



N259: From Outcrop to Subsurface: Understanding and Evaluating Shale Resource Plays (*Alberta, Canada*)

Tutor(s): Paul MacKay, Per Kent Pedersen and Guest

6 Days	Competence Level: Basic Application
 Field Course	
 Classroom Elements	
 HIGH	High Physical Demand

Summary

Outcrops, cores, well logs, field studies and exercises are used to introduce techniques for identifying, understanding and evaluating fractured shale reservoirs. Appreciable time is spent on outcrops examining the geology of shale, with an emphasis on how shale fabric influences natural fracture systems. The roles of geophysics, petrophysics, geochemistry and reservoir engineering in developing interpretations of shale resources are examined.

Learning Outcomes

Participants will learn to:

1. Demonstrate the fundamental characteristics of shale geology.
2. Examine shale depositional processes and the influence of basinal setting on facies distribution.
3. Demonstrate the application of sequence stratigraphic principles to shale dominated successions in different depositional settings for correlation and mapping.
4. Examine the lithological variables that distinguish different shale plays.
5. Analyze shale sections on well logs and in core.
6. Correlate shale sections on well logs and compare traditional lithostratigraphic vs. sequence stratigraphic based correlations.
7. Determine the stress regime for a shale section.
8. Determine fracture intensity from cores.
9. Determine key factors that contribute to a successful shale resource play.

Duration and Training Method

A six-day field course in the foothills of the Canadian Rockies, Alberta, Canada. There will be outcrop visits, a half-day core workshop, and classroom lectures. Lectures introduce the techniques employed to understand and evaluate these fine-grained deposits, and exercises reinforce the learnings. The ratio of field to classroom time is approximately 70:30.

Physical Demand

The physical demands for this class are HIGH according to the Nautilus Training Alliance field course grading system. A good level of fitness is required. Participants will spend several hours away from vehicles on most days with walks of up to 4.8 km (3 miles) along generally easy terrain with modest vertical relief. Several stops require walking down (and up) a short (100 m (300 ft)), steep path to reach outcrops along a riverbank. One field stop requires a 1.6 km (1 mile) hike with a 500 m (1500 ft) elevation gain up a cobble/boulder filled valley. The field area is at elevations between 2000-2500 m (6000-7500 ft) and participants may experience shortness of breath or fatigue due to the altitude. Temperatures can be cold-hot and the weather can be changeable. Travel will be by SUV on black-top roads.



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Who Should Attend

The course is appropriate for all geoscientists, petrophysicists and engineers who are engaged in the evaluation and development of shale resources. It is primarily designed for participants who are new to working resource plays, but experienced staff should also benefit from this course.

Prerequisites and Linking Courses

Participants would benefit from a basic understanding of clastic sedimentology and sequence stratigraphy, as offered in N155 (Introduction to Clastic Depositional Systems: a Petroleum Perspective), but this is not essential.

Related Basic Application Level courses in unconventional resources are N313 (Evaluating Resource Plays) and N184 (Unconventional Resources: Survey of the Main Oil Systems, Core Workshop, Denver).

There are a number of unconventional resource classes offered at a Skilled Application Level. In the field, consider N364 (Fracture Architecture, Sedimentology and Diagenesis of Organic-rich Mudstones of Ancient Upwelling Zones with Application to Naturally Fractured Reservoirs (California, USA)), N367 (Hydrocarbon Plays in a Nearshore-to-Offshore Foreland Basin Transect (Utah and Colorado, USA)) and N379 (Application of Geomechanics to Reservoir Characterization, Management and Hydraulic Stimulation (Wyoming, USA)). Classroom courses are N206 (Seismic for Unconventional Reservoirs), N250 (Evaluation Methods for Shale Reservoirs), N267 (Petrophysics for Shale Gas) and N279 (Geological Characterization and Engineering of Oil and Gas Shales).

Course Content

Participants will learn to use outcrop observations and subsurface data to identify and evaluate shale reservoirs. Two broad themes will be developed:

1. The geology of shales: their sedimentology, stratigraphy, mineralogy and geochemistry as determined from outcrop, core and well log data. Exercises will get participants comfortable with analyzing and correlating shale sections on well logs.
2. Fracturing in shales: the mechanics of failure, how rocks break and how to recognize fractured intervals in the subsurface. Discussions will focus on the natural fracture systems as well as the techniques that can be used to improve access to the reservoirs and improve the communication of the reservoir to the well bore.

Additional topics that will be covered include quantifying fracture intensity, the use of core in understanding the reservoir system and shale reservoir engineering. Other data sets that may aid in fracture detection will be discussed (such as potential field data). Examples of integrated interpretations of producing fractured shale reservoirs will be presented.

The principle outcrops to be studied are in the hills near Kananaskis and along the Highwood River and



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Jura Creek south and west of Calgary. The excellent shale outcrops are representative of resource plays that are under active exploration in the Western Canadian Sedimentary Basin and are relevant to Bakken, Niobrara and other resource plays elsewhere in North America.

Itinerary

Day 1

Lectures:

- Introduction/Safety
- Introduction to Shale Reservoirs
- What is a Fracture

Core workshop at AER

- Jurassic Nikanassin fractured tight gas sandstones
 - Devonian-Mississippian Bakken/Exshaw/Banff shales
 - Triassic Montney siltstones
 - Turonian Second White Specks (Greenhorn) shales
- Drive to and overnight in Kananaskis

Day 2

Lectures

- Alberta Plays -Bakken/Exshaw
- Seismic Anisotropy

Field

- Goat Creek Exshaw
 - Canmore off-leash Dog Park (optional)
- Overnight in Kananaskis

Day 3

Lectures

- Shale Facies
- Seismic
- Scan Line analysis

Field

- Triassic at Hood Creek



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Day 4

Field

- Highwood River
- Fish Scales
- 2WS to Cardium
- 2WS duplex
- Niobrara to Chungo

Day 5

Lectures

- Syria/Kurdistan
- Shale Sequence Stratigraphy and Exercise

Field

- Seebe
- Ghost Dam
- Niobrara facies
- Belly River fracture

Day 6

Lectures

- Second White Specks
- Cardium

Field

- Cardium at Horseshoe dam

Day 7

Depart for home