

Basin-Scale Stratigraphy (Source-to-Sink): Basins of the Pyrenean Foreland, Spain (G117)



Tutor(s)

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Overview

Well-exposed outcrops of the Pyrenean Foreland Basin (PFB) in northern Spain offer a unique opportunity for source-to-sink analyses across thrust and foreland basin settings. This course demonstrates regional linkages of continental to marine environments and teaches fundamentals of play-scale reservoir, source and seal mapping and prediction. We utilize 3D outcrop models, detailed biostratigraphic data and subsurface examples to enhance learning through making maps and predictions. The course presents sequence stratigraphic models across continental, shelfal and deep-water settings in order to understand the external controls on sediment flux from the proximal to distal environments.

Duration and Logistics

A 6-day field course, based in the Pyrenees, with the itinerary dependent on the technical objectives of the group and timeframe. 60-80% of the time will be spent in the field, making active observations and undertaking field exercises, in combination with some classroom exercises and lectures as well as the option for viewing core.

Level and Audience

Intermediate. The course is specifically designed for reservoir engineers, geologists and geophysicists interested in analysing a range of clastic reservoir types from a variety of depositional settings. The field course will examine the reservoir attributes of a wide range of sand-prone deposits focusing on the reservoir quality and property distribution as well as larger scale correlation and gross architecture of distinct stratigraphic units. In addition, play-scale prediction of reservoir, source and seal elements will be covered and play-based evaluation techniques will be discussed and practiced.

Exertion Level

This class requires an **EASY** exertion level. Access to the outcrops is easy with many being road cuts. The longest walk is approximately 3 km over scrubby land. The field area sits at an altitude of up to 1000 m and the weather can be warm with daily highs over 25 degrees Celsius.

Objectives

You will learn to:

1. Review facies associations in siliciclastic depositional systems.
2. Predict external controls on sediment flux from continent to basin.
3. Study the effects of compressional tectonics and the interaction of tectonics and sedimentation.
4. Assess proximal to distal environments of deposition (EoD) and link them in space and time.
5. Employ sequence stratigraphic models to continental, shelf and deep-water settings.

6. Build stratigraphic frameworks across various scales and EoD.
7. Predict occurrence of basin-scale play elements.
8. Place local interpretations into regional context for predictions away from well control.
9. Examine where sediment is stored in shelf environments, as well as when and how sediment is transported to deep water.

Course Content

Course Details

In the Middle Eocene, during the early Lutetian time, this area comprised a series of linked basins that were connected to the Atlantic Ocean in the west. These basins formed due to the Cenozoic convergence of the African and European plates with the Iberian micro-plate that resulted in south-directed thrusting. Middle Eocene deposition in the PFB recorded the interaction of tectonics and sedimentation from the shelf (Trempe Basin) to slope (Ainsa Basin) and basin (Jaca Basin) environments.

In the Oligo-Miocene however, the fluvial system was a closed, terminal system directed transversely across the mountain belt. Large-scale fluvial dispersal systems flowed from the hinterland to the Ebro foreland basin. Smaller more localised fluvial systems shedding from actively uplifting structures including the emergent thrust front, are also present.

This course demonstrates regional to sub-regional linkages of continental to marine environments and the reservoir architecture of clastic systems.

- Source-to-sink analyses.
- Siliciclastic lithofacies nomenclature and definitions, common lithofacies associations, and interpretations of lithofacies in outcrop.
- Use outcrop datasets to interpret EoD and to spatially link them in time and space.
- Sedimentation response to tectonics within convergence zones.
- Evaluate reservoir geometry and connectivity in different EoDs.
- Use outcrop information to predict basin-scale play elements.
- Sediment transport processes and routes.

Day 1: Arrive in Barcelona

Classroom:

- Course introduction and safety brief

Overnight Trempe or Ainsa.

Day 2: Ager to Tremp-Graus basins or Ainsa Basin

Fieldwork:

- Introduction to the Spanish Pyrenees.
- Fluvial depositional systems (Castissent Formation or Equinilla Formation)
- Deltaic/paralic depositional systems (Ager Basin: Baronia Formation, tidal sandbodies in a localised thrust sheet-top basin, Roda Sandstone); Road to Mondot and/or Buil in Ainsa Basin)

Overnight in Ainsa

Day 3: Ainsa Basin

Fieldwork:

- Slope canyon and transition into the Ainsa Basin.
- Ainsa Basin deep-water confined systems

Overnight Ainsa.

Day 4: Ainsa Basin

Fieldwork:

- Ainsa Basin: deep-water channel-lobe transitions (O'Grau, Ainsa)
- Boltana anticline: a deepwater growth fold structure that influenced the evolution of the Ainsa and Inner Jaca Basins.
- Jaca Basin – lobe and basin plain turbidites, including mega-turbidites that serve as event marker horizons

Overnight in Murillo de Gallego.

Day 5: Ebro Basin

Fieldwork:

- Ebro Basin including basin margin alluvial fan systems and Huesca mega-fan system
- Analysis of locally sourced fluvial system at an emergent thrust front with evidence of syn-sedimentary deformation.
- Basin centre fluvial system including fluvial channels and alluvial architecture

Overnight in Murillo de Gallego.

Day 6: Return to Barcelona and travel home

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