

Underground Hydrogen Storage in Porous Media

Introduction

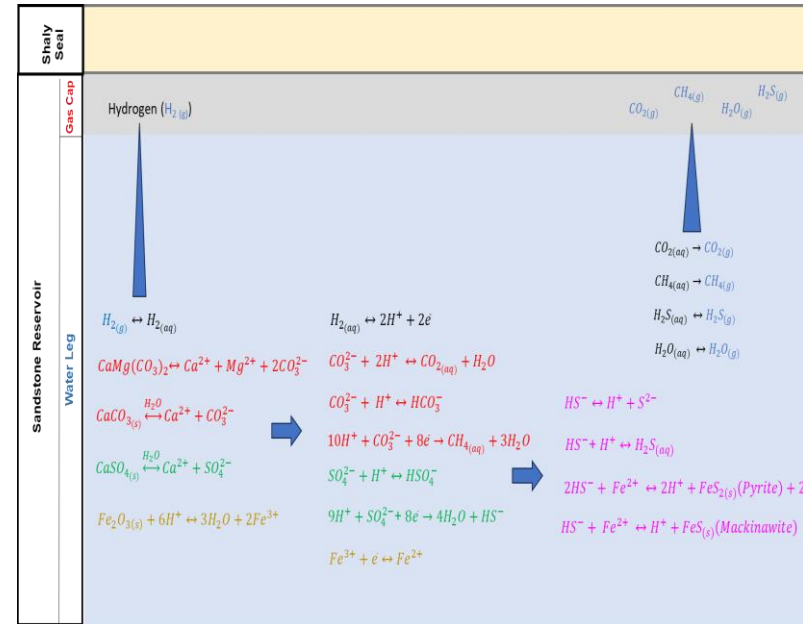
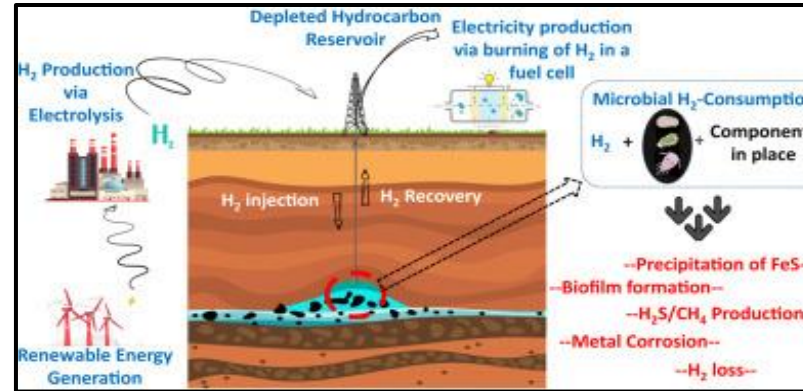
Storing hydrogen in depleted hydrocarbon reservoirs where the infrastructures are already built is a promising and safe solution to contribute to future hydrogen value chain. Porous geological settings can provide huge capacity for hydrogen storage. In order to store hydrogen in a safe and efficient way, the interaction of hydrogen with minerals, and residual fluids are necessary.

GUIDELINES

Existence of microorganisms without the need of light or oxygen in geological setting has created an opportunity for them to consume hydrogen by microbial activities. The products of these biochemical reactions, e.g., H_2S are undesirable and can be toxic and fatal. In addition, the size of hydrogen molecule is extremely small that might diffuse through caprocks, adjacent formations, or into the formation water. The diffusion of hydrogen in the formation water is the primarily mechanism for the geochemical and biochemical reactions. In addition, the reaction between pyrite (mineral) and dissolved hydrogen might occur at temperature above 100 °C leading to the production of H_2S in the storage site.

Primary objective

- Biochemical reactions
 - Evaluation of microbial activities in contact with excess hydrogen
- Diffusion and Dispersion of Hydrogen
 - Evaluation of hydrogen loss through diffusion and dispersion
- Geochemical Reactions
 - Investigation of the interaction between hydrogen and minerals



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Estimated progress of the PhD project:



Publications

- Ahmadpour, Sadeqh, Raoof Gholami, and Mojtaba Ghaedi. "Density driven flow in CO₂ storage sites: A new formulation for heterogeneous layered porous media." *Fuel* 381 (2025): 133721.
- Ahmadpour, Sadeqh, and Raoof Gholami. "Hydrogen sulfide in underground hydrogen storage sites: Implication of thermochemical sulfate reduction." *Deep Underground Science and Engineering* (2025).