
N186: Complex Carbonate Reservoirs: Influence of Facies and Tectonic Processes on Porosity Development (Southern Italy)

Instructor(s): Raffaella Di Cuia and Davide Casabianca

Format and Duration

Field - 6 Days
Moderate Physical
Demand

Summary

The course follows the trajectory of a virtual well drilled in the prospective Monte Alpi (and Tempo Rosso) trend. The effects of a contractional regime on a wide range of carbonate rocks, from basinal to platform margin and interior facies, are observed. Principal among these effects is fracturing, and the resultant implications for reservoir performance are examined. The development of karstic macroporosity is also reviewed.

Learning Outcomes

Participants will learn to:

1. Summarise the geology and structural evolution of the Southern Apennines thrust belt.
2. Assess the reservoir characteristics of different facies types within the Apulian Platform and illustrate the exploration and production strategies for targets with similar characteristics.
3. Characterise the principal sedimentological processes that affect primary and secondary porosity and reservoir quality in the platforms.
4. Evaluate the relationship between sedimentary facies, tectonic style and resulting fracture network in a contractional regime.
5. Appraise outcrop evidence (facies and structural data) and assess how these are best integrated into reservoir description.
6. Evaluate the effects of deformation on a variety of carbonate facies, including Upper Cretaceous rudistic, calcarenitic and peritidal platforms along with heterolithic Mesozoic to Tertiary Flysch.
7. Estimate the dynamic behaviour of carbonate (fractured) reservoirs based on the different depositional facies and on the geomechanical behaviour of the facies when stress regimes are applied.

Training Method

Six field days covering the Apennine Mountains of Southern Italy from the Tyrrhenian coast to the Adriatic coast, starting in Naples and finishing in Rome. The course is primarily field-based with maximum time spent in front of the outcrops. There is a short classroom session on the first night to introduce the regional geology. Examples of public domain data from the local producing areas are included wherever possible to enhance the generic principles outlined during the course.

Physical Demand

The physical demands for this class are MODERATE according to the Nautilus Training Alliance field course grading system. The majority of the stops are close to the coach or involve short walks of a kilometre or two on good trails. Many outcrops are in quarries and these may be uneven underfoot with occasional scrambling up or down quarry benches. Temperatures are expected to be comfortable but it can be hot, especially in the quarries. The final day involves greater physical demand with a 6 km (4

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miles) mountain hike up a steep trail at an elevation of up to 1800 m (6000 ft). Participants need to be equipped for the mountain day with waterproofs and warm clothing, as well as prepared for hot or variable weather on other parts of the trip.

Who Should Attend

Petroleum geologists, reservoir engineers and geophysicists working on carbonate sequences, especially where there is a close relationship between facies, fracturing, structure and potential reservoir performance. Ideally, the components of a subsurface team would greatly benefit from participating together.

Prerequisites and Linking Courses

Participants with familiarity with carbonates will benefit most from this course. There are no formal prerequisites but Nautilus Training Alliance classes N020 (Carbonate Depositional Systems) and N059 (Applied Carbonate Geology) provide suitable primers. N143 (Advanced Concepts in Carbonate Exploration and Reservoir Characterization) can be considered as a linking course, outlining a number of the new and developing ideas in carbonate reservoir geology.

Course Content

Carbonate reservoirs are liable to display a large variability in their characteristics, affecting both performance and economic viability. Prominent among these are primary facies distribution and properties, the sequence stratigraphic framework, diagenesis and fracturing.

Numerous subsurface disciplines contribute to carbonate reservoir characterisation, such integration being crucial to an understanding and prediction of dynamic reservoir performance, and ultimately leads to more closely focused exploration, reservoir development and depletion strategies.

To achieve such a comprehensive reservoir picture, geoscientists must make use of outcrop analogues, evidence from which can be integrated with subsurface datasets from the specific reservoir under study. For the models to have predictive capability, the regional geological evolution however needs also to be integrated to place the reservoir and the processes through which it has been subjected in context. This field seminar aims to provide such elements.

The field area includes a wide range of sedimentary facies, stratigraphic architecture and structural environments, all within a highly compressive setting, sampling two Mesozoic to Cenozoic carbonate platforms, the Apulian and Apenninic, which formed, grew and then collided as elements of the interaction between the African and Eurasian plates. The two platforms and the previously intervening Lagonegro Basin are now stacked in complex thrust sheets in the southern Apennines.

The Apulian Platform is reservoir in the giant Eni-Shell oilfields of the Val d'Agri and also in the undeveloped Tempa Rossa field. Fractures and karst play a major role in the production performance of

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these fields.

In each segment of the class there is emphasis on the linkage between depositional facies, structural development and fracture formation.

Course Itinerary

Day 0

- Arrive Naples, transfer to hotel. Evening course introduction to the field seminar and overview of southern Apennines geology.

Days 1 and 2

- Structural assembly of the Apennines: the structural geology of the two platforms and the previously intervening basin; stratigraphic relations between platform and basin
- Other tectonic units: the external flysch, thrust-top basins and the foreland: structural geometries and lithologies

Days 2 and 3

- Facies, fracturing and karst in platform interior facies in the Murge (Altamura Formation): varied muddy and grainy facies with rudist bioherms and biostromes. Examination of megabreccia deposits and karst macroporosity in the Gargano region.

Days 4-6 at Monte Maiella

A sampled pop-up of the Apulian Platform's northern margin that exposes the platform-slope-basin transition from Turonian to the Eocene. 1000 m of original topographic break can be inferred.

- Organisation of ramp and basinal deposit evolution through time, plus differing fracturing characteristics for similar depositional characteristics
- Porous calcarenites and description of 3D fault and associated fracture networks
- The platform to margin transition and fracture characteristics close to structural hinge
- Characteristics of ramp deposits
- Relationship between mineralisation along faults and matrix porosity impregnation, along with discussion of associated petroleum system
- Understanding of coarse grained facies distribution at reservoir scale
- Identification of main structural features related to tectonic framework
- Observation of possible relationship between fracture intensity/density and type, along with sedimentary facies and bioclast content.

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End of Day 6

- Transfer and overnight near Rome.