N184: Unconventional Resources: The Main Oil Systems *(Colorado, USA)*

Instructor(s): Larry Meckel and Steve Sonnenberg

5 Days	Competence Level: Foundation
Classroom Course	
LOW	Low Physical Demand

Summary

Industry success in unconventional oil petroleum systems has completely changed the landscape of the industry. That success has been driven by need for oil in North America (to reduce imports) and new technology. This survey course will look at all five of these unconventional oil petroleum systems. However the emphasis will be on the tight rocks (the source rock itself and pervasive tight reservoirs), as these are the focus of many successful recent and current plays in the United States and Canada. The course will summarize many of these exciting new resource fields, which of course we now use as analogues for future plays. It will also summarize our current working model for these tight petroleum systems, so important in trying to evaluate and predict them.

Learning Outcomes

Participants will learn to:

1. Develop the current working model for the tight reservoir plays (our most active).
2. Appraise oil resource plays, their worldwide occurrences and how our understanding of them has evolved over time.
3. Contrast these large accumulations with conventional oil fields.
4. Compare the major characteristics of each accumulation type.
5. Characterize how each accumulation type can vary from accumulation to accumulation.
6. Examine cores to determine both the lithologic and petrophysical characteristics of these types of plays.
7. Review production and resource numbers for each play type.
8. Discuss the technology required to produce or develop these plays.
9. Assess the environmental challenges for developing these resources.

Duration and Training Method

A five-day course comprising three days of classroom lectures, one day core examination and one day in the field. The core workshop will be held at the Colorado School of Mines in Golden, Colorado. Lectures, core examination, core exercises and a field trip.

Physical Demand

The physical demands for the field day are LOW according to the Nautilus Training Alliance field course grading system. The field stops are in a quarry and along a highway. Each stop will involve a walk of less than 1 km (0.6 mile) and elevation change of less than 33 m (100 ft). The weather can be cool to warm and dry. Participants should be aware the field stops are at an elevation of 1600 m (5400 ft). Transport will be by bus on black-top roads.

Who Should Attend

The course is intended for professionals who are exploring for or developing these unconventional systems and for managers and others who want a concise overview of the critical subsurface characteristics of these pervasive accumulations.

N184: Unconventional Resources: The Main Oil Systems *(Colorado, USA)*

Instructor(s): Larry Meckel and Steve Sonnenberg

5 Days	Competence Level: Foundation
Classroom Course	
LOW	Low Physical Demand

Prerequisites and Linking Courses

Familiarity with basic geology and petroleum systems would be an advantage but is not essential.

Additional insight into unconventional plays at a Basic Application level is presented in N313 (Evaluating Resource Plays: The Geology and Engineering of Low Permeability Oil and Gas Reservoirs) and N259 (From Outcrop to Subsurface: Understanding and Evaluating Shale Resource Plays, Alberta, Canada).

More advanced treatment of topics covered in N184 is presented in courses N206 (Seismic Tools for Unconventional Reservoirs), N250 (Evaluation Methods for Shale Reservoirs) and N267 (Petrophysics for Shale Gas).

Field courses addressing unconventional oil topics include N245 (Sedimentology and Stratigraphy of Lacustrine Systems, Utah and Colorado, USA), N364 (Fracture Architecture, Sedimentology and Diagenesis of Organic-rich Mudstones of Ancient Upwelling Zones with Application to Naturally Fractured Reservoirs, California, USA) and N367 (Hydrocarbon Plays in a Nearshore-to-Offshore Foreland Basin Transect, Utah and Colorado, USA).

Related courses on the US ETA program are N944 (Shale Gas and Shale Oil Completions Using Multi-Staged Fracturing and Horizontal Wells), N957 (Forecasting Production and Estimating Reserves in Unconventional Reservoirs) and N973 (Reservoir Engineering for Unconventional Gas and Tight Oil Reservoirs).

Course Content

Finding reserves in conventional oil plays is becoming increasingly challenging around the world, however improved technologies have led to a resurgence of interest in unconventional oil plays, also known as pervasive tight oil plays. These include pervasive tight oil sands, mature oil source rocks, tar sands / heavy oil and oil shales, each of which is covered. Coal to liquids projects (CTL) are active in other parts of the world and are also examined in the course.

1. Overview

- Definitions
- Objectives
- Some useful concepts
- Basic reserve / production numbers
- Systems we will examine

2. Our Current Working Model

- For Mature Oil Source Rock Plays
- For Pervasive Tight Reservoir Plays

- Adjustments Required in Our Thinking
- Forces of Expulsion (Rather Than Forces of Buoyancy)
- The Systems are Dynamic
- Nanoporosity Develops in the Kerogen

3. Source Rocks

- Types
- Organic Richness
- Maturity
- Products

4. Mature Oil Source Rocks

- Main characteristics
- Examples of current plays: Bakken, Niobrara, Eagle Ford, Greenhorn, Graneros, Vaca Muerta (Argentina)
- Other key considerations
- Critical elements for play

5. Pervasive Tight Reservoir Systems

- Historical Perspective
- Importance
- Examples
  - Austin Chalk (a type locality)
  - Cardium (Canada) (the new halo plays)
  - Wolfberry (new oil in old places)

6. Heavy Oil – Tar Sands

- Names they go by and definitions
- Examples of active plays: Southern California Heavy Oil Fields, Athabasca Tar Sands.
- Technological challenges
- Environmental considerations
- Some production and resource numbers

7. Oil Shales

- What are they?
- The world's largest: Green River oil shale, CO
- Other examples: Brazil, Estonia, China
- Technology being considered / developed
- Environmental considerations
- Reserves / resource numbers

N184: Unconventional Resources: The Main Oil Systems *(Colorado, USA)*

Instructor(s): Larry Meckel and Steve Sonnenberg

5 Days	Competence Level: Foundation
Classroom Course	
LOW	Low Physical Demand

8. Coal to Liquids

- Origin of technology
- What is currently being done
- Technical problems
- Environmental issues
- What is on the horizon

9. Core Examination (Days 4)

1. Bakken oil play, Williston Basin, ND and MT
2. Niobrara mature source rock, Denver Basin, CO
3. Codell sandstone, Denver Basin, CO
4. J Sand, Wattenberg field, CO
5. Athabasca tar sand, Alberta Basin, Canada
6. Green River oil shale, Piceance Basin, CO

10. Field Trip to the Denver Basin (Day 5)

1. Pervasive tight oil play (Codell, J-sand)
2. Mature oil source rock (Niobrara)
3. Tar sand (Dakota)