N315: Deepwater Slope Canyons and Channel Complexes *(Southern and Central California, USA)*

Instructor(s): Bryan Cronin and Dominic Armitage/ Steve Hubbard

Format and Duration

Field - 7 Days
Moderate Physical Demand

Summary

Submarine canyon, slope channel complexes and related deep-water slope elements have a wide range of morphologies, architectures and facies that are difficult to predict in the subsurface. The class will emphasize the recognition of facies diversity in the subsurface, and seismic to subseismic architectural organization. Field visits to coastal exposures of slope sediments, slope channels, canyons and fans are interspersed with classroom sessions on processes and architectures in modern and ancient deep water systems. Exercises in the field include lateral mapping of channel stacking patterns using photomosaics and overlays, synthetic log correlation, sketching and detailed facies examination. Classroom exercises include seismic interpretation of slope-channel complexes and other seismic architectures; and integrating core, log and seismic in a larger group exercise. This course takes a process-based approach to deep-water depositional environments enabling the participant to apply key learnings globally. The range of scales covered in both the classroom and the field make this course relevant to both exploration and development scale.

Learning Outcomes

Participants will learn to:

1. Evaluate the internal and external geometries of submarine canyons, slope-channel complexes and other architectures in slope systems (such as MTDs, crevasse splays).
2. Understand the sequence stratigraphic context of the main deep-water reservoir systems; focusing on the timing of sand input, bypass, deposition and seal development.
3. Compare and contrast deep water facies types and coarse-grained sediment bodies, including slope channel complex and canyon-fills, and enveloping deep water facies and architectures – both non-reservoir and fringing 'halo' reservoir.
4. Interpret facies associations in deep water clastic settings, from log, core and seismic attributes where possible.
5. Analyse and predict sand body architecture, correlations and connectivity.
6. Evaluate lateral and vertical facies variation in submarine canyon and slope channel complex fills.
7. Assess vertical and lateral depositional sequences development in submarine canyon and slope channel complex fills.
8. Formulate depositional models for amalgamated channel elements in a channel margin to channel complex axis context.
9. Compare canyon, slope channel complex, MTD, channel levee and other deep-water models.
10. Create an interpretation from well data in a submarine canyon fill/ slope-channel complex environment.

Training Method

This is a seven-day field and classroom course in central and southern California focused on outcrop work that uses a combination of field excursions, field-based exercises with a correlation exercise, and classroom lectures. The approximate split of field to class time is 60:40.

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Physical Demand

The physical demands for this class are MODERATE according to the Nautilus field course grading system. The field areas are at sea level in and around Monterey (central) and La Jolla (southern), California, where temperatures range from cool and damp to warm and humid. There will be walks of up to 1 km (0.6 miles) most days, with some wading on a sandy beach required to visit some outcrops. The longest walk on the class is 4.5 km (3 miles) with an ascent of 100 m (300 ft) at the end. There is also one location that requires the use of a rope for participants to pull themselves up a short, steep stretch of rock. Transport on the course is by bus.

Who Should Attend

The course is appropriate for geoscientists and engineers with an interest in deep water systems, and especially channel or canyon systems. This trip will be particularly suitable for those working West African, Caribbean and Brazilian margins; Southeast Asia, East Africa, Nile Delta, North Slope of Alaska, Palaeogene North Sea and Atlantic Margins, or Gulf of Mexico.

Prerequisites and Linking Courses

Attendees should have a working knowledge of deep water processes and channel architectural elements of turbidite systems, such as is offered in N155 (Introduction to Clastic Depositional Systems: a Petroleum Perspective).

Those interested in upper-slope systems and channel architectures may wish to attend N102 (Deepwater Slope Channel Complexes: Architecture and Evolution to Distal Facies, South and East Turkey), while N247 (Sedimentology, Stratigraphy and Architecture of Fluvial, Deltaic and Deepwater Reservoirs: An Outcrop Perspective of Linked Depositional Systems, Arkansas, USA) explores the relationship between linked fluvial, deltaic and deep water systems.

Those interested in expanding their understanding of the influence of structural controls on deep water clastic systems may wish to attend N028 (Sand-Rich Turbidite Systems and Megaturbidites: From Slope to Basin Plain. Facies, Stacking Patterns and Controlling Factors, Pyrenees, Spain). This theme is also dealt with in classroom course N043 (Gulf of Mexico Petroleum Systems).

Those interested in deep water clastics modeling may wish to attend N292 (Deepwater Depositional System Stratigraphy for Exploration and Development, Arkansas, USA).

Course Content

The class visits famous outcrops of southern and central California that were the early inspiration for many turbidite architectural theories. It focuses on facies, facies associations, sand body correlation, architecture and connections. At Pigeon Point the class sees a wide range of facies, with levee dominated sections with exceptional fine grained facies exposure. At Point Lobos the class views canyon edge

contacts, and channel architecture correlations. At San Clemente the class studies the correlation of offset asymmetrical channels and migrated channels. At Blacks Beach the class examines lateral and vertical facies variation and discuss depositional sequences. At La Jolla cove the class views a variety of fine- and coarse-grained environments expressed in a transgressive to regressive sequence.

Itinerary

Day 0:

Arrive Monterey airport, overnight in Monterey, California.

Day 1:

Introductory lectures on the geology of California and turbidity current sedimentary processes.

Field work at Pescadero State Reserve and Pigeon Point. Overnight in Monterey.

Day 2:

Classroom session on deep water depositional systems and processes. Excursion to Point Lobos State Reserve; study of canyon margin and fill architecture. Overnight in Monterey.

Day 3:

Transfer to La Jolla. Field excursion to Tourmaline Beach Surfing Park. Classroom session on deep water depositional systems and processes. Overnight in La Jolla.

Day 4:

Classroom session on deep water architectures and sequence stratigraphy. Excursion to La Jolla Cove; turbidite sheet sands, soft sediment deformation, deep water mudstones. Overnight in La Jolla.

Day 5:

San Clemente State Beach; correlation and study of stacked and offset-stacked fills of slope channels. Overnight in La Jolla.

Day 6:

Classroom session on deep water architectures. Excursion to Torrey Pines State Reserve and Blacks Beach; comparison of shallow and deep water deposits; the nature of slope unconformities and candidate sequence boundaries, slope sediments and slope channel architectures. Overnight in La Jolla.

Day 7:

Classroom session on deep water architectures. Excursion to Blacks Beach; canyon architectures and facies. Overnight near La Jolla.

Day 8:

Travel home.