Experimental reservoir physics for underground hydrogen storage (UHS) in porous media

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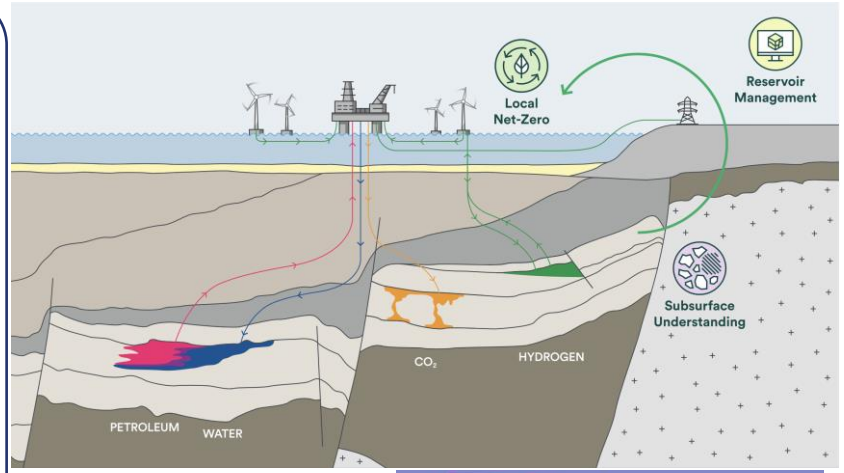
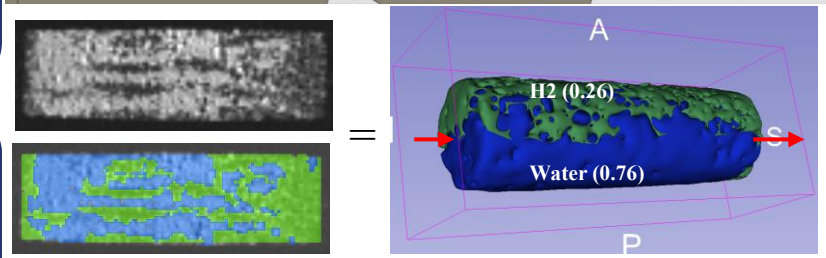
Introduction

The efficiency of hydrogen recovery in short- and long-term cyclic operations of underground hydrogen storage (UHS) within porous media is a crucial factor for successful implementation.

However, various factors can hinder hydrogen recovery, including structural and capillary trapping, dissolution in water, microbial consumption, and ineffective recovery strategies. The objective of my research has been to explore how microbial consumption impacts the efficiency of short-cycle hydrogen recovery.

To achieve this, I have developed a sand pack methodology to simulate hydrogen storage in a sandstone reservoir containing bacteria in formation water (brine). I have measured hydrogen consumption and analyzed its impact on reservoir rock properties, particularly storage capacity, fluid flow, and distribution.



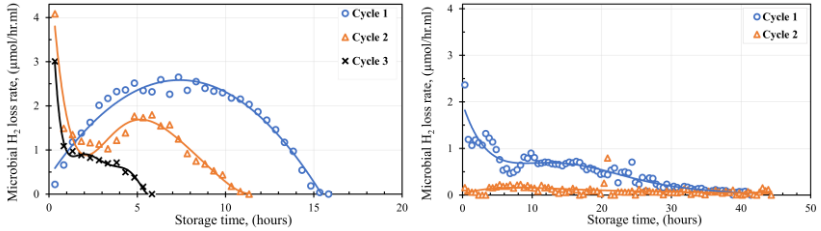


Primary objective:

Core scale quantitative assessment of porous media hydrogen loss by microbial activities using modern visualization methods.

Project goals:

1. Develop an experimental methodology to study hydrogen loss in porous media due to microbial activities.
2. Quantify in-situ hydrogen loss kinetics due to microbial activities and its effect on porous media properties
3. Provide quality laboratory data to validate a fully coupled numerical model that simulate short cycle cyclic hydrogen storage in porous media



Estimated progress of the PhD project:

Just started ... | < 50 % | > 50 % | Almost done ☺

Publications (in the pipeline)

- Experimental study of microbial hydrogen consumption rates by Oleidesulfovibrio alaskensis in porous media
- Impact of specific surface area on anaerobic microbial hydrogen consumption by a sulphate reducer: A sand pack study
- In-situ quantification of hydrogen loss due microbial consumption using MRI imaging
- Predicting ultimate hydrogen production and residual volume during cyclic underground hydrogen storage in porous media using machine learning

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