N235: Exploring for Carbonate Reservoirs *(Dolomites, Italy)*

Instructor(s): Trevor Burchette and Alberto Riva

Format and Duration

Field - 6 Days
High Physical Demand

Summary

This course is targeted at geoscientists and allied disciplines engaged in petroleum exploration in basins where carbonate rocks are anticipated. Through a series of lectures, exercises using wireline logs, seismic and field work in the incomparable Italian Dolomites, participants will obtain a thorough grounding in the controls on the geometries of carbonate platforms, their seismic expression, petroleum systems in which carbonate rocks are key, and the data requirements for assessing carbonate exploration prospects.

Learning Outcomes

Participants will learn to:

1. Characterise and confidently address the issues specifically related to the exploration for carbonate reservoirs.
2. Integrate a variety of wireline log and stratigraphic data with seismic datasets through carbonate formations using sequence and seismic stratigraphic principles.
3. Develop exploration concepts using knowledge of carbonate depositional facies and sequence stratigraphy.
4. Evaluate trap styles, structural setting and the controls on reservoir quality in carbonate-dominated settings at a range of scales.
5. Integrate datasets of various kinds to intelligently generate play concepts and generate parameters for use in carbonate prospect generation and evaluation.

Training Method

A seven-day field and classroom course in the Italian Dolomites, comprising outcrop studies combined with exercises and extensive discussion of case studies using subsurface data. Each field day comprises an extended exercise using observation and interpretation to consolidate classroom learning. The proportion of field to classroom time is around 60:40

Physical Demand

The physical demands for this class are HIGH according to the Nautilus Training Alliance field course grading system and participants will need a good degree of physical fitness and be properly equipped in order to complete the field excursions. Fieldwork is in the Dolomite mountains of northern Italy and hikes range from 6 to 17 km (4 to 10 miles) per day with altitude gains of up to 1000 m at elevations of up to 2800 m. The hikes will be mostly on established trails but these can be steep and uneven. Participants should be prepared for these in order to gain maximum benefit from the course.

Transport on the course will be by small coach, with most of the driving on established black-top roads. Several field areas are accessed using open ski lifts and attendees will need a good head for heights as they will be suspended 50 m or more above the ground.

Correct mountain equipment is ESSENTIAL. This should consist of:

- Waterproof hiking boots with ankle support (approach shoes are NOT acceptable)
- Waterproof outer shell (ideally jacket and trousers)
- Warm clothing to be carried on the mountain (gloves and hats should be considered)
- Backpack and a small first aid kit, particularly for blisters

Who Should Attend

The course is principally aimed at geoscientists and allied subsurface staff with more than 3-4 years experience in the industry. Prior experience with carbonate rocks is not essential, although the course is particularly suited to those having some familiarity with carbonate facies and depositional systems. Attendees are assumed to have some experience of seismic and well log interpretation, as well as an understanding of the principles of sequence stratigraphy.

Prerequisites and Linking Courses

A useful precursor to this course is N020 (Carbonate Depositional Systems: Reservoir Sedimentology and Diagenesis). Other carbonates courses offered through the Nautilus Training Alliance that address carbonate exploration topics include N059 (Applied Carbonate Geology, Mallorca, Spain) and N091 (Carbonate Reservoir Architecture and Applied Carbonate Sequence Stratigraphy). For experienced carbonate workers the Nautilus Training Alliance offers an exercise and discussion-based three-day classroom course N073 (Workshop in Geological Seismic Interpretation: Carbonate Systems) and a six-day field course N143 (Advanced Concepts in Carbonate Exploration and Reservoir Characterization, Northern Spain).

Course Content

The Dolomites of Northern Italy are world-class exposures of carbonate platform facies and related dolomitisation. Those exposures are used in this course to relate carbonate depositional facies to seismic-scale geometries and dolomitisation models.

1. Principles of carbonate sedimentation

Carbonates and clastics compared; Brief introduction to carbonate rocks and the controls on carbonate sedimentation; The "carbonate factory"; Biotic changes through time; "Drowning" events in carbonate systems.

2. Carbonate platform morphologies and facies distributions

Carbonate depositional environments and facies; Applicability of modern environmental analogues; Ramps; Rimmed shelves; Isolated buildups; Epeiric systems; Evolution of carbonate platforms; Intra-shelf basins; Evaporites; Reservoir potential of carbonate platform facies.

3. Sequence stratigraphy and architecture of carbonate systems

Principles of sequence stratigraphy; Carbonate sequence stratigraphy; Icehouse vs greenhouse

depositional styles; Cyclicity; Implications for reservoir architecture.

4. Structural controls on platform location and evolution

Structural controls on carbonate platform style and location; Deformation of carbonate successions; Carbonate reservoirs in differing structural regimes.

5. Seismic expression of carbonate systems

Carbonate seismic facies; Seismic stratigraphy of carbonates; Impact on interpretation of limits on seismic resolution.

6. Petroleum systems in a carbonate provinces

Carbonate-dominated petroleum systems; Carbonate play fairways; Trap styles; Source rocks and seals in carbonate systems; Reservoirs styles; Stratigraphic and diagenetic trapping; CO2 and H2S issues in carbonate provinces; Carbonate field case studies.

7. Exploration specifics

Log facies and signatures in carbonate interpretation; Regional correlation and correlation methods; Drilling carbonate prospects safely; Net-to-gross; Production rates from carbonate reservoirs; Use of analogues in exploration; Case studies.

8. Controls on carbonate reservoir quality and producibility

Influence of diagenesis on reservoir quality; Carbonate rock textures and porosity; Porosity vs depth; Karst and unconformities; Dolomitization and reservoir quality; Impact of faults and fractures.

9. Participant case studies/exploration problems

Participants are encouraged to make brief presentations on examples of carbonate exploration problems that are problematic/of interest in a no-notes discussion and analysis session.

Itinerary

Below is a provisional itinerary for the course, details may be subject to change depending on the prevailing weather conditions.

Day 0:

- All participants arrive
- Course Introduction and Objectives

Day 1: Classroom lectures and exercises

- Introduction to carbonate rocks and reservoirs
- Principal carbonate exploration issues
- Carbonate platform styles and sequence stratigraphy
- Seismic expression of carbonate sequence architecture

Day 2: Field excursion

- Catenaccio / Rosengarten. Dip traverse through a major prograding carbonate platform and sequence stratigraphic divisions

Day 3: Classroom lectures and exercises

- Exploration concepts in carbonate ramp systems
- Exploration concepts in rimmed carbonate systems
- Exploration concepts for isolated buildups and intrashelf basins
- Structural aspects of carbonate rocks

Day 4: Field excursion

- Alpe di Siusi/ Seiser Alm. Comparison of the seismic-scale geometric relationships between Ladinian and Carnian platforms, sequence stratigraphic interpretations and reservoir potential

Day 5: Classroom lectures and exercises

- Carbonate source rocks
- Fractured carbonate reservoirs and karst
- Core store visit
- Parameters for prospect evaluation of carbonate reservoirs

Day 6: Field excursion

- Sella. Sequence stratigraphic interpretation of an isolated carbonate build-up of Carnian age

Day 7: Field excursion

- The Latemar (provisonal). Platform interiors and cyclicity, steep platform margins.
- Diagenesis and dolomitization

Day 8:

- All depart