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## N577: Outcrop Analogues for CO<sub>2</sub> Storage (*Devon and Dorset, UK*)

Instructor(s): Richard Worden and Howard Johnson

### Format and Duration

Field - 5 Days

Low Physical Demand

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## Summary

Using outcrop studies, participants will consider the effects of reservoir geometry, porosity, permeability, and geomechanical properties on CO<sub>2</sub> 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 CO<sub>2</sub> pressure, well design, and completions strategies.

**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.**

## Learning Outcomes

Participants will learn to:

1. Detail the effect of reservoir properties on CO<sub>2</sub> storage capacity and CO<sub>2</sub> injectivity.
2. Examine the influence of reservoir heterogeneity on CO<sub>2</sub> movement patterns.
3. Explain how faults with different orientations and geometries may undergo reactivation at elevated CO<sub>2</sub> pressures.
4. Develop strategies for considering possible CO<sub>2</sub>-water-rock reactions depending on host rock mineralogy and fluid chemistry.
5. Evaluate CO<sub>2</sub> 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 CO<sub>2</sub> 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.

## Course Content

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

1. How reservoir geometry will affect CO<sub>2</sub> flow patterns.
2. The effect of reservoir permeability on CO<sub>2</sub> injectivity.
3. How reservoir porosity affects CO<sub>2</sub> storage.
4. The effect of geomechanical properties on reservoir strength and behaviour following CO<sub>2</sub> 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 CO<sub>2</sub>-loss, CO<sub>2</sub> diffusive loss, and fracturing at elevated CO<sub>2</sub> pressure.
7. The effect of stress orientations in the subsurface relative to fault orientations and the possibility of fault reactivation at elevated CO<sub>2</sub> pressure.
8. The influence of rock properties on CO<sub>2</sub> 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 CO<sub>2</sub> reservoirs
- Exmouth: impacts of faults, fault damage zones, and juxtaposition on CO<sub>2</sub> storage

### Day 2

- Budleigh Salterton/Sidmouth: top-seals for CO<sub>2</sub> storage projects
- Ladram Bay: effects of reservoir heterogeneity

### Day 3

- Watton Cliff, West Bay: fault seal and stress fields; effects of cemented bands within sandstones
- Freshwater Bay, Isle of Portland: carbonates as CO<sub>2</sub> reservoirs

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### Day 4

- Durdle Door and Man o'War Cove: chalk for CO<sub>2</sub> storage and EOR (enhanced oil recovery); drilling and completions; reactivity with CO<sub>2</sub>
- Lulworth Cove: effects of tectonics; offshore aquifers as potential CO<sub>2</sub> storage reservoirs
- Kimmeridge Bay: fault systems; fractured shales for waste CO<sub>2</sub> injection

### Day 5

- Wytch Farm overview: modern systems; environmental impact of CO<sub>2</sub> storage projects; repurposing old hydrocarbon fields for CO<sub>2</sub> storage
- Studland Bay: poorly consolidated sands for CO<sub>2</sub> storage
- Course wrap up
- Transfer to Heathrow Airport