

N108: Exploration and Geological Model Development in Fluvial Reservoirs (*Southern Pyrenees, Spain*)

Instructor(s): Gary Nichols and Philip Hirst

Format and Duration

Field - 4 Days

Low Physical Demand

Summary

This field-based course integrates fluvial sedimentology with applied exploration and field development, using case studies from Southern Pyrenees, Spain. There are extensive outcrops of the deposits of both externally draining systems from the Eocene and Miocene deposits of an internally draining Distributive Fluvial System. Variations in fluvial architecture are considered in terms of proximal to distal settings within the depositional systems and the impact of the architecture on field developments are considered. Business Impact: the area provides analogues for fluvial reservoirs at a variety of scales and settings, proving input on the development of reservoir models.

Learning Outcomes

Participants will learn to:

1. Evaluate the sedimentology and basin fill architecture of internally and externally draining fluvial systems.
2. Predict significant changes in sedimentology and stratigraphic architecture, both laterally and up or down dip in fluvial reservoir systems.
3. Integrate the interactions of extrinsic and intrinsic controls on fluvial architecture.
4. Assess the impact of fluvial architectures, flow zones and sedimentary heterogeneity on potential recovery in different hydrocarbon fluid and development scenarios.
5. Evaluate and rate different modelling options for different architectures, fluids and development scenarios.
6. Consider the issues of up-scaling in heterogeneous fluvial systems and select appropriate techniques to use in different scenarios.

Training Method

A four-day field course in the foreland basins of the Southern Pyrenees. The course focusses on the examination of fluvial facies at different scales in outcrops and provides opportunities to consider inputs to reservoir models

Physical Demand

The physical demands for this class are LOW according to the Nautilus Training Alliance field course grading system. Fieldwork is carried out in the agricultural lowlands of the Ebro Basin. Access to the outcrops is easy, with most localities being roadside stops. Some short walks up to 0.5 km take in river-side paths and scrub land.

Who Should Attend

The course is aimed at exploration and development geoscientists, petrophysicists and reservoir engineers who are keen to better understand fluvial systems and the practical application of that knowledge in the generation of reservoir models. Participants are expected to be familiar with the basic

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concepts of generating reservoir models and have a basic understanding of fluvial sedimentology.

Course Content

Hydrocarbon reservoirs within fluvial depositional settings are challenging environments for geoscientists to interpret and develop. Significant changes in stratigraphic architecture occur over short distances, both laterally and up or down dip, and strongly impact production performance. An understanding of the issues involved in developing different fluvial architectures and the decisions required to model these complex heterogenous reservoirs are critical to predicting the long term production behaviour.

Chronostratigraphic control is often poor and sandstone body correlation is difficult because of the multi-scale heterogeneity of fluvial deposits. Predictive models of fluvial systems are the subject of much academic discussion, with sea level controlled models only applicable in coastal regions. Many fluvial systems preserved in the rock record are generated in internally draining basins or far upstream of sea level influence and are subject to different control mechanisms. Observations from modern and ancient analogues suggest that fluvial facies have a wide range of architectures, supported in the subsurface by different production behaviours from similar facies.

The foreland basins of the Southern Pyrenees in northern Spain formed south of the Pyrenean orogenic belt, which developed in the Cenozoic as a result of crustal shortening between the Eurasian plate and the Iberian sub-plate. Examples of deposits of both externally-draining fluvial systems and internally-draining Distributive Fluvial Systems are considered. Exposures allow fluvial channel and overbank facies to be examined at reservoir scale and for correlation over tens of kilometres up and down flow. During the course, the differences that might be expected in analogue fluvial systems under different conditions of tectonic setting, climate and sediment supply will be emphasised.

Predictive facies models will be discussed and their application to understanding the controls on the architectures developed and preserved in the rock record, from both an exploration and development perspective. Understanding the controls on fluid flow behaviour within the reservoir is key to determining how to model it for different development scenarios. The course will examine production challenges posed by different sedimentary stacking and sedimentary depositional structures. Questions of scale, from core to log to outcrop to simulation model and then how to upscale in complex heterogenous environments will be discussed in the field and classroom.

Day 0

Arrival in Barcelona and transfer to hotel

Evening course safety brief and introductory lecture, followed by group dinner in the hotel

Day 1

The Eocene Tremp-Graus Basin

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Basin introduction and the Castissent Sandstone unit

Fieldwork at several locations in the basin along an east-west transect

Hotel in Huesca for the remainder of the course

Day 2

The Miocene Ebro Basin and the Huesca Distributive Fluvial System

Series of locations examined in a down-system transect across the basin

Day 3

The Miocene Ebro Basin and the Huesca Distributive Fluvial System

Continuation of examination of proximal-distal variations

Locations which allow detailed consideration of fluvial architecture

Day 4

Facies at the margin of the foreland basin

Transfer to Barcelona and departure