

Seals, Containment and Risk for CCS and Hydrogen Storage (G570)



Tutor(s)

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Overview

This course examines the nature and properties of seals as they relate to containment for permanent storage of CO₂ and cyclical storage of hydrogen and/or compressed air. The course will provide a grounding in the geomechanics of seals and how seals and their properties are created in the subsurface. While most data and analysis relating to seals has been acquired from and applied to the containment of oil and gas, this course will show how such data can be applied to CCS and gas storage. Particular attention will be given to the different sealing requirements of CO₂ and hydrogen relative to oil/gas and water.

Duration and Logistics

Classroom version: A 3-day course comprising a mix of lectures, case studies and exercises. The manual will be provided in digital format and participants will be required to bring a laptop or tablet computer to follow the lectures and exercises.

Virtual version: Five 3.5-hour interactive online sessions presented over 3 to 5 days comprising a mix of lectures and exercises. The course manual will be provided in digital format.

Level and Audience

Advanced. This course is aimed at geoscientists and engineers working in energy transition with responsibility for projects to assess and manage gas storage

Objectives

You will learn to:

1. Evaluate the nature of containment seals and their properties in the deep earth (>1km/0.62 miles below surface).
2. Apply knowledge of seal integrity to estimates of column heights and associated storage volumes.
3. Assess the concepts of seal integrity and how to predict risk of seal breach/failure.
4. Appraise current knowledge of seal behaviour using case studies.
5. Manage the requirements for permanent CO₂ storage using CCS versus short-term/cyclic storage for hydrogen air.
6. Characterize data requirements and limitations to assess seal integrity and risk (data sourced mainly from oil/gas boreholes).
7. Evaluate different trapping requirements for gas storage (currently data-poor) relative to oil/gas (historically data-rich).
8. How geochemical fluid-rock reactivity may impact seals to gas storage over time.

Course Content

Session 1

- Introductions
- Objectives of the course
- What is a seal?

Session 2

- Rock types/lithology/seal distribution and relationship with deposition
- Rock properties of seals - class exercise
- Seal integrity versus seal capacity versus seal breach
- Seals and baffles in relation to water as pore fluid

Session 3

- Seals in relation to a stored fluid
 - Membrane seals
 - Hydraulic seals including fault seals

Session 4

- Seal capacity
- Estimating column height - class exercise
- Seal failure - criteria and field evidence

Session 5

- Seal risk - group exercise
- Discussion of seal risk

Session 6

- Chemical reactions relevant to CCS
- Fluid- rock interaction and change in seal properties
- Impact of long-term fluid-rock interaction on storage selection

Session 7

- Evaluation of a regional seal – group exercise
- Seal breach risk – case studies

Session 8

- Saline aquifers – definitions, types of “trap” and case studies
- Depleted fields – range of examples and case studies

Session 9

- Hydrogen storage – case studies
- Differences between hydrogen storage and CCS
 - Short-term storage
 - Impact of cycling storage on seal integrity

Session 10

- Review of topics covered in course
- Course feedback

Some sessions include practical exercises to emphasise learnings. The practicals vary from ‘quick-look’ exercises to longer problems to be worked through. Exercise materials will be tailored to participants’ experience and whether the course is taught online or in-person.