

## N011: High Resolution Sequence Stratigraphy: Reservoir Applications (*Utah, USA*)

Instructor(s): Andy Pulham and Lee Krystinik

### Format and Duration

Field - 5 Days  
Moderate Physical Demand

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## Summary

**Business Impact:** Attendees will learn to recognise key **marginal marine facies** and **key surfaces**, their sequence **stratigraphic significance**, and **reservoir implications**.

This course evaluates key sequence stratigraphic principles and their usage in reservoir applications, based on detailed sedimentological and stratigraphical examination of the deltaic marginal to shallow marine deposits of the Cretaceous Book Cliffs and Coal Cliffs, SE Utah, USA.

## Learning Outcomes

Participants will learn to:

1. Assess the sedimentology, ichnology, and stratigraphic architecture in coastal plain and nearshore settings (wave-dominated deltas, fluvial-dominated deltas and shoreface systems) using core and outcrop.
2. Evaluate and correlate key stratigraphic surfaces and parasequence stacking patterns in shoreline systems, and their use at reservoir scale.
3. Evaluate the sedimentary cyclicity and sequence stratigraphic hierarchy at reservoir to sub-regional scales.
4. Interpret the influences of subsidence, eustasy, and sediment supply in creating stratigraphic architecture in marginal marine settings.
5. Predict reservoir continuity and lateral variability in coastal plain successions, based upon observations in linked marine facies.
6. Predict facies changes in marginal marine settings during changes in relative sea-level and understand the significance of evolving paleogeography for reservoir presence and exploration opportunities.
7. Integrate the stratigraphic stacking patterns observed in the outcrops and in the correlation exercises to predict reservoir presence and trapping configurations in undrilled areas removed from immediate datasets.

## Training Method

This is a five-day field course in Utah with outcrop instruction (80%) supported by classroom presentations and exercises (20%). Subsurface examples will be linked to outcrops to illustrate applications of observations. Attendees will work as teams on some exercises.

## Physical Demand

The physical demands for this class are MODERATE according to the Nautilus Training Alliance field course grading system. The field area is semi-desert with sparse vegetation. There will be walks of up to 0.7 km (0.5 mile) most days over rocky trails, outcrops and some steep ground. The longest hike of the trip will be 2.5 km (1.5 mile). The field area is at an elevation of approximately 2000 m (6000 ft), and when combined with hot temperatures, may lead to unexpected fatigue or shortness of breath for some

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participants. Transport is by SUVs. Most driving is on blacktop and well-marked dirt roads, with some outcrops reached by dirt track with moderately technical driving.

### Who Should Attend

Exploration and development geologists and geophysicists seeking training in deltaic and shallow marine stratigraphy or a refresher course. Reservoir engineers seeking more information about stratigraphic controls on reservoir behaviour and techniques in reservoir zonation. Asset Managers responsible for exploitation of marginal marine clastic reservoirs.

### Prerequisites and Linking Courses

It is assumed that participants have a basic knowledge of sedimentology and stratigraphy before attending this course.

Those wanting to apply sequence stratigraphic concepts to well-log correlation for characterization and prediction of sandstone reservoirs could subsequently attend N451 (Practical Oil-Finders Guide to Siliciclastic Sequence Stratigraphy (Wyoming, USA)). N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelfal Successions: Deltas, Shorelines and Origins of Isolated Sandstones (NW Colorado, USA)) would also be an excellent follow-up class.

### Course Content

Outcrops, cores and subsurface examples will be used to demonstrate stratigraphic architecture, correlation using key surfaces and reservoir applications. Attendees will learn to recognise key marginal marine facies and surfaces, their sequence stratigraphic significance and reservoir implications.

Focus will be on the nature, recognition and correlation of key stratigraphic surfaces and their use at reservoir scale investigations. Reservoir description tools and techniques will be illustrated and explored throughout the course.

#### Day 0: Travel to Salt Lake City, Utah

- Optional group dinner.

#### Day 1: Introduction to the field area

- Introduction to the course, and sedimentology and stratigraphy of southeast Utah.
- Outcrop traverse from 'mountains to coast', en route to Price, Utah.
- A regional transect through the Kenilworth Member of the Blackhawk Formation.
  - Examine the architecture of a prograding shoreline complex and test stratigraphic principals and concepts for dip and strike prediction of lithofacies and reservoir elements.
  - Discuss the implications of the observations and how they might impact production and exploration strategies.

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### Day 2: Shoreline systems and parasequence patterns

- A field exercise involving reservoir scale architecture of a wave-dominated shoreline complex.
  - Recognition of key facies in wave-dominated delta systems and understanding sequence stratigraphic building blocks; observation of cyclicity and vertical and lateral facies changes.
  - Participants will interpret outcrop sections and integrate these in a township-scale correlation exercise.

### Day 3: Parasequence correlations

- Classroom and field correlation exercise (continued from previous day) and lectures on stratigraphic tools and concepts.
- Field work comprises sedimentology and stratigraphic architecture in coastal plain and nearshore settings including up and down-dip examination of previously observed parasequences and their stacking patterns.
- Travel to Emery, Utah.

### Day 4: Ferron Sandstone and fluvial-dominated deltas

- Review of Coal Cliff stratigraphy followed by examination of this fluvially-influenced deltaic system.
- Sedimentology and stratigraphic architecture in coastal plain and nearshore settings are observed and discussed in comparison with the wave-dominated beach-shoreface systems seen on days 1, 2, and 3.

### Day 5: Ferron Sandstone reservoir stratigraphy

- Examination of Ferron Sandstone cores and a well correlation exercise and discussion of the distribution and prediction of reservoir quality in marginal settings.
- Correlations from the core and log data are tested and reconciled at outcrop.
- Final evening presentations and group dinner.

### Day 6

- Group drives from Emery to Salt Lake City for departure.

Click on following links to view drone-acquired 3-D models of some of the outcrops:

<https://sketchfab.com/3d-models/willow-creek-ut-1d72b92069f24b23a446d2b9b5a9c64a>

<https://sketchfab.com/3d-models/coyote-basin-ut-8e548520caec42f9af230e03241c2d4a>