






# N271: The Bakken Petroleum System as a Resource Play (*Montana, USA*)

Tutor(s): Steve Sonnenberg, Mike Hendricks and Jennifer Miskimins

6 Days	Competence Level: Skilled Application
	Field Course
	Classroom Elements
	Moderate Physical Demand

## Summary

This course will examine the petroleum geology and selected engineering topics of the Bakken / Sappington / Exshaw / Three Forks plays. The classroom sessions and core workshop will focus on the subsurface analysis of the oil plays in these units in the Williston Basin, while the field time will be spent visiting the western Montana equivalents of some of the productive units.

## Learning Outcomes

Participants will learn to:

1. Characterize various factors related to oil production from the Bakken Petroleum System.
2. Assess the technologies available for tight reservoir exploitation.
3. Assess the natural fracture patterns in the basin.
4. Instigate geological and geochemical evaluations of a pervasive oil system, including determination of source rock and reservoir parameters.
5. Assess the mechanical stratigraphy of a section.
6. Evaluate matrix porosity and permeability.
7. Assess reservoir drive mechanisms in the Bakken Petroleum System.
8. Examine hydraulic fracturing design requirements, including proppant and fluid types.
9. Judge the benefits of hydraulic fracturing diagnostic techniques and how they integrate with geological and geophysical analyses and models.
10. Integrate learnings from Williston Basin case studies into pervasive oil system evaluations.

## Duration and Training Method

This is a six-day course comprised of classroom lectures with exercises and case histories (2.5 days), core workshops (1.5 days), and field stops (2 days).



## Physical Demand

The physical demands for this class are HIGH according to the Nautilus Training Alliance field course grading system. A fair level of fitness is required. Participants will spend several hours away from vehicles on days 5 and 6 with walks of up to 5.6 km (3.5 miles). Some stops are along generally easy terrain, but some require scrambling up (and down) steep talus slopes. Most stops have modest vertical relief (up to 100 m (330 ft)), but the Sacagawea/Hardscrabble field stop is a 3.5 mile (5.6 km) round trip hike through a well-maintained trail that begins at the Fairy Lake Campground at 7650ft (2330m) above sea level and reaches the outcrop at 9520ft (2900m). The trail is characterized by a changing gradient throughout the traverse, numerous switchbacks, a few large snow-covered patches, scree-covered path in the upper section of the ascent, and occasional mountain goats. The field area is at elevations between 1500-2900 m (4900-9500 ft) and participants may experience shortness of breath or fatigue due to the altitude.



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<b>MODERATE</b> Moderate Physical Demand	

Temperatures can be cold-hot and the weather can be changeable. Travel will be by SUV on black-top or well marked gravel roads.

## Who Should Attend

Any geologist, geophysicist, petrophysicist or engineer who is exploring for and developing tight oil resource plays. The course will be particularly helpful for those working the Bakken / Sappington / Exshaw / Three Forks units in the greater Williston Basin, but the lessons learned can be applied to other tight oil plays.

## Prerequisites and Linking Courses

Familiarity with unconventional oil plays, as presented in N313 (Evaluating Resource Plays) or N184 (Unconventional Resources: The Main Oil Systems, Colorado, USA), would be an advantage but is not essential.

Related Skilled Application Level courses addressing unconventional oil plays include N279 (Geological Characterization and Engineering of Unconventional Oil and Gas Shales: Classroom and Field Seminar, Oklahoma, USA), N287 (Exploiting Clastic Resource Plays in Fluvial Through Shallow Marine Environments: a Modern/Ancient Approach, Alberta, Canada) and N291 (Geological Reservoir Characteristics of Siliciclastic Unconventional Light Oil Plays, Western Canada Sedimentary Basin, Alberta, Canada).

## Course Content

The 6 days of lectures, field visits, exercises and discussions are designed to provide broad exposure to the hydrocarbon plays currently being exploited in the Williston Basin. It is expected that many of the lessons learned will have applicability to resource plays in other settings.

## Itinerary (Subject to Change)

### Day 0

Travel to Bozeman, Montana

### Day 1, Classroom: Geology of the Bakken Petroleum System




Lectures and exercises addressing:

- Tight oil
- Regional geology
- History of production
- Petroleum system basics
- Bakken mud rocks
- Lower Lodgepole



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Overnight in Bozeman

## Day 2, Classroom: Engineering of the Bakken Petroleum System

Lectures and exercises focused on:

- Hydraulic fracturing - why do it?
- Vertical vs horizontal completions and associated diversion techniques
- Stress and mechanical properties
- Materials used and conductivity
- Modeling
- Monitoring and diagnostics
- Post treatment analysis
- Exercises

Overnight in Bozeman

## Day 3, Classroom: Geology of the Bakken Petroleum System and Core Workshop at Montana State University

- Three Forks
- Reservoir drive
- Field Examples

Overnight in Bozeman

## Day 4, Core Workshop at Montana State University

Overnight in Bozeman

## Day 5, Field Visits: Three Forks and Sappington type sections

- Milligan Gulch
- Logan Gulch

Overnight in Bozeman

## Day 6, Field visits and course wrap-up session

- Sacagewea/Hardscrabble Peak

Overnight in Bozeman



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Field Course



Classroom Elements

**MODERATE**

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## Day 7

Depart for home