Summary

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 depth, specifically high amplitude sea level changes, sediment supply and importance of varied gravity flow processes to reservoir elements and their distribution in space and time. Observations and interpretations are supported by lectures, case studies, analogs and recently acquired 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 six-day course, consisting primarily of field work with classroom tuition. The proportion of field time to classroom time is approximately 80:20. Classwork will comprise keynote presentations, case studies and reviews of each day of fieldwork. Outcrop investigations will be linked to subsurface examples, both generically and with respect to recently acquired behind outcrop well data from field localities within the study area. Observations will start in shelf margin settings and end at the distal limits of sand on the basin floor. This course will also make use of Digital Outcrop Imagery (DOI).

Physical Demand

The physical demands for this class are LOW according to the Nautilus Training Alliance field course.
grading system. Access to the coastal outcrops is relatively easy and there will be walks of up to 2 km (1 mile) most days, all at sea level. The longest walk on the class is approximately 3 km, (2 miles), with no ascent or descent over 50m (160 feet). There will be one boat trip (weather dependent) to view key cliff exposures that can only be seen from offshore (3 hours duration).

Who Should Attend

The course is relevant to all subsurface geoscientists who wish to broaden and deepen their knowledge of deep marine clastic plays. Tuition will provide a broad working knowledge of these systems for graduate and inexperienced staff, while providing further insights to experienced participants who need to extend their knowledge for a more detailed application to subsurface projects.

Prerequisites and Linking Courses

It is assumed that participants will have knowledge of the fundamental processes and terminology of sedimentology before attending this class.

Geoscientists can expand on the lessons learnt on N009 in other Nautilus Training Alliance deepwater field courses (at Skilled Application Competence Level). For example, those interested in upper-slope systems and channel architectures could attend N442 (Reservoir Architecture of Deep Water Systems, California), whilst N033 (Characterisation, Modelling, Simulation and Development Planning in Deepwater Clastic Reservoirs, Tabernas, Spain) focuses on modelling and development planning in deepwater systems. For a focus on seismic stratigraphic interpretation of deepwater depositional systems, utilising practical workflows for mapping, predicting and quantifying deepwater reservoirs, consider N483 (Geological Seismic Interpretation of Deepwater Systems: Depositional Environments, Reservoir Architecture and Stratigraphy).

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, Ireland. 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 deepwater 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 newly acquired behind outcrop well data will be included as appropriate.
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

Fieldwork

Fieldwork, supported by classroom lectures and daily reviews, will describe the evolution and internal characteristics of a deepmarine clastic system within the West Clare Carboniferous Basin. Episodes of deepmarine clastic input will be related to up-dip processes in deltaic and slope settings, and will be described and interpreted in a sequence stratigraphic context.

Outcrop observations will be further illustrated with reference to subsurface examples and case histories.

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 context.

Anticipated/planned itinerary (dependent on weather and tides):

Day 0

- Arrival and transfer to the small coastal community of Kilkee
- Late afternoon, field excursion 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
- Slope systems; sedimentology and stratigraphy
- Slumps, slides, debris flows and slope sands; including channels, growth faults and overbanks

Day 3: Lecture and Field
- Deepwater processes and products
- Inner fan sedimentology and stratigraphy; channel complexes, slumps and condensed sections

Day 4: Field
- Boat trip
- Mid-fan sedimentology and stratigraphy; channels, sheets and sediment by-pass surfaces

Day 5: Lectures and Field
- Summary shelf margin to deepwater stratigraphy and models for deepwater sedimentation
- Fan fringe sedimentology and stratigraphy; deep basin mudrocks and distal fan elements

Day 6: Lectures and Field
- Synthesis of deepwater systems and key lessons from the Clare Basin
- Outer fan stratigraphy; sheets

Day 7
- Transfer to Shannon and departure