

N451: Practical Oil-Finders Guide to Siliciclastic Sequence Stratigraphy (*Wyoming, USA*)

Instructor(s): Lee Krystinik and Randi Martinsen

Format and Duration

Field - 6 Days
Moderate Physical Demand

Summary

This course provides a pragmatic, non-jargon, oil-finder's approach to use sequence stratigraphic concepts to predict marine, deltaic, and fluvial sandstone reservoirs, and to find oil and gas. The daily itinerary includes brief conceptual lectures, outcrop observations on superb three-dimensional exposures, core examination linked to log characteristics and reservoir quality, and field-scale and regional well-log correlation exercises. The course visits outcrops that have excellent behind-the-outcrop cores and complete log suites, including image logs.

This course ultimately provides participants with the skills to maximize exploration and development drilling success.

Learning Outcomes

Participants will learn to:

1. Characterize siliciclastic depositional environments and sequence stratigraphic building blocks from outcrop and core, and apply this knowledge to the subsurface.
2. Construct predictive frameworks for basin fills from limited log data.
3. Integrate diverse subsurface data sets into a predictive conceptual framework for regional and local reservoir prediction.
4. Develop predictive models for sandstone reservoirs in various accommodation settings.
5. Correlate well logs within a predictive sequence stratigraphic model to identify new potential stratigraphic traps or internal reservoir heterogeneities.

Training Method

This is a six-day field course based in Rock Springs, Wyoming, USA. Participants will spend roughly three-quarters of the time in the field. Classroom time will mostly be spent on conceptual lectures, and working on cores in teams, with one day devoted to applying concepts learned on the outcrops and from core to subsurface exercises across a spectrum of sequence stratigraphic settings.

Physical Demand

The physical demands for this class are MODERATE, according to the Nautilus field course grading system. The outcrops are generally less than 50 m (150 ft) of relief, and all exposures are within 1 km (0.6 miles) of where the vehicles will park. Scrambling over rock outcrops will be required, but most of the hikes are considered moderate, with one hike approximating 1.6 km (1 mile) over broken terrain. The field area is at an elevation of approximately 2200 m (6600 ft). June temperatures in this part of Wyoming are moderate, although weather can be as cool as freezing and as high as 30°C (85°F). Weather in June is typically dry, sunny, and occasionally windy, but rain and rarely snow or sleet may occur. Driving will be in SUVs on black-top and unpaved roads.

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Who Should Attend

Geologists, geophysicists, engineers and other professionals engaged in production and/or exploration for clastic reservoir systems should attend this course. Although the course is designed for experienced participants, those with less experience would also benefit from this course.

Prerequisites and Linking Courses

It would be helpful for participants to have a basic understanding of clastic sedimentology, as presented in N155 (Introduction to Clastic Systems: A Petroleum Perspective), N251 (Well Log Sequence Stratigraphy: Applications to Exploration and Production), and N003 (Geological Interpretation of Well Logs).

Complementary courses to N451 are N011 (High Resolution Sequence Stratigraphy: Reservoir Applications (Utah, USA)) and N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelf Successions (NW Colorado, USA)). In Europe, consider N432 (Clastic Reservoir Characterisation for Appraisal and Development (South Pyrenees, Spain)). These courses provide an excellent conceptual basis that dovetails well with the wide range of reservoir styles and more prospect-oriented approach of N451. N451 differs from these courses by showing the response of reservoir systems to variable sediment supply and accommodation, and thus complements the learnings from these classes. This course provides real world examples of how sedimentary successions may vary significantly from the “textbook” examples in N011 (High Resolution Sequence Stratigraphy: Reservoir Applications (Utah, USA)).

Course Content

This course exposes participants to continental, coastal plain, and coastal/deltaic reservoirs that were deposited in a range of different subsidence regimes, as well as uplift, producing very different, but predictable reservoir morphologies and thicknesses. Subsurface well-log exercises will be directly linked to:

1. outcrops of the same rocks,
2. a series of 165-285 m (500-850 ft) long, continuous cores from just behind the observed outcrops, and
3. complete log suites (including FMI) of the cored well bores.

Students also work using laptops for well-log correlation to do predictive, applied sequence stratigraphy. Each day covers a particular component of sequence stratigraphy in lecture and in the field. Following brief introductory lectures on days 2 through 4 and 6, students spend about 6 hours examining outcrops in the field. Then students return to the lecture room to examine cores and link them to FMI images and log responses. Day 5 will be spent doing applied subsurface exercises on a regional and a local scale, all within the context of the outcrop observations of facies variability and continuity.

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Reservoir prediction that impacts the “bottom line” is the ultimate focus of each component of the course.

The subsurface and outcrop examples are textbook quality, but with real-world complexities common in many subsurface reservoirs. By working with these superb data, students will learn to use a clear and pragmatic approach to predictive sequence stratigraphy.

Itinerary

Day 0 Fly into Salt Lake City, Utah

Day 1 Drive from Salt Lake City to Rock Springs, Wyoming, followed by lecture, core viewing, and a field stop to observe isolated point bars in a high accommodation coastal plain

- Safety briefing and lecture covering introductory overview
- Core examination linked to log response and reservoir quality (Almond Fm)
- Three well conceptual exercise panel for progradational highstand systems tract

Day 2 Lecture and field stops on progradational systems, followed by core and log work

- Outcrop work on shoreface, deltaic and distributary deposits of a progradational system (Rock Springs Fm)
- Core examination
- Well correlation exercise

Day 3 Lecture and field stops on lowstand incision and valley fills

- Outcrop work on incised valley fills (Rock Springs Fm) and sheet-like deposits (Ericson Fm)
- Core examination
- Well correlation exercise

Day 4 Lecture and field stops on moderate to low accommodation systems

- Outcrop work on moderate to low accommodation system (Dakota Fm) and low accommodation system (Frontier Fm)
- Core examination
- Well correlation exercise

Day 5 Lecture, exercise on subsurface applications and correlation, core work and log correlation

- Core-to-log and reservoir quality comparison – porosity and permeability vs. lithofacies assessment, linked to log response

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- Core examination
- Well logs for the Almond Fm

Day 6 Lecture, followed by outcrop work on transgressive and lowstand successions of the Almond Fm.

- Field work on Almond barrier/lagoon and coastal-plain fluvial succession
- Core examination, log comparison and linkage to reservoir quality
- Review of a transgressive sequence set correlation panel (Almond Fm. barrier/back barrier/coastal plain/fluvial, with significant lowstand events)

Day 7 Drive from Rock Springs to Salt Lake City for flights home