

# Modeling and Development Planning in Carbonate Reservoirs, Provence, France (G034)



## Tutor(s)

[Mark Bentley](#): TRACS International Consultancy and Langdale Geoscience.

## Overview

Using analogue outcrops in the Luberon and Cassis area of southern France, this course develops workflows for static and dynamic modeling in carbonate reservoirs, covering in particular the issues of conceptual reservoir characterization, the handling of scale and the representation of fracture detail in cellular models. The analogue section chosen is a direct analogue for Shuaiba/Kharaib Middle East reservoirs, including high and low energy areas of rudist platforms, inner and outer shelves, and chalks. The modeling principles are transferable to other carbonate environments.

## Duration and Logistics

7 days; field activities and exercises (100%); the outdoors will be used as a classroom.

## Level and Audience

**Advanced.** A course for technical professionals working in integrated teams who are planning development activities in carbonate reservoirs (reservoir engineers, geoscientists, petrophysicists) and all involved in reservoir and simulation modeling.

## Exertion Level

This class requires an **EASY** exertion level. Provence is quite comfortable in the late summer to fall, with temperatures of 10-25°C (50-80°F) and occasional rain showers. The field locations are all easily accessible requiring only a short walk from the transport. The longest walk is approximately 0.5km (0.3 mile) along a road section. There will be one boat trip (weather dependent) to view key cliff exposures that can only be seen from offshore (1-2 hours duration).

## Objectives

You will learn to:

1. Describe a carbonate reservoir in terms of essential reservoir elements and the architectural arrangement of those elements.
2. Evaluate reservoir property distributions for those elements in a form suitable for input to static/dynamic reservoir modeling.
3. Judge the scale at which a static/dynamic modeling exercise should be conducted, including any need for multi-scale modeling.
4. Prepare rules of thumb for effective property modeling in carbonates at a range of scales.
5. Assess fracture systems in carbonates and explain the options for modeling them (explicit DFN vs implicit effective properties).
6. Apply the concept of representative elementary volumes (REV) to fractured and unfractured carbonates.

7. Discuss optimal development planning for an oil reservoir based on the outcrops seen during the course.
8. Catch up with current research activities in carbonate reservoirs.

## Course Content

### Course Details

Carbonate reservoirs are often poorly modeled, and the distinction between workflows for carbonates and clastics is often missed. The lack of clear  $k/\phi$  relationships in carbonates distinguishes them from their clastic counterparts, and fractures, in particular, can be difficult to model without convoluted workflows.

Reservoir modeling schemes are applied to contrasting analogue outcrops in the Luberon and Cassis areas. These cover environments ranging from inner to outer platforms, through shelf to proximal basin, including a spectacular karstified fracture system. The outcrops selected are age-equivalent analogues for Middle Eastern Shuaiba/Kharaib carbonates on the opposing side of Tethys.

Topics covered include:

- Carbonate reservoir characterization
- Fracture characterization
- Model scale and upscaling
- Representative elementary volumes in carbonates
- Well placement
- Simulation and forecasting in carbonates

### Exercises

The chosen analogue areas for model design exercises are the Orgon area (shelf and proximal basin chinks) and platform carbonates of the Rustrel and La Nesque areas. The large outcrops at La Nesque lend themselves well to the seismic forward modeling task. Karsts and faults/fractures are superbly represented in the Fontaine du Vaucluse area. The outcrops along the Mediterranean coastline around Cassis display contrasting styles of world-class examples of natural fractured reservoirs, on-scale.

### Day 1: Arrive in Marseilles

*Arrival in Marseilles and transfer to Gordes.*

## Day 2: Lateral Homogeneity

Classroom:

- Course introduction and safety briefing
- Regional tectonics, Tethys
- Stratigraphy versus Middle East

Fieldwork:

- Orgon region
  - Lateral Homogeneity
    - Critical order of magnitude k
    - Kv/Kh
    - Three forces
    - Dispersive nature of the subsurface

*Overnight Gordes.*

## Day 3: Lateral Heterogeneity

Fieldwork:

- Rustrel region
- Lateral Heterogeneity
  - Small-scale k heterogeneity
  - Handling scale
  - Thief zones
  - Forecasting water breakthrough

*Overnight Gordes.*

## Day 4: Large Scale Architecture

Fieldwork:

- La Nesque region
  - Large Scale Architecture
    - Gross architecture
    - Imagine on seismic
    - Coning behavior
    - Large scale vs small scale models

*Transfer and overnight in Cassis*

## Day 5: Fractures and Karst

Fieldwork:

- Cassis region
  - Fractures and Karst
    - Damage zone architecture
    - Matrix vs fracture flow
    - Naturally fractured reservoir architectures

*Overnight in Cassis.*

## Day 6: Field Development Planning

Fieldwork:

- Cassis region
  - Field development planning in carbonates
    - Conceptualization
    - Development scenarios
    - Optimal well planning choices

Classroom:

- Course summary and wrap up

*Overnight in Cassis.*

## Day 7: Departure

*Departure from Marseilles.*