Sand-rich Turbidite Systems: From Slope to Basin Plain, Pyrenees, Spain (G016)

Tutor(s)

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Overview

This course in the Central Pyrenees will visit spectacular outcrops of Eocene deep marine clastics in the confined mini-basin settings of the Ainsa and Jaca basins. Shelf-slope-basin relations are examined in detail and reveal features such as ponding in sub-basins, system architecture and reservoir stacking patterns. Identification of facies types is emphasized at both reservoir and exploration prospect scales. The use of the outcrops as analogs for producing oil and gas fields is discussed and 3-D models of the basin infill and deep marine deposition will be shown. Attendees are encouraged to bring their own data for discussion as either presentations or as posters.

Duration and Logistics

A 6-day field course comprising a mix of outcrop examination and discussion (70%), core examination (15%) and supporting classroom lectures (15%). The course is conducted in the Central Pyrenees of northern Spain, with attendees arriving in and departing from Barcelona, Spain. The course materials are supplied as a short, printed field guide with supporting lecture material provided in digital format – if you wish to access this while on the course you will need to bring a laptop or tablet computer.

Level and Audience

Advanced. Suitable for geoscientists and reservoir engineers seeking to understand deepwater clastic reservoir distribution, prediction and compartmentalization. Appropriate for asset teams looking to develop a common understanding of their deepwater clastic reservoirs.

Exertion Level

This class requires an **EASY** exertion level. Travel between outcrops will be by small coach and there are several short hikes of 2–3km (1.2–1.8 miles) over uneven ground, but nothing overly strenuous. The weather can be variable and ranges from hot and dry to cold and very wet, with fall temperature ranges of 5–30°C (40–85°F), so please be prepared. Field days start around 9am and finish at 6–7pm. (Please note that meals are taken rather late by North American and northern European standards.)

Objectives

You will learn to:

1. Recognize genetically linked facies deposited by submarine gravity flow processes within a partitioned foredeep, from slope to basin plain.
2. Identify the transitions between the various components of the system (channel, lobe, etc.), their controls and predictive aspects.
3. Characterize the geometry and scale of sand bodies and their stacking patterns in outcrop and compare with reservoir units in analogous subsurface settings.

4. Assess the relation between syndepositional tectonics and partitioned mini-basins that act as receiving basins.
5. Assess and predict the control of sand body geometry and reservoir architecture on reservoir production characteristics.
6. Assess high-frequency cyclicity recorded in the sediments and relate these patterns to intrinsic and extrinsic basin controls.
7. Apply predictive models for the infill of facies and stacking patterns based on the interplay between mini-basin geometry/development and sediment infill.

Course Content

Course Details

The Eocene Hecho Group offers one of the best-exposed systems of deep marine clastics in a confined mini-basin setting. The field area is within a foreland basin in front of a fold and thrust belt and consists of small, partitioned, piggyback basins above the main regional detachments. These thrusts were active during deposition and so provide an analog to salt mini-basins. Preserved sediments show syntectonic depositional features of infill geometries.

Depositional systems are exposed in laterally extensive and correlatable outcrops that progress from slope feeders, canyons, channels and their related overbank deposits, channel-lobe transition, sheet-like lobes and, finally, basin plain sheet systems. Some of the exposures are seismic-scale, and the integration of fieldwork, subsurface and rock data has allowed individual beds and sand packages to be correlated over tens of kilometers, with visible down-current facies changes within each depositional package. Distinctive and thick carbonate megabreccias (megaturbidite beds), derived from the flanking margins of the foredeep, have been mapped among the turbidite depositional systems, with some traced along an extension of nearly 200km (124 miles). High-resolution measured sections, bed-by-bed correlation cross-sections and detailed geological mapping will be integrated to interpret individual outcrops and place them in the basin-scale depositional framework. This approach will be useful to exploration and production problems from basin to reservoir scales, bringing together a wide range of facies, beds and stacking patterns that characterize the different elements of a turbidite system.

Day 1: Arrive In Barcelona

Meet at Barcelona airport for travel to the Ainsa region.

Classroom:

- Course introduction and safety briefing

Fieldwork:

- Vaca Muerta basin overview and Arro channels

Overnight Escalona.

Day 2: Slope and basin floor channels of the Ainsa sub-basin

Fieldwork:

- Morning field excursion – north and south Ainsa channel systems
- Afternoon field excursion – Guaso panoramic Ainsa basin overview and orientation; terminal basin complex. Fosado Canyon system and Rio Forcaz Hotel stop

Classroom:

- Flume studies, facies classifications, channel-levee analogs

Overnight Escalona.

Day 3: Channel-levees, channel lobe transition and basin floor onlap

Fieldwork:

- Morning field excursion – Banaston system overbank facies and cyclical stacking patterns, Labuerda. Transition between overbank and frontal splay facies. Frontal splay complex San Vicente. Discussion of exploration and production implications
- Afternoon field excursion – Banaston and Ainsa systems large-scale basin onlap, Campodarbe. Boltana Channel, Banaston system channel fill, by-pass and hyperconcentrated flows

Overnight Escalona.

Day 4: Channels, channel-lobe transition and Jaca sub-basin

Fieldwork:

- Morning field excursion – Morillo system mass transport complexes, overbank / levee facies and frontal splay complexes, Sieste. Boltana anticline canyon and Janovas
- Afternoon field excursion – Banaston system channel-lobe transition, Bergua
- Lectures and discussions – channel simulation, participants' contributions

Overnight Escalona.

Day 5: Basin floor sheets and lobes

Fieldwork:

- Morning field excursion – down-dip evolution and high-frequency stacking patterns, Fanlo Road and Sarvisé. Downstream evolution of the Arro channel at Broto. Biescas roadside stop
- Afternoon field excursion – massive sandstones at Puente de Torrijos

Overnight Jaca.

Day 6: Basin floor lobes and megaturbidites

Fieldwork:

- Morning field excursions – distal basin floor lobes and sheet-like sands in the Jaca basin; megaturbidites

Return to Barcelona for travel home.