N215: Advanced Techniques for Modelling Fluvial and Deltaic Architecture using Petrel *(Utah, USA)*

Instructor(s): Huw Williams and Paul Davies

6 Days	Competence Level: Skilled
Field Course	
Classroom Elements	
LOW	Low Physical Demand
Computer Usage	

Summary

This geocellular modelling course, focuses on teaching participants novel and practical methods to build realistic models of fluvial and deltaic sediment body architecture, demonstrated using Petrel software. The techniques can easily be adapted to other surface-based 3D static modelling packages.

Learning Outcomes

Participants will learn to:

1. Evaluate offshore, shoreface, fluvial/tidal channel and coastal plain facies from outcrop, core, log signatures and reservoir properties.
2. Characterise sequence stratigraphic surfaces from outcrop, core and log signatures.
3. Construct a sequence stratigraphic framework for the reservoir modelling of fluvial and deltaic depositional environments.
4. Appraise sedimentary stacking patterns from core and log data and predict fluvio-deltaic architecture in areas of the model with little or no well data.
5. Construct realistic conceptual models which the final 3D models can be checked against.
6. Perform novel correlation techniques to define connectivity in the static model.
7. Assemble 3D Petrel models after analysing large-scale outcrops.
8. Formulate a strong overall knowledge and perspective of different static reservoir modelling strategies, workflows and techniques.
9. Integrate core, log and any other available data to build deterministic reservoir models which distribute reservoir properties realistically in 3D and establish flow and non-flow units within it.
10. Propose the advantages of novel deterministic modelling techniques, unique to this course, which are used to create realistic sedimentary architecture.
11. Perform deterministic modelling using Petrel and compare modelling results with, and understand the shortcomings of standard Petrel modelling techniques.

Duration and Training Method

A six-day field and classroom-based reservoir geology and modelling course in Grand Junction, Colorado and Green River, Utah. The proportion of field, classroom and software modelling time is approximately 60/10/30. The course blends outcrop instruction with corresponding instruction in building 3D Petrel models of the same outcrops. Generally, the mornings are spent in the field with afternoon classroom core and modelling sessions.

Physical Demand

The physical demands for this class are LOW according to the Nautilus Training Alliance field course grading system. The field sites visited include National Monuments, cliffline exposures and roadside stops

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in the high plains desert of western Colorado and eastern Utah at altitudes of 1500-2000 m (4500 - 6000 ft). In June and September the weather is generally sunny with early morning temperatures of 15° C (59 °F)and afternoon temperatures 30 °C+ (86 °F+), and relative humidity rarely exceeding 15%. The terrain is generally flat however 1 day consists of a more strenuous walk of MODERATE demand. This walk involves a long morning away from the cars in a initially shaded and cool canyon, however temperatures can become very hot towards midday. 4km hike with a max elevation gain of 150m. Transport is by 4WD vehicles on a variety of black-top and loose surface roads.

Who Should Attend

This class is for experienced geoscientists who are interested in accurately and realistically modeling sedimentary architecture. Although the class is based around fluvial and deltaic outcrop examples, many of the techniques can be easily adapted to other depositional environment types.

Prerequisites and Linking Courses

Participants should have an understanding of the fundamentals of sedimentology, sequence stratigraphy and ideally some familiarity and experience with reservoir modelling.

Special Requirement:

Participants are required to bring a laptop with Petrel version 2007, or later, installed. The relevant modules are: Geoscience Core, Well Correlation and Facies Modelling. It is the participant's responsibility to ensure that the software runs on the laptop they bring; the easiest option will be to bring the appropriate mobile dongle licence.

Related companion and follow up courses to N215 are: N012 (Reservoir Modelling Field Class, Utah, USA), N106 (Advanced Reservoir Modelling, Elgin, Scotland), N033 (Characterisation, Modelling, Simulation and Developing Planning in Deepwater Clastic Reservoirs, Tabernas, Spain) and N215 sister course N213 (Reservoir Characterisation and 3D Modelling of Coal-bearing, Fluvio-Deltaic Sediments, Kentucky, USA).

Course Content

Outcrops, cores and well logs are used by the participants to build a series of Petrel models using a range of different modelling techniques. The results are then compared to outcrop reality in order to ascertain which techniques are the most suitable for analogous subsurface reservoir modelling studies.

The course follows the typical workflow of a subsurface 3D modeling study and is aimed at making a series of realistic, predictive models of sedimentary geometries and architecture using detailed knowledge of sedimentolgy and sequence stratigraphic concepts.

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Although the class is based around comparison between fluvio-deltaic outcrop examples and corresponding 3D models, many of the techniques can be easily adapted to other depositional environments.

The primary topics covered in the course are:

1. Overview of different modelling techniques and modelling strategies
2. Diagnostic outcrop, core and log interpretation of fluviodeltaic environments and facies
3. Integration of core, log and reservoir properties to define flow and non-flow units
4. Building a sequence stratigraphic framework for reservoir modelling
5. Correlation techniques using well data
6. Deterministic modelling techniques using Petrel
7. Using Petrel hierarchy, zone logs and layering
8. Comparison of modeling results from different Petrel techniques

Itinerary and Teaching Objectives:

Day 0:

- Evening introduction in Grand Junction, Colorado

Day 1:

- Lectures: Geological content and setting; Petrel data sets
- Field: Colorado National Monument – large-scale stratigraphic overview
- Field: Beckwith Plateau – seismic scale overview
- Overnight in Green River, Utah

Day 2:

- Lecture: Cretaceous depositional environments and facies
- Field: WoodsideTrail Canyon – Kenilworth Member exercise
- Lectures: Petrel modeling methodologies; Correlation; Flooding Surface Exercise: Kenilworth Petrel model
- Overnight in Green River, Utah

Day 3:

- Exercise: - Kenilworth Petrel model (cont.)
- Syndicate presentations of Kenilworth Petrel exercise
- Lecture: Kenilworth model discussion

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- Field: Tusher Canyon overview – Kenilworth Member
- Field: Bluecastle Butte – Kenilworth Member
- Field: Battleship Butte – Kenilworth Member
- Lectures: Petrel hierarchy, zone logs and layering
- Overnight in Green River, Utah

Day 4:

- Lecture: Cores, Logs and Reservoir Properties
- Exercise: Desert/Castlegate core-log calibration
- Field: Tusher Canyon - Castlegate Sandstone and Desert Member exercise
- Syndicate presentations of Tusher Canyon exercise
- Overnight in Green River

Day 5:

- Field: Blaze Canyon west – Desert/Castlegate
- Field: Blaze Canyon – Desert/Castlegate
- Field: Thompson Canyon – Desert/Castlegate
- Field: Sagers Canyon – Desert/Castlegate
- Exercise: Desert/Castlegate Petrel model (cont.)
- Overnight in Green River

Day 6:

- Syndicate review of Desert/Castlegate Petrel exercise
- Lecture: Discussion of Desert/Castlegate Petrel exercise
- Field: Pinchout of Castlegate shorefaces
- Lecture: Trip review, wrap-up and evaluation
- Overnight in Grand Junction