N279: Geological Characterization and Engineering of Unconventional Oil and Gas Shales: Classroom and Field Seminar

Instructor(s): Roger Slatt and Yucel Akkutlu

6 Days	Competence Level: Skilled
Field Course	
Classroom Elements	
LOW	Low Physical Demand

Summary

This two-part course is designed to integrate the latest information on the geological characterization and engineering characteristics of resource shales. Part I will present an overview of some common unconventional resource shales and develop an integrated workflow for the geological characterization of shales. Part II will present engineering aspects of the drilling, completion, production and reservoir management of shales, including recent advances and economic analysis.

Learning Outcomes

Participants will learn to:

1. Design a workflow for the integrated characterization of resource shales.
2. Develop a sequence stratigraphic framework for regional to local correlation and mapping of best potentially-productive intervals within a shale sequence.
3. Evaluate the stratigraphic distribution of micro- and macro-fractures within brittle-ductile couplets at the laminae- to- sequence scale for predicting best potential horizontal drilling targets.
4. Evaluate shale analytical data with increased confidence and knowledge of constraints on data acquisition.
5. Assess rock types and build a sequence stratigraphic framework using well-log and/or seismic data.
6. Assess the variables that affect drilling and hydraulic fracturing for improved drilling and production management.
7. Evaluate current drilling and completion practices for shale wells.
8. Estimate porosity and permeability using core plugs and crushed shale samples.
9. Model shale gas transport coefficient for reservoir simulation studies.
10. Perform pressure transient analysis using Diagnostic Fracture Injection Testing (DFIT).
11. Perform material balance calculations for shale.
12. Identified transient flow regimes during shale gas production from horizontal wells.
13. Estimate total fracture surface area of a well contributing to the production.
14. Identify fracture interference using production data.
15. Evaluate production decline trends of various Woodford gas wells.
16. Perform shale oil and gas in-place calculations.
17. Analyze case studies of history-matching production data for wells from Marcellus, Eagle Ford, and Bakken.
18. Become aware of the environmental considerations related to water utilization and groundwater protection.

Duration and Training Method

This is a five-day course consisting of lectures and exercises. This course will use a ‘paperless’ format, whereby participants will be provided with a digital manual containing the entire set of lecture figures and exercises.

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Participants must bring a laptop computer with the ability to read PDFs from a USB port to the course.

Who Should Attend

This course is designed mainly for geoscientists unfamiliar with, or unable to keep up with, the continuing flow of new information on unconventional resource shales as exploration and development targets, but reservoir engineers and petrophysicists will also benefit from improved understanding of shale reservoirs.

Prerequisites and Linking Courses

A basic understanding of unconventional resource shales, as offered in N313 (Evaluating Resource Plays: The Geology and Engineering of Shale, Tight and Coal Seam Gas Plays) is recommended. Familiarity with mineralogy, stratigraphy and geologic structure would be useful but not essential. Related geoscience and engineering courses are identified on the Nautilus Unconventional Resources Subject Matter Competency Map, available on the Nautilus Training Alliance website.

Course Content

This is a two-part course.

Part I (days 1 to 3) addresses geoscience issues:

- an overview of some common unconventional resource shales;
- depositional processes and how they relate to poro-permeability (including fracture properties) and lithology, fabric, mineralogy and organic geochemistry (including biomarkers);
- commonality of a sequence stratigraphic framework for resource shales and how to develop that framework; seismic response;
- geomechanical properties of shales, with emphasis on ductile-brittle couplets at the sequence- to-bed scales.

An integrated gas shale characterization workflow is provided. Limited exercises will be presented, with emphasis on selecting optimal target strata for drilling.

Part II (days 4 and 5) is designed to complement the integrated characterization workflow. It includes:

- drilling, completion, and stimulation technologies;
- sampling and laboratory measurements for shale;
- reservoir engineering;
- environmental considerations in developing unconventional resources; and
- future directions in unconventional resource engineering.

The course also addresses recent advances in economic analysis of shales. Lecture and exercise material

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is supplemented with integrated case history information on the Woodford and Barnett Shale, from which both instructors have considerable experience.