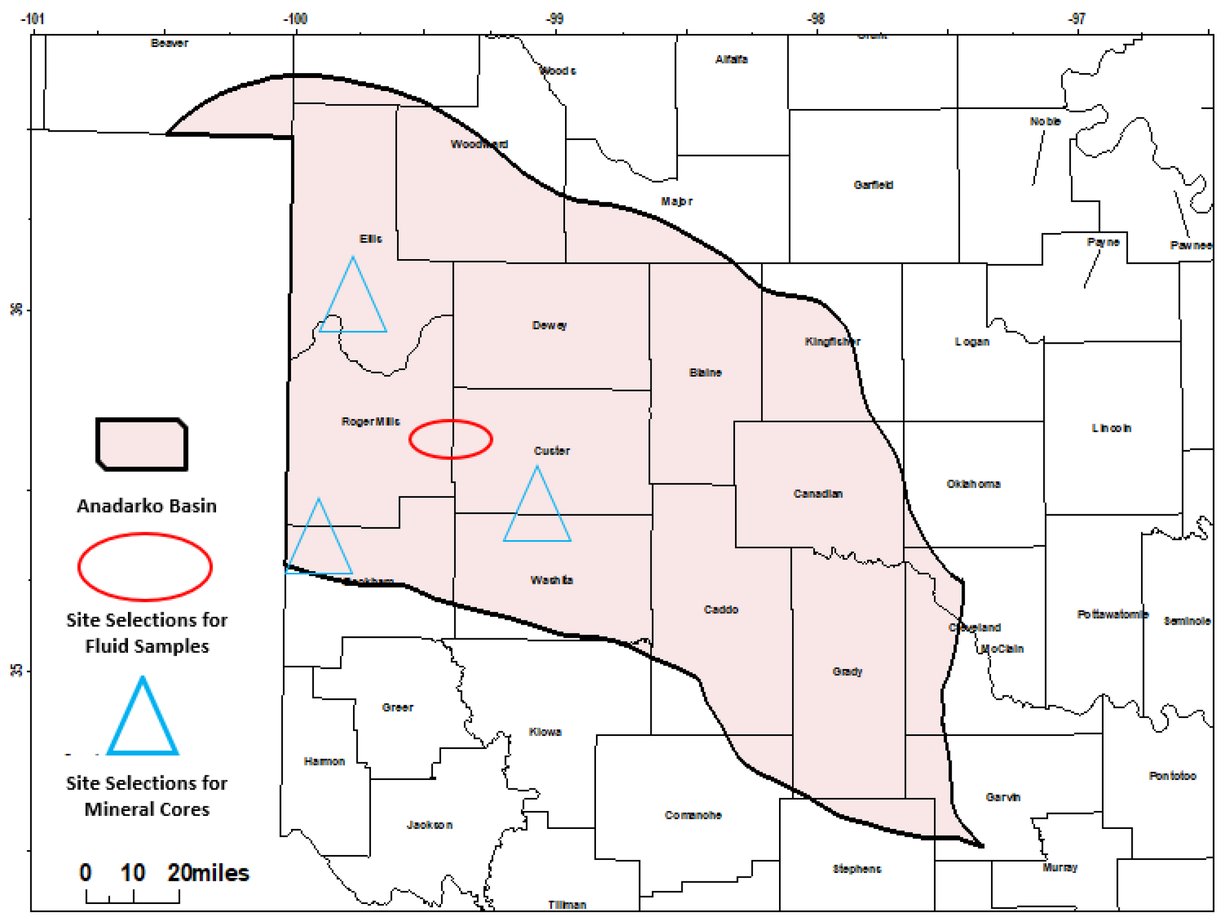
Schematic of tri-axial core holder testing system with an online micro-GC for sensitive H_2 and CH_4 measurement.

Rock Characterization	Fluid Flow Behavior	Operational Performance
Pore Structure	Fluid Transport	Cyclic Process
Surface	Multi-Phase Flow	Geochemical Rxns
He Porosimetry	Compositional Flow	Contamination
N_2 BET	Core-Plug Flow	Core-Plug Flow
Hg Intrusion	Hg Intrusion	SEM
X-ray Tomography	X-ray Tomography	X-ray Diffraction
X-ray Diffraction	In-Line GC	In-Line GC
SEM		

Properties to be measured and experimental **Methods**

Modeling & Mapping

Objectives:
- Compile available core data from ~10,000 Oklahoma wells and samples from >50,000 wells, well logs, seismic data, and production reports.
- Create a geologic model of the area and representative maps of the basin-wide geological data highlighting hydrogen storage potential and supporting development of strategies for working and coordinating with other state agencies on regulatory and EJ topics.
- Conduct detailed modeling to estimate hydrogen gas movement and loss within the reservoir and caprock utilizing experimental data.



Locations where core and fluid samples were taken in the Anadarko Basin

Societal Considerations

Objective: Identify community and local workforce benefits, by:
1. Advancing DEIA through recruiting, contracting, and the Technical Advisory Committee membership, and community benefits tools training.
2. Identifying communities likely to benefit from jobs created by hydrogen storage projects in Oklahoma
3. Providing public access to data on workforce impacts, both online and through minority-serving institutions.

Preliminary Workforce Analysis Findings
- Early assessments of areas being explored for underground hydrogen storage potentially overlap with areas with workforce experienced in the oil and gas industry.
- There is ample opportunity for future workforce benefits to flow to members of Tribal Nations and disadvantaged communities.
- Updates to workforce skills and Health and Safety training can leverage the existing workforce development of adjacent industries.

Acknowledgement

This material is based upon work supported by the U.S. Department of Energy, Office of Fossil Energy and Carbon Management, under Award Number DE-FE0032351.

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