

N189: Fundamental Concepts of Carbonate Depositional Systems and Reservoirs

Format and Duration
Classroom - 5 Days

Instructor(s): Dan Bosence

Summary

This course defines the processes of carbonate sediment accumulation in carbonate platforms in different tectonic settings and identifies target depositional facies that commonly form reservoirs. The diagenetic changes that carbonate rocks undergo during their burial history are reviewed through a series of informative classroom lectures, including a review of the commonly occurring carbonate reservoir types.

Learning Outcomes

Participants will learn to:

1. Compare carbonate rocks, minerals and their pore systems.
2. Illustrate the formation of limestones and dolomites.
3. Contrast carbonate facies from rimmed shelves and ramps.
4. Analyse the diagenetic changes that affect carbonate rocks; mineralogy, textures and porosity evolution.
5. Interpret the evolution of porosity and permeability in carbonates.
6. Illustrate the classification of carbonate reservoir types; depositional versus diagenetic controls.
7. Sketch the major changes that have taken place in carbonate depositional systems through geological time.

Training Method

This is a classroom course.

Who Should Attend

This course is aimed at geoscientists who require a fundamental understanding of carbonate depositional systems, diagenesis and modern facies models. The course will build from first principles and assumes no prior knowledge of carbonates but a basic understanding of geoscience is required.

Prerequisites and Linking Courses

There are no geoscience prerequisites for this course, however those with little or no geoscience experience would benefit from attending N097 (Introduction to the Oil and Gas Industry). The class links well with N003 (Geological Interpretation of Well Logs).

Course Content

Despite hosting around 60% of the world's hydrocarbon reserves, carbonate rocks form reservoirs that are often viewed as complex and unpredictable. The study of carbonates requires additional skills to those needed to understand clastic systems. The application of modern facies models and facies patterns to subsurface carbonate systems allows some predictions to be made about the occurrence of different facies and their likely reservoir potential. Similarly, some basic rules and principles can be used to predict the diagenetic changes that carbonate rocks undergo with burial and how this affects their quality as hydrocarbon reservoirs.

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The course will be divided into four parts:

Part 1 will introduce the building blocks of carbonate rocks; carbonate minerals, carbonate grain types, rock textures, and the different environments in which they form. Carbonate depositional processes will be studied using case studies from present-day humid and arid sedimentary environments. Facies models will be developed that aid in the prediction of potential reservoir facies. Practical work on a range of carbonate facies will be integrated with the lectures.

Part 2 focuses on diagenetic changes such as recrystallisation and dissolution that affect carbonate sediments from the time of their deposition through to burial and hydrocarbon charge. These changes may fundamentally alter the porosity and permeability of carbonate rocks and therefore have an important, sometimes overriding, control on reservoir quality. Images of various diagenetic textures and structures will be studied and their relationship to porosity and permeability discussed.

Part 3 will integrate the skills learnt in parts 1 and 2 to achieve an understanding of carbonate reservoirs. These are often said to form three main types; those controlled by the occurrence of particular sedimentary facies, those controlled by particular diagenetic fabrics and those controlled by fracture systems. Case studies of different reservoir types will be studied as well the different schemes that are used to classify different carbonate reservoir rock types.

Day 1:

- Introduction to carbonate minerals and carbonate rocks
- Classification of limestones and their pore systems
- Introduction to carbonate depositional systems and reservoirs
- Carbonate sedimentation in a modern, humid climate setting; south Florida and the Bahamas
- Rimmed carbonate shelves and carbonate platforms
- Facies models for rimmed shelves

Day 2:

- Carbonate and evaporite sedimentation in a modern arid climate setting; Arabian Gulf
- Ramp facies models
- Major controls on occurrence of carbonate platforms (climate, tectonic, oceanographic etc.)

Day 3:

- Principles and models of carbonate sequence stratigraphy and comparison with clastic systems
- Application of seismic carbonate sequence stratigraphy (worked examples)

Day 4:

- Near surface diagenetic environments of limestones and dolomites and relation to depositional sequences

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- Burial diagenetic environments of limestones and dolomites. Diagenetic trends with burial and uplift

Day 5:

- Porosity and permeability of carbonate rocks
- Carbonate reservoir types; depositional and diagenetic controls
- Carbonate platforms, facies and reservoirs through time