



N251: Well Log Sequence Stratigraphy: Applications to Exploration and Production

Tutor(s): Jeff May

5 Days

Competence Level:
Basic Application



Classroom Course

Summary

This seminar provides a hands-on, practical approach to the sequence stratigraphic analysis of well logs and its application to well-log correlations. The course is conducted in a workshop format within which participants are introduced to the basic concepts and models of sequence stratigraphy, followed by numerous exercises. The class provides the skills for better prediction, evaluation, and development of reservoirs by geoscientists and engineers.

Learning Outcomes

Participants will learn to:

1. Analyze the major geologic controls and their interaction on the filling of basins.
2. Comprehend and critically analyze the often-confusing terminology utilized in sequence stratigraphy.
3. Apply appropriate sequence stratigraphy models to various basin settings.
4. Analyze and subdivide stratigraphic successions from well logs into packages of increasing or decreasing accommodation and identify chronostratigraphically significant surfaces.
5. Examine the pitfalls of lithostratigraphic vs. chronostratigraphic well-log correlations when predicting and drilling reservoir targets as well as performing economic evaluations.
6. Correlate well logs using sequence stratigraphy concepts.
7. Apply reservoir-seal-source rock concepts to sequence stratigraphic cross sections.
8. Generate maps of genetically related sequence stratigraphic units.
9. Demonstrate and predict new stratigraphic prospects or previously untapped reservoir compartments.
10. Determine the influence of chronostratigraphic surfaces on reservoir quality and flow units.

Duration and Training Method

This is a five-day classroom course that runs in Golden, Colorado, on the campus of Colorado School of Mines. Lectures, discussions, and individual and group exercises introduce participants to the concepts of sequence stratigraphy and develop methodologies for its practical applications. Approximately 25% of the course time is allocated to lectures, 65% to exercises and 10% to core viewing.

Who Should Attend

Exploration and development geologists who want an introduction to sequence stratigraphy and the ability to create geologically meaningful well-log correlations and maps. Also, geophysicists who routinely construct well-to-seismic ties and integrate their interpretations with the work of geologists, paleontologists, and/ or reservoir engineers. Reservoir engineers and geosteers will also benefit from the concepts and techniques presented.

Prerequisites and Linking Courses

An understanding of basic siliciclastic and carbonate depositional settings and facies is strongly recommended, but not mandatory. Familiarity with wireline logs is also highly desirable.

Appropriate courses providing these fundamental concepts include N155 (Introduction to Clastic



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Depositional Systems: a Petroleum Perspective); N020 (Carbonate Depositional Systems: Reservoir Sedimentology and Diagenesis) and N003 (Geological Interpretation of Well Logs).

For those who desire more advanced training, this course links to many Nautilus Training Alliance courses, including N244 (Clastic Reservoir Prediction Using Advanced Sequence Stratigraphic Interpretation, Wyoming, USA); N011 (High Resolution Sequence Stratigraphy: Reservoir Applications, Utah, USA); N091 (Carbonate Reservoir Architecture and Applied Carbonate Sequence Stratigraphy, West Texas and SE New Mexico, USA); and N059 (Applied Carbonate Geology: Carbonate Facies and Reservoirs, Mallorca and Menorca, Spain).

Course Content

Through the integration of lectures and hands-on exercises, attendees first learn the fundamental concepts and terminology of sequence stratigraphy. Participants then build upon this knowledge in the interpretation and correlation of well logs. A key step is the recognition of significant chronostratigraphic surfaces (e.g., sequence boundaries/lowstand surfaces of erosion, marine regressive surfaces of erosion, marine transgressive surfaces of erosion, flooding surfaces, maximum flooding surfaces) as expressed in well logs. These surfaces are then used in constructing numerous log correlation sections for a variety of depositional environments in both siliciclastic and carbonate settings. Such skills allow one to subdivide stratigraphic intervals into meaningful genetic packages, interpret depositional histories, and build geologically accurate maps to enhance exploration and development. Ultimately, participants will develop analytical insights and skills necessary to help identify and predict new prospects, assess drilling targets, and better produce reservoirs.

Day 1

Introduction

Controls on Basin Fill and Sequence Development

- Exercise: Relative Sea Level Cycles

Sequence Stratigraphic Models

- Exercise: Siliciclastic Basin Fill
- Exercise: Siliciclastic Chronostratigraphy

Parasequences and Parasequence Stacking

- Exercise: Recognition of Flooding Surfaces and Stacking Patterns
- Exercise: Parasequence Definition & Facies - Blackhawk Formation core and well log
- Exercise: Correlation of Well Logs - lithostratigraphy vs. chronostratigraphy

Day 2



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Parasequences and Parasequence Stacking (continued)

- Exercise: Almond Sandstone Well Logs - retrogradational parasequences
- Exercise: Parkman Sandstone Well Logs - progradational parasequences

Sequences and Sequence Boundaries

- Exercise: Sequence Boundary Model
- Exercise: Recognition of Sequence Boundaries - Villeta Formation well logs and core descriptions
- Exercise: Sequence Boundary Identification and Correlation - Muddy Sandstone core and well logs
- Exercise: Recognition of Sequence Boundaries - Segoe Canyon well log

Day 3

Carbonate Sequence Stratigraphy Models

- Exercise: Carbonate Basin Fill
- Exercise: Carbonate Chronostratigraphy
- Exercise: Flooding Surfaces & Parasequences in Carbonates - Lodgepole Formation well log
- Exercises: Identification of Surfaces & Systems Tracts in Well Logs
 - Pearsall-Bexar-Glen Rose Formations
 - Natih Formation
 - Thamama Group
- Exercise: Carbonate Parasequences & Sequences in Core - Marmaton Formation

Continental to Shallow Marine Sequence Stratigraphy

- Exercise: Continental Sequence Boundary Identification
- Exercise: Incised Valleys - South Louisiana Miocene well logs
- Exercise: Parasequences and Incised Valleys - Yegua Formation well logs & mapping

Day 4

Continental to Shallow Marine Sequence Stratigraphy (continued)

- Exercise: Falling stage systems tract (forced regression) - Woodbine Formation
- Exercise: Carbonate Platform to Shelf Edge - Paris Basin Jurassic

Deep Marine Sequence Stratigraphy

- Exercise: Systems Tracts Identification - Gulf of Mexico Pleistocene well log
- Exercise: Systems Tracts Correlation - Gulf of Mexico Miocene well logs (growth faulted margin)

Day 5



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Deep Marine Sequence Stratigraphy (continued)

- Exercise: Systems Tracts in Mixed Siliciclastics and Carbonates - Pennsylvanian of Oklahoma and Kansas
- Exercise: Systems Tracts in Mixed Siliciclastics and Carbonates - Permian Spraberry Formation, Midland Basin

Shale Sequence Stratigraphy

- Exercise: Interpretation of Biogenic-Dominated (Intrabasinal) Systems - Niobrara Formation
- Exercises: Interpretation of Detrital-Dominated (Extrabasinal) Systems
 - Mowry Shale core and well logs
- Exercise: Interpretation of Evolving Extrabasinal to Intrabasinal System - Graneros & Greenhorn Formations

Course Wrap-Up