
Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel*
*Mark of Schlumberger**Tutors:**

Huw Williams & Paul Davies (Reservoir Geology Consultants Limited)

Duration:

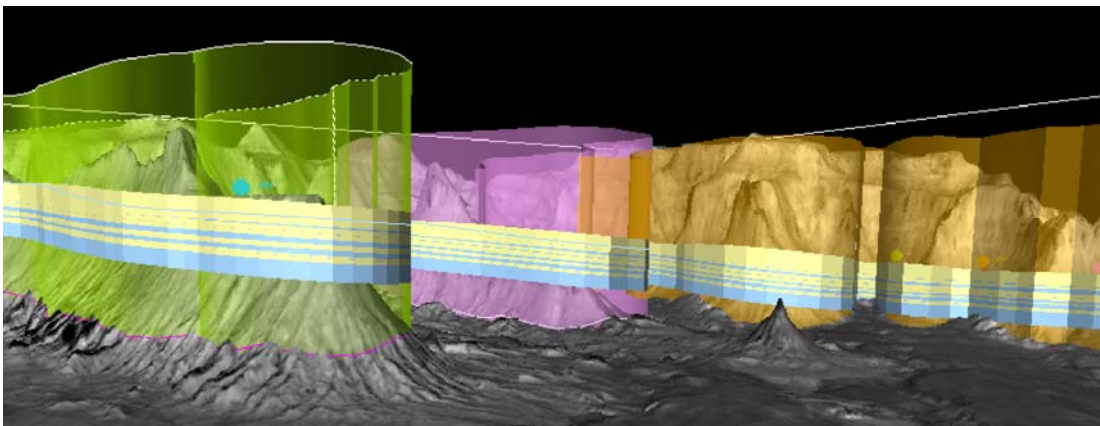
A six day field and classroom-based reservoir geology and modelling course in Grand Junction, Colorado and Green River, Utah.

Summary

This is a Skilled Application level reservoir geocellular modelling course, focused on teaching the course 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 3-D static modelling packages.

Overview:

Petrel is used by participants to integrate core and well log data in a series of deterministic model exercises. The results are compared with other traditional Petrel modelling techniques and each is then evaluated against outcrop reality in order to ascertain which techniques are the most suitable for analogous subsurface reservoir modelling studies.



Battleship Butte; Blackhawk Formation shorefaces in reality at outcrop (top) and Petrel model (below)

Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel*

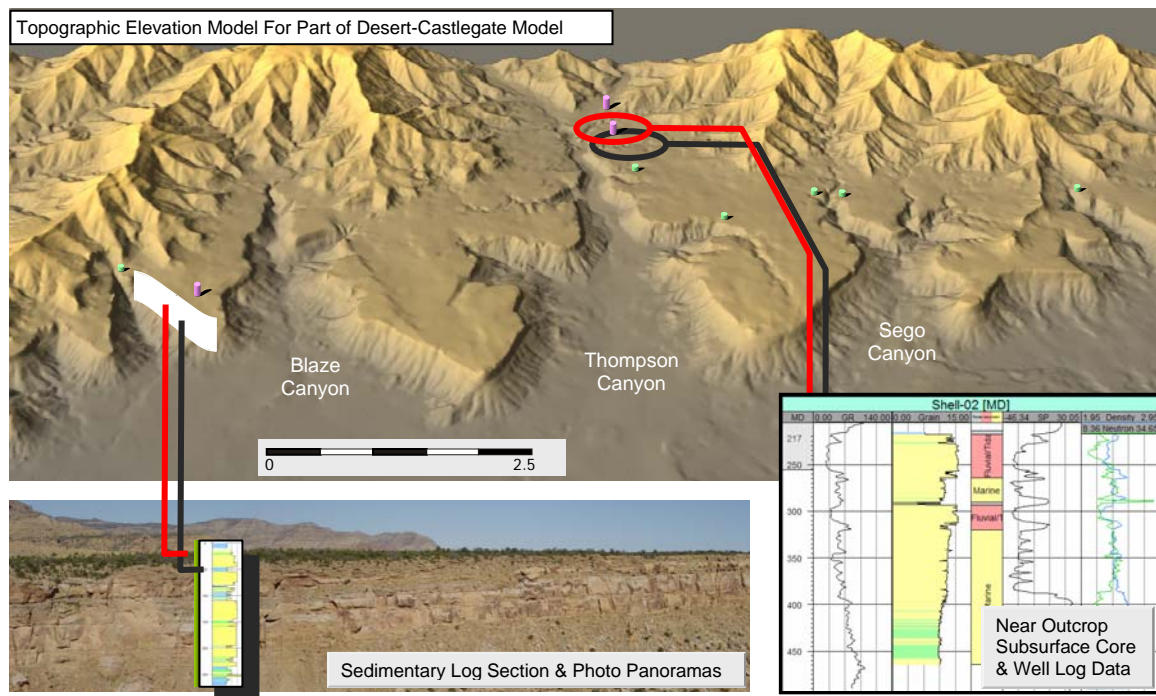
*Mark of Schlumberger

Content:

The course follows the typical workflow of a sub-surface 3-D modelling study and is aimed at making a series of realistic predictive models of reservoir geometry and architecture using detailed knowledge of sedimentology and sequence stratigraphic concepts.

The primary topics covered in the course are:

1. Diagnostic outcrop, core and log interpretation of fluvio-deltaic environments and facies
2. Integration of core, log and reservoir properties to define flow units
3. Building conceptual models and sequence stratigraphic framework for reservoir modelling
4. Correlation techniques from well data
5. Deterministic modelling techniques
6. Using hierarchy, zone logs and layering
7. Comparison of results from different modelling techniques and implications for static connectivity



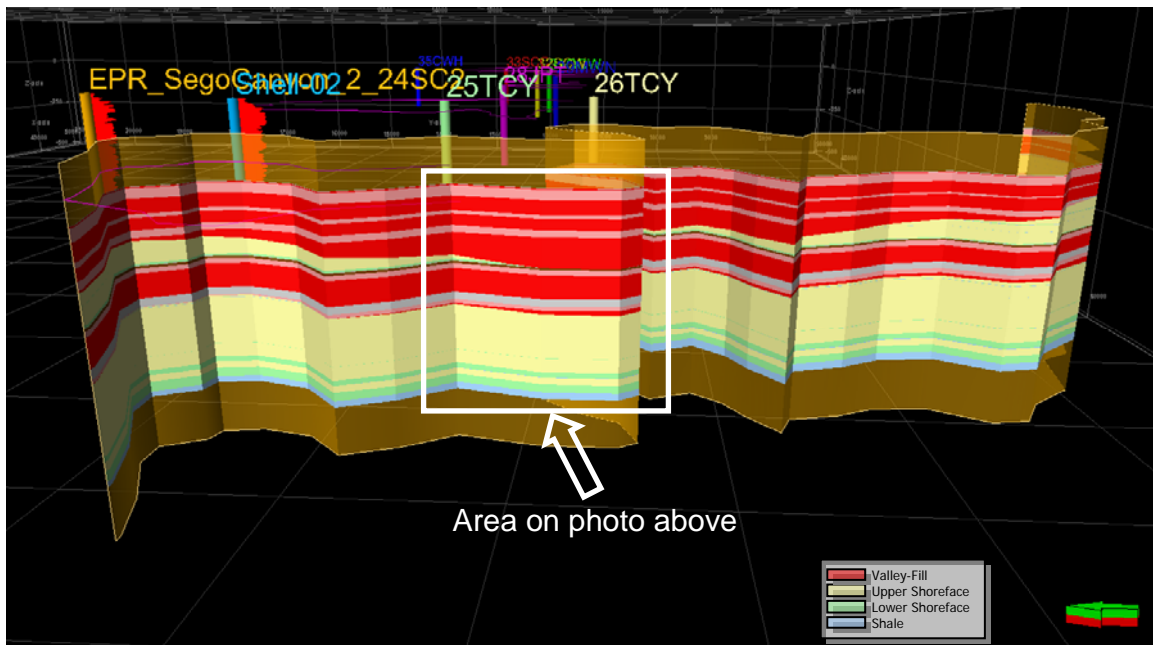
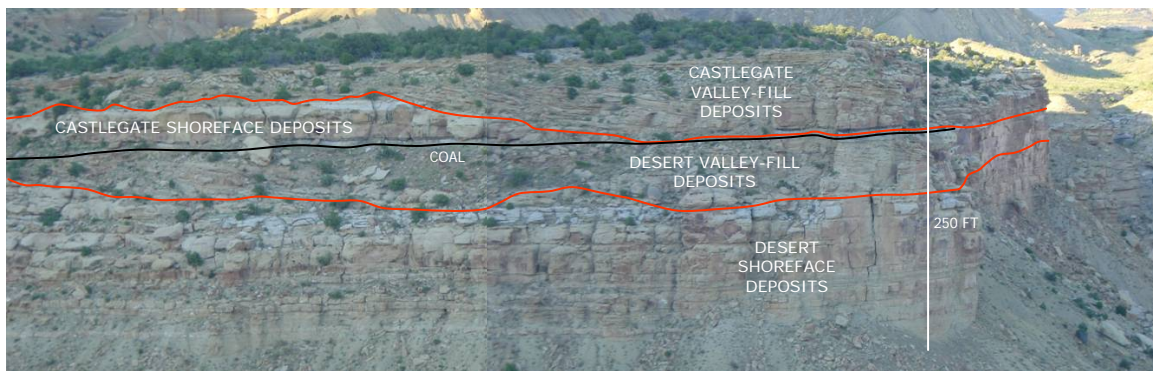
Example of a small part of the data set used to build the Desert/Castlegate Petrel model

Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel*
*Mark of Schlumberger**Itinerary and Teaching Objectives:**

- Day 0: Evening introduction in Grand Junction, Colorado
Overnight in Grand Junction
- Day 1: Lectures: Geological setting; Petrel data sets; Cretaceous depositional environments & facies
Field: Woodside Trail Canyon – Kenilworth Mbr. exercise
Field: Beckwith Plateau – seismic scale overview
Overnight in Green River, Utah
- Day 2: Lecture: Kenilworth model introduction; Sequence Stratigraphy;
Correlation; Flooding Surfaces
Exercise: - Kenilworth Petrel model
Overnight in Green River, Utah
- Day 3: Syndicate presentations of Kenilworth Petrel exercise
Lecture: Kenilworth model discussion
Field: Tusher Canyon overview – Kenilworth Mbr.
Field: Bluecastle Butte – Kenilworth Mbr.
Field: Battleship Butte – Kenilworth Mbr.
Overnight in Green River, Utah
- Day 4: Lecture: Cores, Logs & Reservoir Properties.
Exercise: Desert/Castlegate core-log calibration.
Field: Tusher Canyon – Castlegate Sst; Desert Mbr; Grassy Mbr
Lecture: Modeling channel & valley-fill deposits
Exercise: Desert/Castlegate Petrel model
Overnight in Green River
- Day 5: Field: Blaze Canyon west – Desert/Castlegate
Field: Blaze Canyon – Desert/Castlegate
Field: Thompson 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: Sagers Canyon: Pinchout of Desert/Castlegate deltas
Lecture: Trip review, wrap-up and evaluation
Overnight in Grand Junction

Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel*

*Mark of Schlumberger



High resolution Petrel model with corresponding outcrop photographs (above) showing how complex sedimentary architecture can be captured using the deterministic modelling procedures demonstrated on the course

Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel**Mark of Schlumberger**Learning Outcomes**

On completion of this course, and after the application of the learnings in their job, participants will have built Competence to the **Skilled Application Competence Level** in understanding advanced and novel techniques in 3D geocellular reservoir modelling, with specific exposure to modelling fluvial and deltaic architecture using Petrel. Although the class is based around fluvial and deltaic outcrop examples, many of the techniques can be easily adapted to other depositional environments.

