
N577: Outcrop Analogues for CO₂ Storage (*Devon and Dorset, UK*)

Instructor(s): Richard Worden and Howard Johnson

Format and Duration

Field - 5 Days

Low Physical Demand

Summary

Business impact: Participants on this field course will learn to **apply outcrops** along the Devon and Dorset coast as **geological analogues** for some **major CCS projects including Hynet (Hamilton), Endurance, Acorn/Goldeneye, and East Mey.**

Using outcrop studies, participants will consider the effects of reservoir geometry, porosity, permeability, and geomechanical properties on CO₂ flow patterns, storage, injectivity, reservoir strength, and behaviour at high fluid pressure. Analogues to top-seals for CCS sites will be considered, plus fault reactivation at elevated CO₂ pressure, well design, and completions strategies.

Learning Outcomes

Participants will learn to:

1. Detail the effect of reservoir properties on CO₂ storage capacity and CO₂ injectivity.
2. Examine the influence of reservoir heterogeneity on CO₂ movement patterns.
3. Explain how faults with different orientations and geometries may undergo reactivation at elevated CO₂ pressures.
4. Develop strategies for considering possible CO₂-water-rock reactions depending on host rock mineralogy and fluid chemistry.
5. Evaluate CO₂ well completions strategies.
6. Appraise top-seals in terms of their lateral and stratigraphic variability of geomechanical and petrophysical properties.
7. Develop approaches for considering the possible extent of reservoir dilation and reservoir fracturing due to elevated CO₂ pressure.

Training Method

This is a field course supported by short classroom sessions. Discussion and hands-on exercises will be conducted at all field localities.

Physical Demand

The physical demands for this class are **LOW** according to the RPS field course grading system. Basic fitness is required. All outcrops are coastal and there will be multiple walks of up to 2 km (1.2 miles) most days along beaches and cliff top paths, all at around sea level. The longest walk will be approximately 3 km (1.8 miles) with elevation gain of 125 m (400 ft). Transport will be by coach on paved roads.

Who Should Attend

This course is aimed at geoscientists and engineers, but other subsurface staff will also find the course useful. Team leaders and managers of teams involved in CCS projects would also benefit from

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participation. This field course is suitable for multi-disciplinary team attendance.

Prerequisites and Linking Courses

Participants are expected to have a working knowledge of petroleum geoscience and the fundamentals of CCS, such as that provided on N565 (Carbon Capture and Storage for Geoscientists and Engineers) or through RPS' Foundations of CCS self-paced e-learning courses EC003, EC004, EC005, and EC006.

Course Content

The field course will visit reservoir and top-seal analogues to consider the following key topics:

1. How reservoir geometry will affect CO₂ flow patterns.
2. The effect of reservoir permeability on CO₂ injectivity.
3. How reservoir porosity affects CO₂ storage.
4. The effect of geomechanical properties on reservoir strength and behaviour following CO₂ injection (i.e., reservoir dilation, fracturing) at high fluid pressure.
5. Reactions that may occur in sandstone and carbonate reservoirs, focussing on the rate and likelihood of dissolution versus precipitation of minerals.
6. Top-seals for CCS sites - geometry, heterogeneity, permeability, capillary entry pressure, and advective CO₂-loss, CO₂ diffusive loss, and fracturing at elevated CO₂ pressure.
7. The effect of stress orientations in the subsurface relative to fault orientations and the possibility of fault reactivation at elevated CO₂ pressure.
8. The influence of rock properties on CO₂ injection well design and completions strategies - weak (friable) vs. relatively strong (brittle) lithologies.

Course Itinerary

Please note that the following itinerary is subject to weather and tidal conditions.

Day 0: Arrival

- Group to meet at Heathrow Airport for transfer to Sidmouth
- Introductory meeting to include HSSE briefing

Day 1

- Dawlish: aeolian-fluvial sandstones as CO₂ reservoirs
- Exmouth: impacts of faults, fault damage zones, and juxtaposition on CO₂ storage

Day 2

- Budleigh Salterton/Sidmouth: top-seals for CO₂ storage projects
- Ladram Bay: effects of reservoir heterogeneity

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Day 3

- Watton Cliff, West Bay: fault seal and stress fields; effects of cemented bands within sandstones
- Freshwater Bay, Isle of Portland: carbonates as CO₂ reservoirs

Day 4

- Durdle Door and Man o'War Cove: chalk for CO₂ storage and EOR (enhanced oil recovery); drilling and completions; reactivity with CO₂
- Lulworth Cove: effects of tectonics; offshore aquifers as potential CO₂ storage reservoirs
- Kimmeridge Bay: fault systems; fractured shales for waste CO₂ injection

Day 5

- Wytch Farm overview: modern systems; environmental impact of CO₂ storage projects; repurposing old hydrocarbon fields for CO₂ storage
- Studland Bay: poorly consolidated sands for CO₂ storage
- Course wrap up
- Transfer to Heathrow Airport