Alert Geomaterials Doctoral School 2025

Solving geomechanics challenges in the energy transition

TU Delft

Active Learning activity

Use your expertise to propose a solution/study to address one challenge

- Provide a roadmap of your proposal on a draft poster

➢Include field/experimental/numerical campaign

1. *~30min*: Discussion in group
   - ➢2 groups per challenge + 2 online breakout rooms
2. *~15min*: Presentation to another group

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Shallow Geothermal Energy

Key Challenge: Integrate and optimize shallow geothermal energy solutions in existing cities

- Problem: Difficulty to integrate SGE in existing constructions
- Implications: Far from optimal use
- Conditions: Your city is constructing an underground metro system from scratch

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Offshore Wind Energy

Key Challenge: Noise generated during monopile driving

- Problem: Installation of monopile foundations by impact pile driving generates intense impulsive underwater noise
- Implications: Potential disturbance or injury to marine mammals and fish, need for costly mitigation measures
- Conditions: Peak levels can exceed ~190 dB

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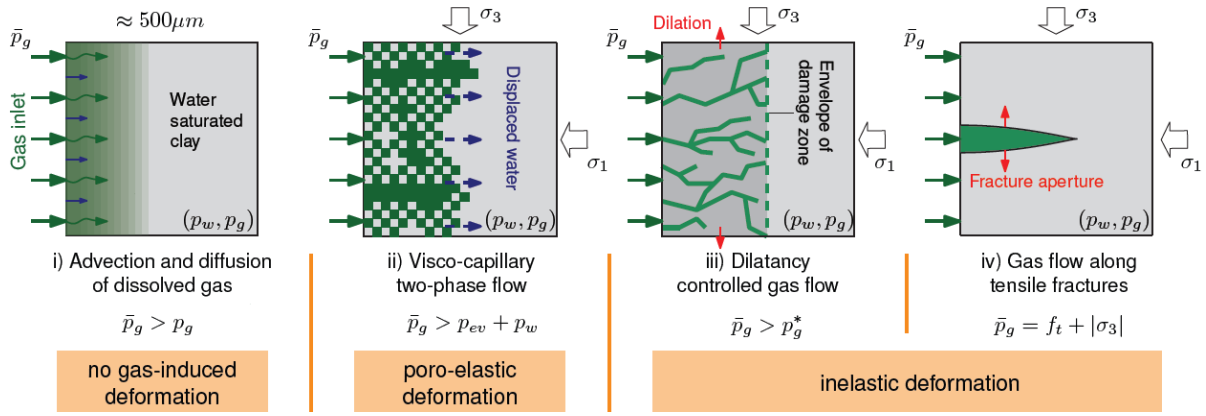
Geological Disposal of Radioactive Waste

Key Challenge: Gas production resulting from metal corrosion

- Problem: gas production can lead to gas pressure build-up, if production rate is higher than diffusion rate, which may lead to the creation of discrete, gas-specific pathways (e.g. fracturing or pathway dilation)

- Implications: volatile radionuclides could be transported with the gas phase + the creation of discrete pathways could ask as preferential flow paths for water and radionuclides



Liaudat *et al.* (2023), adapted from Marschall *et al.* (2005)

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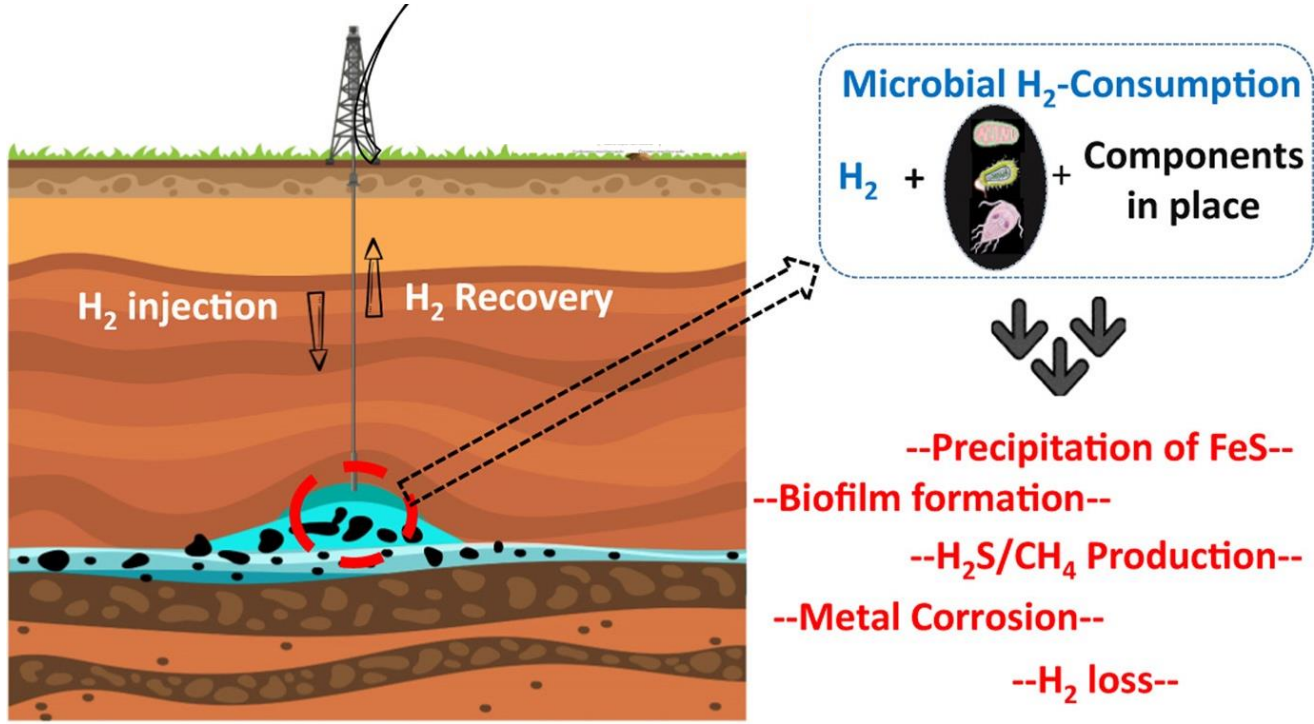
Underground Hydrogen Storage

Key Challenge: Microbial activity during UHS

- Problem: Indigenous subsurface microbes can metabolize H_2 and produce unwanted byproducts
- Implications: Reduced storage capacity, contamination, safety risks
- Conditions: Microbial activity typically up to ~50 °C



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Thaysen, E. M. et al. (2021). Estimating microbial growth and hydrogen consumption in hydrogen storage in porous media. *Renewable and Sustainable Energy Reviews*.

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Active Learning activity

Key Challenges:

- Integrate and optimize shallow geothermal energy solutions in existing cities
- Noise generated during monopile driving
- Gas production resulting from metal corrosion
- Microbial activity during Underground Hydrogen Storage