At overall Competence Level 3: Skilled Application, participants completing this course will be able to:

1. Confidently recognize offshore, shoreface, fluvial/tidal channel and coastal plain facies from outcrop, core, log signatures and reservoir properties.
2. Recognize and interpret 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. Interpret 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 3-D models can be checked against.
6. Use novel correlation techniques to define connectivity in the static model.
7. Better appreciate scale and dimension in 3-D models through comparison of large-scale outcrop and corresponding Petrel models.
8. Formulate a strong overall knowledge and perspective of different static reservoir modelling strategies, work flows and techniques.
9. Integrate core, log and any other available data to build deterministic reservoir models which distribute reservoir properties realistically in 3-D and establish flow and non-flow units within it.
10. Understand 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.

Training Method and Physical Demand

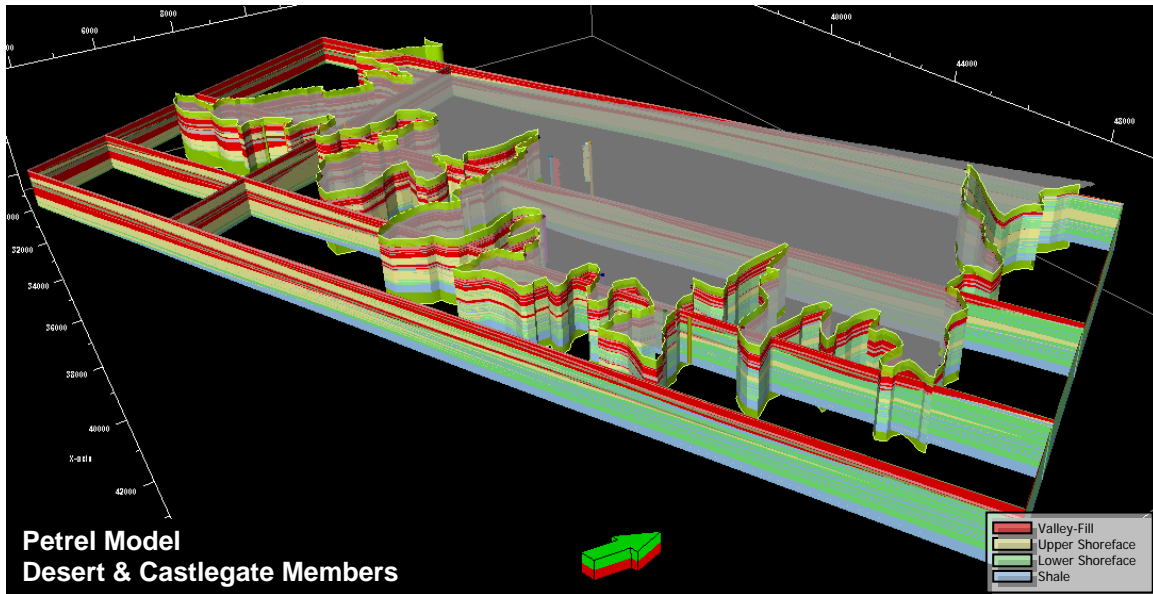
The course blends outcrop instruction with corresponding instruction in building 3-D Petrel models of the same outcrops. Generally, the mornings are spent in the field with afternoon classroom core and modelling sessions.

The physical demands for this class are MODERATE according to the standard field course grading system. The field sites visited include national monuments, cliffline exposures and roadside stops in the high plains desert of western Colorado and eastern Utah at altitudes of 1500-2000m. In June and September the weather is generally sunny with early morning temperatures of 15° c and afternoon temperatures 30°c+, and relative humidity rarely exceeding 15%. The terrain is

Advanced Techniques for 3-D Modelling of Fluvial and Deltaic Architecture using Petrel*

*Mark of Schlumberger

generally flat with one 2 km hike having a maximum elevation change of 100m. Transport is by 4WD vehicles on a variety of black-top and loose surface roads.



Large-scale deterministic Petrel model built as one of the exercises, showing intersections plotted along the cliffline for comparative purposes

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.

Who Should Attend ?

This class is for 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.