

N358: Fine-Grained Carbonate Reservoirs (*Etretat, Northern France*)

Instructor(s): Andy Gale

Format and Duration

Field - 4 Days

Low Physical Demand

Summary

The course focuses on the identification, characterization and interpretation of chalk facies, including pelagic chalks, redeposited chalks, condensed sequences (including hardgrounds), and the parameters controlling reservoir properties in each of these. Diagenetic processes affecting poroperm will be considered in detail. The fracture characteristics and history, and affects on permeability of each facies will also be covered.

Learning Outcomes

Participants will learn to:

1. Assess a number of different chalk facies and how these fit into the depositional systems in which they form.
2. Characterise the depositional processes which control facies distribution within a variety of chalk successions.
3. Develop an understanding of how sea level changes control stacking patterns, sequences and facies distributions in chalks and hence overall reservoir potential.
4. Evaluate the diagenetic processes taking place in chalks, the interaction between sedimentation and diagenesis, and the products of these and their affects on poroperm.
5. Integrate logs for correlations with coeval successions, identify marker horizons and incorporate other data including biostratigraphy and chemostratigraphy.
6. Relate the physical characteristics of individual facies to fracture style and thus controls on permeability.
7. Assess redeposited chalks, and assess their likely lateral extent, geometries and reservoir potential.

Training Method

A four-day field course comprising both fieldwork and classroom presentations and exercises. Practical classand field-based exercises are based on field logging, identification of key lithologies and diagenetic processes and their interpretation in terms of depositional systems. The proportion of field time to classroom time is approximately 75:25.

Physical Demand

The physical demands for this class are LOW according to the Nautilus field course grading system. The majority of stops are beach locations accessed by steps or hard surfaced slipways. The longest walk on the class is just over 3 km (2 miles) along a small road giving access to a particular beach. One stop involves the descent and ascent of a series of steep steps in order to access the outcrop. All transport during the class is by coach.

Who Should Attend

This course is multi-disciplinary and is designed for geoscientists, petrophysicists and reservoir engineers involved in exploring carbonate basin settings and/or appraising/developing finegrained carbonate

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reservoirs. The lectures and exercises, as well as field discussions will integrate the various disciplines. The class will benefit those with some experience of carbonate reservoirs and issues relating to facies and porosity prediction.

Prerequisites and Linking Courses

Having some prior experience of carbonate systems is an advantage and attendance on Nautilus course N020 (Carbonate Depositional Systems) is suggested for those with little or no knowledge of carbonate rocks and reservoirs. Class N059 (Applied Carbonate Geology: Carbonate Facies and Reservoirs (Menorca and Mallorca, Spain) would also serve as a potential primer for this class.

A number of linking courses, both in the field and classroom, are available on the GTA Programme. A wide range of carbonate reservoir topics are addressed including reservoir characterisation (N143: Advanced Concepts in Carbonate Exploration and Reservoir Characterisation, Northern Spain; N336: Carbonate Reservoir Description Based on Core and Well Data), fracturing and faulting (N186: Complex Carbonate Reservoirs: Influence of Facies and Tectonic Processes on Porosity Development; N134: Carbonate and Shale Faulting and Fracturing Field Seminar) and sequence stratigraphy (N073: Workshop in Geological Seismic Interpretation: Carbonate Systems; N091: Carbonate Reservoir Architecture and Applied Sequence Stratigraphy, West Texas and SE New Mexico). Modern carbonate systems can also be examined - for example on course N329 (Improved Models for Exploration and Production Scale Heterogeneity on Isolated Carbonate Platforms: Crooked-Acklins Platform, Southern Bahamas).

Course Content

Outcropping Cretaceous chalks on the Haute Normandie coast provide an excellent introduction to the facies, depositional systems and reservoir geology of these sediments. The course will help participants develop a detailed understanding of chalk depositional processes, facies, diagenetic processes and products, and how these are controlled by primary productivity, sea level, local tectonics and other extrinsic factors (e.g. Milankovitch cyclicity). This provides a firm basis for understanding parameters which control reservoir quality in chalk depositional systems.

The Normandy coast provides extensive exposures of Cenomanian to Santonian Chalks, which record progressive deepening of the Cretaceous sea, recorded in the gradual cut-off of clastic supply and an increasingly oceanic depositional regime in which white pelagic chalks dominated. The region was strongly affected by deep erosive currents which created spectacular channels, on the flanks of which extensive redeposition took place in the form of slump sheets and debris flows, analogous with those present in the Central Graben of the North Sea.

Approximate itinerary:

Day 1: Travel and Introduction

Morning: Travel to France and transfer to hotel

Afternoon: Safety brief and introductory lecture:

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- Chalk petrography and sedimentological control on facies

Short excursion to view the cliffs in Etretat

Overnight: Domaine Saint Clair, Etretat

Day 2: Fieldwork and Classroom

Morning: Lecture

- Diagenesis and its control on poroperm

- Correlation in chalks (what is possible and how can it be achieved?)

- Chalk reservoirs

Afternoon: Fieldwork

Port Petrolier: Field identification of chalk facies and diagenetic products, assessing poroperm, logging, sequence stratigraphy, exercises

Tilleul: slump sheets; channels, mounds, exercise

Overnight: Domaine Saint Clair, Etretat

Day 3: Fieldwork

Morning: Fecamp; fractures, reservoir examples

Afternoon: Senneville; chalk facies variability, debris flows, regional hardgrounds and basinwide correlation

Overnight: Domaine Saint Clair, Etretat

Day 4: Fieldwork and Classroom

Morning Fieldwork: Vaucottes; slump sheets

Afternoon Fieldwork: Banc a Cuves; channels, slump sheets, seismic resolution, exercise

Evening course wrap up and summary lecture

Overnight: Domaine Saint Clair, Etretat

Day 5: Hotel check out and transfer to depart France