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Project Title.

Subsurface Hydrogen Migration and Reactions for Geological Hydrogen Production and Engineered Storage

Abstract.

Hydrogen (H₂) has been identified as a “green” carbon-free energy alternative, and there is an intense global research effort to accelerate and reduce the cost of clean hydrogen production. There is also an emerging interest in the geological natural hydrogen, which includes sites in Nebraska. In addition, reliable and safe storage is imperative for success as an alternative fuel and energy source. The potential for underground hydrogen storage (UHS) has been recognized, as several projects in Europe and North America are currently underway to investigate the feasibility of UHS. Yet, our understanding on the origin and flow of H₂ is still in its infancy. It is necessary to understand the migration and reaction(s) of H₂ with other in-situ fluids, solid minerals, and microorganisms to successfully practice geological H₂ production as well as UHS.

The overall objective of this research program is to advance understanding of H₂ generation, migration, and reactions for primary lithological, hydrological, and biogeochemical conditions. To achieve the overall objective, the scope of major research objectives is as follows: (1) Examine the diffusive and advective flow of hydrogen for several key lithological conditions, (2) Explore geologic hydrogen production, with a potential of co-CO₂ sequestration, in conjunction with field monitoring at the candidate site near the Midcontinent Rift in Nebraska, and (3) Investigate abiotic/biotic H₂ reactions with in-situ fluids and solid minerals, as well as H₂ loss/ consumption by microorganisms.

This proposed project will initiate critically needed research related to the production of geological natural hydrogen as well as the engineered storage of hydrogen. Moreover, this project will provide the team with a crucial opportunity to collaborate with Natural Hydrogen Energy, who drilled the first U.S. hydrogen well in Nebraska, as well as scientists at the U.S. National Laboratories laying the foundation for expanded research opportunities.