
N514: Clastic Reservoirs from Source to Sink: Low-Accommodation versus High-Accommodation Basin Settings (*Wyoming, USA*)

Instructor(s): Ron Steel & Cornel Olariu

Format and Duration

Field - 5 Days

Field - 5 Days

Moderate Physical

Demand

Summary

Business Impact: This course facilitates deep discussions with technical experts about **reservoir distribution and quality** either in the context of **exploration or production**. Attendees will return to their workplaces with a more **comprehensive and practical understanding of source to sink clastic sedimentology and sequence stratigraphy**.

This field school allows participants to follow and track depositional environments from fluvial to shallow marine to slope and deepwater that were laid down in the Cretaceous Interior Seaway of North America (Sevier vs. Laramide). Wave, tide and fluvially dominated delta types will all be contrasted in an attempt to understand a wide spectrum of marine depositional processes including the development of hyper-pycnites.

When the Cretaceous Interior Seaway became broken by Laramide tectonics, the deepwater Washakie Basin developed in Southern Wyoming, and we can examine shelf-edge deltas as deepwater delivery systems. Further, slope channels can be observed in the field and afternoon exercises will be undertaken that allow the age equivalent basin floor turbidites to be mapped in detail. Lectures on shelf edge deltaics and hyper-pycnites will augment the field work. This course is designed as a refresher on sequence stratigraphic principles and attendees will learn to describe and interpret key stratal surfaces and their sequence stratigraphic significance.

Learning Outcomes

Participants will learn to:

1. Assess the sedimentology and stratigraphic architecture in fluvial, coastal plain, shallow marine, and deepwater slope settings (comparing wave, tidal and fluvially dominated deltas).
2. Identify, evaluate and correlate key stratigraphic surfaces and parasequence stacking patterns in shoreline systems, and their use in exploration and production scales of investigation.
3. Evaluate the bedforms, sedimentary cyclicity and sequence stratigraphic hierarchy at reservoir scales.
4. Interpret the influences of tectonics, eustasy, and climate in creating stratigraphic architecture in marginal marine settings.
5. Describe reservoir continuity in paralic depositional settings, based upon field observations.
6. Use well log motifs as a valuable tool to differentiate delta top from shallow marine from slope to deepwater.
7. Predict up-dip to down-dip and along strike facies changes in marginal marine and shelf edge settings and understand the significance of evolving paleogeography for reservoir presence and quality.
8. Integrate the stratigraphic stacking patterns observed in the outcrops and wells in the correlation exercises to predict reservoir presence on the slope and basin floor and to cartoon potential trapping configurations in undrilled areas.

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Training Method

This is a five-day field course in Wyoming with outcrop instruction (70%) supported by classroom presentations and exercises (30%). Exercises linking local well data to outcrops illustrate the subsurface applications of field observations. Attendees will work in 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. The longest hike of the trip will be 2.5 km (1.5 mile) and involves ascending moderate slopes. 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 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. Reservoir engineers seeking more information about sedimentological controls on reservoir behaviour and techniques in reservoir zonation. Asset Managers and Team Leaders responsible for exploitation of marginal marine clastic reservoirs. Even those with experience in these depositional environments will benefit from attending this course.

Prerequisites and Linking Courses

It would be helpful for participants to have a basic understanding of clastic sedimentology and some familiarity with well logs, as presented in N003 (Geological Interpretation of Well Logs).

Complementary courses to N514 include 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), N096 (Recent Depositional and Stratigraphic Analogues for Fluvial and Shallow Marine Reservoirs, South Carolina, USA), and N499 (Shallow Marine Reservoir Analogues and their Application to the Jurassic of the North Sea, Isle of Skye and Raasay, UK).

Course Content

Outcrops, and subsurface well data will be used to illustrate facies types, depositional environments and stratigraphic architecture, allowing participants to correlate using key stratal surfaces. Focus will be on the paralic depositional environments, with emphasis on the implications for the slope and the deepwater.

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Day 0

- Travel to Salt Lake City, Utah.
- Optional group dinner.
- Overnight in an hotel close to the airport for the first night.

Day 1: Introduction to the field area

- Health and Safety Overview.
- Introduction to the course.
- Traverse the Wasatch Front en route to the field area.
- Stratigraphy of the Interior Seaway.
- View the Ericson Formation proximal fluvial deposits.
- Overnight in Rock Springs, Wyoming.

Day 2: Sedimentology of the Haystack Mountains Formation

- Examine the detailed facies architecture of parasequences 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.
- Complete the progradational sequence by observing distributary channels and delta top facies.
- Overnight in Rawlins, Wyoming.

Day 3: Fluvial, shoreline systems and incised valleys of Fox Hills Formation

- A team based field exercise involving reservoir scale architecture of a shoreline complex that is capped by an incised valley complex.
- Recognition of key facies in fluvial and shelf edge delta systems and understanding of the sequence stratigraphic hierarchy.
- Evening lecture on shelf edge deltas and hyperpycnites.
- Overnight in Rawlins, Wyoming.

Day 4: Characterisation of slope channels

- Classroom exercises in the morning and field work in the afternoon.
- Participants will interpret outcrop sections and integrate these in an inter-well scale correlation exercise.
- Exercise focuses on correlation of sequences and clinoform geometries.
- Field work comprises sedimentology and geometry of slope channels to understand conduits for sediment transport between the shelf and the deeper water.
- Evening exercise to complete correlations.

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- Overnight in Rawlins, Wyoming.

Day 5: Characterisation of basin floor fans

- Contour mapping exercise in the morning to complete the source to sink mapping and palaeogeographies.
- Complete the exercise with a discussion of reservoir prediction, sequence stratigraphic controls on reservoir development and architecture.
- Final field work and summary discussion about tectonic changes between basin fills (Sevier vs. Laramide).
- Overnight in Saratoga, Wyoming.

Day 6

- Drive from Saratoga, Wyoming, to Denver, Colorado, for afternoon flights home.