TETRA TECH RPS ENERGY | TRAINING

N335: Modelling Clastic Reservoirs *(Pyrenees, Spain)*

Instructor(s): John Howell and Ed Stephens

Format and Duration

Field - 6 Days
Low Physical Demand

Summary

This course provides an introduction to designing and building reservoir models of clastic depositional systems through to dynamic flow simulation. The course stresses the role of the conceptual facies modelling as a tool for distributing petrophysical properties within the model and reviews a range of clastic depositional systems in renowned outcrops of the Spanish Pyrenees.

Learning Outcomes

Participants will learn to:

1. Apply the reservoir modelling workflow.
2. Examine the role of the conceptual geological model in designing better reservoir models.
3. Analyse reservoir zonation from a geological (rather than engineering) perspective.
4. Use a suitable modelling grid which allows all of the relevant facies based heterogeneities to be incorporated in the model.
5. Illustrate the importance of grid scale and resolution.
6. Analyse the principals of stochastic facies modelling with a review of the tools and algorithms that are available and know how and when to use them.
7. Establish the differences between fluvial, shallow marine and deep marine depositional systems from a modelling perspective.
8. Demonstrate the use of outcrop analogue data for building better reservoir models.
9. Analyse length scale variations for different clastic deposystems on an REV plot, and discuss how this would be handled in a reservoir modelling and simulation context.
10. Demonstrate how kv/kh impacts recovery in different clastic architectures including understanding of transmissibility, determination of bottom water vs. edge water sweep and linkage to depositional confinement.
11. Illustrate the contrasting heterogeneities in different clastic deposystems and determine how much detail is required in a reservoir description based on a consideration of fluid type and production mechanism.

Training Method

A field course supported by classroom lectures and exercises, with field to classroom time in the ratio 60:40. Field examination of depositional systems at both seismic and, more commonly, sub-seismic, sandstone body scale including team exercises, backed up by model results and supporting presentations.

Physical Demand

The physical demands for this class are LOW according to the Tetra Tech RPS field course grading system. The longest walk on the field course is approximately 3 km (1.8 miles) along a hillside track. Other walks of up to 1 km (0.6 miles) take in roadside sections, quarries, and scrubby hill land.

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Participants should be aware that some localities are at an altitude of around 1000 m (3000 ft) and field temperatures may exceed 25C. Transport will be by coach on paved roads.

Who Should Attend

This multi-disciplinary course is designed for geoscientists, petrophysicists, and reservoir engineers involved in developing descriptions and models of reservoirs.

Course Content

The technical content of the course can be considered in a matrix. One axis of this matrix is the specific depositional environment (fluvial, shallow marine, deep marine) the other is the various stages of the reservoir modelling workflow. This work flow can be summarised as follows:

1. Model design – what is the purpose of the model?
2. Data analysis and the erection of a conceptual geological model, summarised as "if you can't draw it you can't model it!"
3. Model zonation, based on key geological surfaces.
4. Grid design and building.
5. Grid population with facies.
6. Facies population with petrophysics.
7. Model application.

Many aspects of stages 2 to 5 will differ, depending upon the specifics of the depositional environment. We will start by reviewing and understanding that work flow and the implications it has on model building. Then we will visit outcrop examples of all of the key types of depositional system and review the key specifics of zoning, grid building and grid population at each building up a better understanding of the model building process and also the role of facies as carriers for petrophysical properties.Throughout the course we will conceive an overall sedimentological model for the outcrops and take a reservoir engineering perspective on the observed heterogeneity - does any of it matter? Outcrop-based permeability data will be used to support the observations on heterogeneity and to discuss how small scale heterogeneity can be reasonably scaled in to a simulation model. Outcrop-based models will also help define, from an engineering perspective, the concept of effective net.

Itinerary

Day 0:

- Participants arrive in Barcelona and travel to Ainsa

Day 1:

- Classroom introduction:

  - Reservoir model design
  - Reservoir modelling workflow
  - The role of the conceptual geological model
  - The role of facies modelling
- Fieldwork:
  - Grid design and resolution and Modelling deep marine systems. The Ainsa Basin is largely filled by a succession of turbidites deposited in different parts of a submarine fan system of Eocene age. The Ainsa Turbidites are well exposed representing these different settings for sand body formation
- Overnight Ainsa

Day 2:

- Continuation of fieldwork in the Ainsa Basin including canyon and distal fan deposits
- Overnight Ainsa

Day 3:

- Correlation and sequence stratigraphy in reservoir modelling and Modelling Shallow Marine Systems. The Eocene Roda Sandstone is a tidally-dominated succession of shallow marine sandstones which includes excellent exposure of a range of facies deposited in different sub-environments
- Overnight Ayerbe

Day 4:

- Populating grids with facies and Modelling Fluvial systems. The Huesca Fluvial system is an Oligocene to Miocene age depositional system that can be traced laterally over tens of kilometres. Exposures provide excellent examples of the heterogeneity of fluvial deposits. Field visits to Bolea and Roldan
- Overnight Ayerbe

Day 5:

- Reservoir Modelling exercise in fluvial system. The case study is a large (>1 km wide and up to 100 m high) outcrop of fluvial channels sandstone bodies enclosed in a matrix of fine-grained overbank deposits (Piraces, southeast of Huesca)
- Overnight Ayerbe

Day 6:

- Classroom Course synthesis: reservoir modelling in different clastic depositional environments (fluvial, shallow marine, deep marine) and the stages of the reservoir modelling workflow.
- Return to Barcelona and depart in the afternoon

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