



N289: The Niobrara Formation as a Resource Play (*Colorado, USA*)

Instructor(s): Steve Sonnenberg, Gloria Eisenstadt, Bruce Campbell and Jennifer Miskimins

6 Days

Competence Level:
Foundation



Field Course



Classroom Elements

Summary

The course will present the regional geology of the Niobrara Formation, set it in a petroleum system context and discuss it as an emerging resource play in the Rocky Mountain Region. A wide range of topics will be covered to familiarize participants with the important nuances of the Niobrara. Log, core and seismic examples of producing areas will be presented and recent developments discussed.

Learning Outcomes

Participants will learn to:

1. Examine various factors related to tight oil production.
2. Determine the technologies available for tight reservoir exploitation.
3. Establish the presence, or otherwise, of natural fractures.
4. Determine if a pervasive hydrocarbon producing system exists.
5. Determine the type of source rocks present.
6. Initiate geological and geochemical reconnaissance evaluations.
7. Analyse the mechanical stratigraphy of a section.
8. Use and apply seismic products such as horizontal transverse isotropy (HTI) vectors, most positive and negative curvature, and parameters of brittle-ductile behavior as proxies for fracture density and direction.
9. Interpret deformation timing and style and determine the relationship of fractures measured in wells and outcrop to faults and fractures implied from 3D seismic data.
10. Examine hydraulic fracturing design requirements including proppant and fluid types.
11. Verify the benefits of hydraulic fracturing diagnostic techniques and how they integrate with geological and geophysical analyses and models.

Duration and Training Method

This is a six-day field course, comprising 3 days in the classroom (1 day each for geology, geophysics and engineering topics), a 1/2 day of core workshop and 2 1/2 field days.

Physical Demand

The physical demands for this class are MODERATE according to the Nautilus field course grading system. A fair level of fitness is required. Participants will spend several hours away from vehicles on days 4 and 5 with walks of up to 3 km (2.4 miles) along generally easy terrain with modest vertical relief (up to 100 m (300 ft)). 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 or hot and the weather can be changeable. Travel will be by bus on black-top roads.

Who Should Attend

Geologists, geophysicists, and engineers who are exploring for and developing resources in the Niobrara Formation in the Rocky Mountain Region. The course will be particularly helpful for any geoscientist trying to map and correlate the Niobrara, but the lessons learned in the course can be applied to other tight oil



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plays.

Prerequisites and Linking Courses

Familiarity with unconventional oil plays, as presented in M313 (Evaluating Resource Plays) or M184 (Unconventional Resources: The Main Oil Systems, Colorado, USA), would be an advantage, but are not essential. A related course at Basic Application Level is M259 (From Outcrop to Subsurface: Understanding and Evaluating Shale Resource Plays, Alberta, Canada). A range of courses, addressing resource play topics, are also available.

Course Content

This course provides an introduction to the emerging Niobrara resource play. The petroleum system approach will be used to describe the Niobrara. A key emphasis will be to show the important elements and processes for continuous oil and gas accumulations. Numerous examples will be shown to summarize differences in types of accumulations (conventional versus unconventional/continuous) in existing Niobrara fields. A wide range of topics will be covered to familiarize the participant with the important nuances of the Niobrara. Log, core and seismic examples of producing areas will be presented and recent developments discussed. The emphasis of the geophysics portion of the course is the integration of traditional structural mapping and analysis with seismically-derived products such as HTI vectors, curvature, coherence, and brittle-ductile parameters. Lectures and exercises will highlight both the usefulness and difficulties associated with using seismic data and associated products to determine the timing, orientation and density of fractures in the Niobrara.

Participants will learn screening techniques which may help identify “sweet spots” in the Niobrara fairway. The lessons learned in the course can be applied to other tight oil plays.

Itinerary (subject to change)

Day 0

Travel to Golden, Colorado.

Days 1 to 3

Classroom sessions in Golden, to include:

- 1 day of geology lectures and exercises. Lectures to cover:
 - Factors related to tight oil production
 - Technologies available to exploit tight reservoirs
 - Natural fracture identification
 - Pervasive hydrocarbon systems
 - Source rock characterization
 - Geological and geochemical reconnaissance methods
 - Importance of mechanical stratigraphy
 - Matrix porosity and permeability
 - Reservoir drive mechanisms in the Niobrara



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- 1 day of geophysics lectures and exercises. Participants will work with hands-on exercises from 3D data from a Niobrara field. Lectures and exercises will emphasize understanding the derivation and sensitivity of seismic products such as HTI vectors, curvature, coherence, and results of seismic inversion to predict fracture direction and density. Discussions will highlight examples of both straight-forward and nonunique correlations
- 1 day of engineering lectures and exercises focused on the stimulation of the Niobrara formation and the design of wellbores used in the play. Lectures and exercises will focus on diagnostic evaluation techniques such as fracture injection tests, design of multi-stage treatments and associated diversion techniques, and design of treatment fluids, proppants, and conductivity needs
Overnights in Golden, Colorado.

Day 4

Core workshop at USGS facility, Lakewood, Colorado.

Overnight in Cañon City, Colorado.

Day 5

Niobrara field stops in central Colorado:

- Cañon City outcrops

Overnight in Dillon, Colorado.

Day 6

Niobrara field stops in western Colorado:

- Kremmling Walcott and New Castle sections

Overnight in Grand Junction, Colorado, with return flights home the next morning.