N009: Sedimentology, Stratigraphy and Reservoir Geology of Deepwater Clastic Systems *(County Clare, Ireland)*

Instructor(s): Andy Pulham and Martin Evans / Peter Haughton

5 Days	Competence Level: Skilled
Field Course	
Classroom Elements	
LOW	Low Physical Demand
3D Outcrop Imagery	

Summary

Business Impact: Participants on this course will learn to appreciate the **sedimentology** and **stratigraphy** of deepwater systems and apply this understanding to the **prediction** of **reservoir presence**, **quality**, **distribution**, and **architecture**. Participants will thus be equipped to add value to subsurface projects **across the E&P life-cycle**.

The focus of this course is an outcrop examination of basin floor, slope and shelf margin architecture and stratigraphy. Controls on deepwater sedimentation are discussed in detail, specifically high amplitude sea level changes, sediment supply and the importance of varied gravity flow processes to reservoir elements and their distribution. Observations and interpretations are supported by lectures, case studies, analogues, and behind-outcrop core and wireline log data.

Learning Outcomes

Participants will learn how to:

1. Validate the range of gravity flow processes and products, their recognition in the subsurface and reservoir implications.
2. Evaluate the temporal and spatial distribution of the key elements of sand-rich basin-floor turbidite and associated slope systems.
3. Characterise the stratigraphic architecture, scale and distribution of potential reservoir units in sand-rich turbidite systems.
4. Evaluate reservoir description tools and techniques; cores, logs and seismic, for the variety of depositional settings examined.
5. Assess the contrasting nature of internal reservoir characteristics through a variety of deepwater depositional elements and its implications for exploration and exploitation risks.
6. Assess the large-scale controls that can operate on deepwater depositional systems, with particular emphasis on high-resolution sequence stratigraphy in basin floor, slope and associated deltaic systems.
7. Evaluate regional scale links from basin margin to basin floor settings and make well constrained predictions of reservoir presence and potential quality.

Duration and Training Method

This is a five-day course, consisting primarily of field work with classroom tuition, in an approximately 80:20 ratio. Classwork will comprise keynote presentations, case studies and reviews of each day of fieldwork.

This course will make use of Digital Outcrop Imagery (DOI).

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Physical Demand

The physical demands for this class are LOW according to the Nautilus Training Alliance field course grading system. All outcrops are coastal and there will be multiple walks of up to 2 km (1 mile) most days, all at around sea level with no ascent or descent exceeding 50 m (160 feet). The longest walk on the class is approximately 5 km (3 miles). Transport will be by coach on paved roads. There will be a three-hour boat trip (weather dependent) to view key cliff exposures.

Who Should Attend

The course is relevant to all subsurface Geoscientists who wish to broaden and deepen their knowledge of deep marine clastic plays. Non-geoscience staff will also benefit from participation. This field course is suitable for multi-disciplinary team attendance.

Prerequisites and Linking Courses

While there are no formal pre-requesites for this course, it is assumed that participants have knowledge of the fundamental processes and terminology of sedimentology.

To build on the lessons learned on N009, we recommend D483 (Geological Seismic Interpretation of Deepwater Systems: Depositional Environments, Reservoir Architecture and Stratigraphy) and N033 (Characterisation, Modelling, Simulation and Development Planning in Deepwater Clastic Reservoirs (Tabernas, Spain)), among others.

Course Content

The field-based component will investigate high resolution sequence stratigraphy, stratigraphic architecture and depositional processes in basin floor, slope and associated deltaic environments in the West Clare Carboniferous Basin. The glacio-eustatic, high frequency and high amplitude sea-level cycles and high-resolution chronostratigraphic framework of the Carboniferous makes it an ideal analogue for the late Cenozoic and Pleistocene continental margin stratigraphy that forms the major exploration plays in the Gulf of Mexico and Western Atlantic.

Attendees will examine a superbly-exposed basin fill and explore the contrasting reservoir components that are developed from the deep-water basin floor through the slope to shelf margin settings within a sequence stratigraphic context. Comparison with subsurface examples will be made throughout the course and behind outcrop well data will be included as appropriate.

The Clare Basin succession allows examination of shelf margin, slope, proximal through distal fan to deep basin settings. The class provides a unique opportunity to view all these elements in a linked stratigraphic

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context. Focus will be on the key components and stratigraphic architecture of sand-rich turbidite systems, slope deposits and stratigraphic links to up-dip sediment supply systems. Gravity-flow processes, their origin and deposits will be examined. The contrasting nature of reservoir elements through a variety of systems tracts and their implications for exploration and exploitation risks will be the central theme of the course. Reservoir description tools and techniques will be illustrated and their use discussed for the variety of depositional settings examined. Themes are:

1. Controls on deepwater depositional systems
2. Deltaic sediment supply systems and evidence for high amplitude sea-level cycles. Contrasts between low stand shelf edge deltas and incised valleys and highstand and transgressive systems tracts. Implications for deepwater sedimentation
3. Gravity flow processes and products; their recognition and implications
4. Clastic slope systems. Zones of coarse sediment by-pass or significant exploration targets?
5. Basin floor fans. Simple piles of sand or complicated reservoir architectures?
6. Subsurface Case Studies

Below is the planned itinerary for the course. Please note that the itenerary may vary due to weather and tides.

Day 0: Arrival

- Arrival and transfer to the small coastal community of Kilkee
- Late afternoon, walking excursion to the cliffs near Kilkee followed by a group dinner in the hotel

Day 1: Lecture and Field

- Introduction to the Clare Basin stratigraphy and deepwater systems
- Uppermost slope and shelf margin architecture
- Deltaic sequence stratigraphy and implications to deepwater sedimentation

Day 2: Field

- Turbidite systems; sedimentology and stratigraphy
- Slumps, slides, debris flows and slope sands; including channels, growth faults and overbanks

Day 3: Field

- Boat trip
- Architecture of deep-water channels and related sheets
- Deepwater processes and products

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Day 4: Lectures and Field

- Summary shelf margin to deep-water stratigraphy and models for deepwater sedimentation
- Inner fan sedimentology and stratigraphy; channel complexes, slumps and condensed sections
- Mid-fan sedimentology and stratigraphy; channels, sheets and sediment by-pass surfaces
- Fan fringe sedimentology and stratigraphy; deep basin mudrocks and distal fan elements

Day 5: Lectures. Core store, and Field

- Synthesis of deepwater systems and key lessons from the Clare Basin
- Core store visit
- Outer fan stratigraphy; sheets

Day 6: Departure

- Transfer to Shannon and departure