

N035: Sedimentology, Sequence Stratigraphy and Reservoir Architecture of Paralic Deposits (*Utah, USA*)

Instructor(s): Mike Boyles and Keith Shanley

Format and Duration

Field - 6 Days
Moderate Physical Demand

Summary

This course focuses on predicting reservoir facies in shallow marine and coastal plain strata using a practical sequence stratigraphic approach. Parasequences in both high and low accommodation settings are studied from their updip to downdip limits in order to better understand how to use concepts of sediment supply and accommodation to make stratigraphic predictions. Emphasis is placed on recognition and correlation of key surfaces and prediction of reservoir geometry within that framework.

Learning Outcomes

Participants will learn to:

1. Assess the sedimentology of key paralic facies in outcrop and on wireline logs.
2. Evaluate critical surfaces (flooding surfaces and sequence boundary unconformities) in outcrop, core, and well log data.
3. Formulate more realistic subsurface correlations that result in better reservoir geometry representation.
4. Propose stratigraphic barriers and baffles that segregate reservoir facies.
5. Assess parasequence stacking patterns to assist with well correlations and reservoir prediction.
6. Evaluate up-dip to down-dip stratigraphic variations in wave dominated deltaic deposits.
7. Assess the likelihood of down-dip reservoirs in untested structures.
8. Compose interpretations of reservoir systems from subsurface data.

Training Method

A seven-day field class. Tutors employ the technique of guided discovery where delegates work in teams to make observations and interpretations and present their results to the other teams. A summary discussion by the tutors provides a process role model and ensures that everyone understands the key lessons learned. The course is conducted principally in the field (80% of course time), with morning discussions and presentations (15%) on some days, and a core viewing session (5%).

Physical Demand

The physical demands for this class are MODERATE according to the Nautilus Training Alliance field course grading system. Fieldwork is in eastern Utah, where conditions can vary from cold and wet to warm and dry. Participants will be taking short to moderate walks of up to 0.8 km (0.5 mile) most days, and the longest walk on the class is approximately 1.6 km (1 mile) with an ascent of 180 m (600 ft).

The field area is at elevations from 1300-2200m (3900-6600 ft) which may lead to unexpected fatigue or shortness of breath for some participants. Transport is by SUVs. Most driving is on blacktop roads, with some locations being reached by well marked dirt roads.

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Who Should Attend

Members of integrated asset teams charged with the task of working in fluvial and shallow marine reservoir environments. The course is designed for geologists, geophysicists and reservoir engineers and works especially well for geologist/reservoir engineer teams from the same business unit.

Prerequisites and Linking Courses

For geoscientists attending this class, some prior knowledge of sequence stratigraphy and fluvial through shallow marine facies, as is offered in Nautilus Training Alliance course N155 (Introduction to Clastic Depositional Systems: a Petroleum Perspective), is an advantage.

Similar facies and topics are presented on Nautilus field classes N011 (High Resolution Sequence Stratigraphy: Reservoir Applications, Utah, USA), N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelfal Successions: Deltas, Shorelines and Origins of Isolated Sandstones, NW Colorado, USA), N117 (Shoreline and Shelf Reservoir Systems: Outcrop Lessons for Exploration and Production, NW Colorado, USA), N247 (Sedimentology, Stratigraphy and Architecture of Fluvial, Deltaic and Deepwater Reservoirs: An Outcrop Perspective of Linked Depositional Systems, Arkansas, USA) and N115 (High Resolution Sequence Stratigraphy: Application to Deltaic Systems and Reservoirs, County Clare, Ireland). Modern equivalent facies are visited on field class N096 (Recent Depositional and Stratigraphic Analogues for Fluvial and Shallow Marine Reservoirs, South Carolina, USA).

Course Content

The course addresses production-scale stratigraphic questions:

- How to identify stratigraphic surfaces that segregate reservoir facies
- Reservoir correlation
- When and where to expect flow barriers and baffles

The course addresses exploration-scale stratigraphic questions:

- How to use parasequence stacking patterns to assist with well correlations
- Predicting likelihood of down-dip reservoirs in untested structures

The tutors aim to challenge the way people think about paralic stratigraphy and give them deterministic approaches to analyze subsurface well data. Lessons are drawn from world-class outcrops in the Book Cliffs of Utah and Colorado (fluvial to wave dominated deltaic and incised valley fill deposits) to demonstrate common exploration and production scale subsurface situations. The class provides stratigraphic insights to well correlation that allow for more accurate predictions of reservoir distribution in both high and low accommodation settings and provide criteria for assigning risk to the interpretations.

This seminar goes beyond simple facies recognition to giving people skills that allow them to use models to make risk-based predictions of reservoir geometries.

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Itinerary

Day 0:

Arrive in Grand Junction, CO and attend evening orientation lectures. Night in Grand Junction, CO.

Day 1:

Morning lectures on geology of the Western Interior Seaway and introduction to deltaic depositional systems. Drive to Price, UT with stops along the way to view the geology. Field stop in Price to look at facies associated with wave dominated deltas. Night in Price, UT.

Day 2:

Morning lectures on deltaic depositional systems and introduction to sequence stratigraphy. Field stops demonstrate up-dip to down-dip stratigraphic variations in wave dominated deltaic stratigraphy. Focus on how to correlate parasequences through the identification of flooding surfaces. View of the landward pinch-out of a parasequence and discuss the means by which parasequences terminate and the implications for reservoir correlations. Night in Price, UT.

Day 3:

Morning lectures on sequence stratigraphy and identification of sequence boundaries. Demonstrate how to use sequence stratigraphy to understand subsurface correlation through the application of stratigraphic modelling. Classroom exercises emphasize stratigraphic principles and how to use subsurface stacking patterns to predict reservoir distribution and the occurrence of sequence boundaries. Night in Price, UT.

Day 4:

Describe a vertical section and use stacking patterns to make predictions about the down-dip extent of reservoirs. Then use continuous 3D outcrop exposures (6 miles depositional strike by 9 miles depositional dip) to check predictions and to discuss and demonstrate common correlation pitfalls. Night in Green River, UT.

Day 5:

Use outcrop exercises to demonstrate both field and well scale stratigraphic relationships associated with incised valleys and sequence boundaries. Discuss expectations concerning reservoir continuity within incised valley fills compared to marine sandstones. Reinforce learnings by identifying incised valley fills with subsurface correlation exercises. Night in Green River, UT.

Day 6:

Use several outcrop exercises to trace incised valley fills down depositional dip. Discuss importance of incised valleys for reservoir prediction within a field and for the identification of down-dip reservoirs for new exploration plays. Night in Grand Junction, CO.

Day 7:

Morning core workshop viewing examples seen throughout the week in outcrop followed by an afternoon wrap-up session. Night in Grand Junction, CO or return home, depending on flight schedules.

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Day 8:

Participants depart Grand Junction, CO anytime.