

N544: Source to Sink: Provenance, Sediment Routing and Reservoir Characterisation (*Southern Pyrenees, Spain*)

Instructor(s): Philip Hirst and Gary Nichols

Format and Duration

Field - 5 Days

Low Physical Demand

Summary

The Cenozoic history of the Southern Pyrenees preserves whole depositional systems in multiple stages of development; the nature of the erosional realm can be reconstructed from provenance data, structural elements have demonstrable controls on sediment routing, and sedimentation packages can be traced from fluvial through paralic and shelf deposits to slope and deeper water facies. Excellent exposures allow the characteristics of different elements of the systems to be evaluated in terms of reservoir properties, sediment architecture, and reservoir connectivity.

Business Impact: An understanding of the **sources of clastic sediments**, the controls on the **pathways of transport** into and through basins and their distribution into different depositional environments is key to the **characterisation** and **correlation** of sedimentary rocks. This course facilitates **integration** of **multi-disciplinary** teams in solving **basin-scale, reservoir-focussed** problems.

Learning Outcomes

Participants will learn to:

1. Apply structural studies in both source and depositional areas to determine the sediment pathway.
2. Explain the interplay between tectonics, bedrock character, base level, and climatic controls on sediment supply into basins.
3. Use petrographic and geochemical tools in provenance analysis and correlation through depositional systems.
4. Appreciate the differences between endorheic (internally drained) and exorheic (externally drained) basin systems and the effects on stratigraphy and sediment distributions.
5. Characterise reservoir facies in alluvial, fluvial, lacustrine, coastal, shelf, slope and deeper water settings.
6. Review volumetrics of key sedimentary units.
7. Appreciate the key controls on fluid flow and recovery in different depositional systems.
8. Select appropriate field analogues for reservoirs, in the context of depositional system, basin structure and scale.

Training Method

This is a field course, supported by short classroom sessions.

Physical Demand

The physical demands for this course are LOW according to the RPS field course grading system; the course requires basic fitness levels. Fieldwork is carried out in the relatively gentle topography of the southern Pyrenees, at altitudes of 500-1600 m (1650-5250 ft). Access to the outcrops requires some walks of up to 2.5 km (1.5 mi) along roadsides, riverside paths, and through scrubland.

Transport will be by coach on paved roads, supplemented with 4WD vehicles to access several locations.

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Who Should Attend

The course is aimed at geoscientists, petrophysicists, and reservoir engineers who wish to better understand clastic depositional systems from basin-scale to reservoir scale. Multi-disciplinary asset teams would benefit from attendance as a group.

Course Content

The course will follow a transect through the Eocene southern Pyrenean foreland basins from the Tremp-Graus basin in the east through the Ainsa basin to the Jaca Basin in the west. This exorheic system will be contrasted with the internally-draining Miocene Ebro Basin to the south. The course starts and ends in Barcelona.

At each outcrop, the depositional setting will be reviewed in terms of a potential reservoir. The depositional architecture and its influence on reservoir connectivity and heterogeneity will be discussed.

Key topics to be covered are:

1. Tectonic controls on sediment routing systems into the Eocene Tremp-Graus Basin and the Miocene Ebro Basin.
2. Provenance analysis.
3. Contrasting fluvial tracts formed in a valley-confined setting in the Eocene with distributive fluvial systems in the Miocene.
4. Sediment-body geometries will be compared in fluvial, tidally-influenced coastal and shelf deposits and in slope and basinal settings.
5. Reservoir characterisation of clastic depositional facies in each of the different settings, considering the scales of heterogeneities within and between reservoir units.
6. The importance of analogues in building geological models of a subsurface reservoir, pitfalls and key considerations when choosing appropriate analogues for any system.

The following itinerary is intended as a guide, and may be modified according to weather and/or the participants' interests and focus.

Day 0: Arrival in Barcelona

- Course introduction and HSSE briefing

Day 1: Field

- Montllobat Pass Viewpoint - introduction to the main structural features and stratigraphy
- Mas de Faro – fluvial system, supply, and routing
- Calvera Pass – endorheic basin proximal facies
- La Roca – fluvial facies near shoreline
- Overnight in Graus

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Day 2: Field

- Graus – proximal fluvial system
- Pano – coastal, barrier, and lagoonal facies
- Guaso – viewpoint of basin
- Santa Maria de Buil – marine-fluvial transition
- Overnight in Ainsa

Day 3: Field

- Ainsa viewpoint – seismic scale slope channel system
- Ainsa Quarry – slope and submarine fan channel
- Boltana – structural evolution, rotated syn-sedimentary anticline
- Broto – submarine fan lobe facies
- Core Store – slope and submarine fan channel
- Overnight in Ainsa

Day 4: Field

- Drive Ainsa to Arguis - stop to examine Campodarbe fluvial
- Belsue Atares View – deep marine to delta front transition
- Pico de Aguila transmitter tower – impact of emergent thrust front
- Roldan front view – alluvial fan context
- Roldan car park – alluvial fan detail
- La Galocha - lacustrine
- Overnight in Huesca

Day 5: Field and departure

- Albero Bajo – channel body stacking in Distributive Fluvial System
- Piraces – fluvial system architecture (endorheic system)
- Monasterio El Pueyo – viewpoint and course summary
- Transfer to Barcelona for departure