






N438: Geoscience and Engineering Evaluation of Unconventional Source Rock Reservoirs: The Eagle Ford at Lozier Canyon (*Texas, USA*)

Instructor(s): Art Donovan and Noel McInnis

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| 5 Days | Competence Level: Skilled |
|  Field Course | |
|  Classroom Elements | |
|  HIGH | High Physical Demand |

Summary

World-class, completion-scale exposures of the Eagle Ford in Lozier Canyon provide an opportunity to visualize the vertical and lateral variability that occurs along a wellbore in a source rock reservoir and to discuss the geologic and engineering challenges associated with unconventional source rock plays. A unique aspect is the integration of 21st century data similar to the information collected from boreholes and cores in the subsurface. Learnings apply to other resource plays, such as the Woodford, Utica, Marcellus, Haynesville, Duvernay, and Vaca Muerta.

Learning Outcomes

Participants will learn to:

1. Value the power of visualizing subsurface stratigraphy in outcrops hundreds of feet high and thousands of feet in lateral extent.
2. Characterize vertical and lateral variations in TOC, maturity, composition and organofacies, as well as thickness variations, of the primary reservoir zones across an unconventional source rock play fairway.
3. Evaluate bed-scale variability in mechanical stratigraphy.
4. Assess inherited physiography and sequence stratigraphy to explain thickness variations of the primary reservoir zone across a play fairway.
5. Gauge the difference in risk factors between unconventional source rock and tight rock plays.
6. Integrate outcrop, core, well log, geochemical, and engineering data in an unconventional source rock play.
7. Predict the vertical and lateral variability, thickness variations, and sweet spots across the play fairway of an unconventional source rock reservoir.
8. Estimate stimulated rock volumes and effective fracture heights in source rock plays, as well as how variations in completion techniques affect production outcomes.
9. Investigate the value of bringing outcrops into the 21st Century by collecting petrophysical, geochemical, chemostratigraphic, and biostratigraphic data similar to that collected in the subsurface.
10. Value the importance of porting the subsurface stratigraphy to the outcrops, and avoiding local provincial nomenclature.




Duration and Training Method

This five-day field course starts and ends in Austin, Texas. The first two days will be based in Del Rio, Texas, and the last two in Austin. Fieldwork (60% of time) is supported by lectures and team exercises (20% of time) and core viewing (20% of time). The course is structured so that the week is an ongoing group discussion on unconventional source rock reservoirs. Participants are encouraged to share their own experiences with source rock plays and to bring examples and presentations for discussion.



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Physical Demand

The physical demands for this class are HIGH according to the Nautilus Training Alliance field course grading system. A very good general level of fitness is required. The first field day includes a 3km (2 mile) hike, while the second field day consists of a day-long 12km (8mile) hike. Conditions are dry and arid, temperatures should be moderate during the trip, rain is unlikely, but windy conditions are not uncommon. Staying hydrated is critical.

Who Should Attend

The course integrates geoscience and engineering topics and is designed to appeal to geologists, geophysicists, reservoir engineers, completion engineers and drilling engineers. When geoscientists and engineers working on the same asset have attended in the past, they have remarked that the course is a powerful tool to help them develop an integrated approach to unconventional source rock reservoirs.

Prerequisites and Linking Courses

Participants should have a familiarity with resource plays, such as presented in N313 (Evaluating Resource Plays).

Related skilled level courses include classroom course N250 (Evaluation Methods for Shale Reservoirs) and field courses N241 (Depositional Processes, Fabrics and Stratigraphic Framework of Mudrocks: Applications to Shale Reservoirs, Colorado and Wyoming USA), N364 (Fracture Architecture, Sedimentology and Diagenesis of Organic-rich Mudstones of Ancient Upwelling Zones with Application to Naturally Fractured Reservoirs, California, USA) and N379 (Application of Geomechanics to Reservoir Characterization, Management and Hydraulic Stimulation, Wyoming, USA).

Course Content




World-class exposures of a source rock and unconventional source rock reservoir are examined in spectacular outcrops of the Eagle Ford Group in Lozier Canyon, an area that few scientists have had to opportunity to visit over the past 50 years. These completion-scale exposures, hundreds of feet high and thousands of feet in lateral extent, provide a unique opportunity to visualize in the minds-eye the vertical and lateral variability that occurs along a well bore within the subsurface in source rock reservoir. The primary canyon exposures are coupled with hikes through side canyons which afford the opportunity to walk bed-by-bed through an unconventional source rock reservoir and six million years in the earth's history. Highway exposures provide windows to study the underlying Georgetown, Del Rio, and Buda; sample the Eagle Ford; and examine the overlying Austin Group.

The Austin area provides stops to discuss regional thickness variations within source rock plays, conduct exercises, as well as an opportunity to look at unconventional reservoirs in core at the Bureau of Economic Geology.



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A unique aspect of all the outcrops that will be visited during the seminar is the integration of 21st century petrophysical, geochemical, chemostratigraphic, biostratigraphic, chronostratigraphic, and sequence stratigraphic data that was collected from the outcrops. These data are similar to the information collected from boreholes and cores in the subsurface and, when coupled with the uniqueness of the Lozier Canyon outcrops, provide unique portals into the Eagle Ford in the subsurface.

Unconventional reservoirs are those reservoirs which have permeability to viscosity ratios that require the technology to alter either the permeability of the rock or the viscosity of the fluid to result in commercial rates of flow. The fracking of horizontal wells has transformed low permeability tight rock and source rock reservoir systems. In Tight Rock plays, the reservoir is not a source rock. Oil and gas migrate into reservoirs typically consisting of coarse silt- to fine sand-sized clastic and carbonate grains. The risk elements are similar to those in conventional reservoirs: reservoir, source, seal, trap, reservoir deliverability, and charge access. In Source Rock plays, the reservoir is also a source rock and typically consists of organic-rich siliceous or calcareous mudstones. The risk elements are very different to those of conventional and tight rock plays, and require focus on TOC, maturity, and reservoir composition, thickness, and pressures.

The focus of this seminar is on unconventional source rock plays, in particular the geologic and engineering learnings from the Eagle Ford Group in the subsurface of South Texas, as well as the outcrops of West Texas. However, the learnings from examination of the Eagle Ford play are applicable to other unconventional source rock plays such as the Woodford, Utica, Marcellus, Haynesville, Duvernay, and Vaca Muerta.

Course Itinerary

Day 1

- Arrive in Austin International Airport by noon, bus drive to Del Rio
- Class: Introductory lecture, safety brief and what to expect; dinner
- Overnight: Del Rio

Day 2

- Field: General west Texas stratigraphy and Eagle Ford introduction
- Overnight: Del Rio




Day 3

- Field: Day-long walk through an unconventional source rock reservoir
- Overnight: Austin



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Day 4

- Field, AM: Bouldin Creek outcrops
- Class, PM: BEG Core Repository
- Overnight: Austin

Day 5

- Class, AM: Lecture / exercises / summary / lunch
- Adjourn 1pm, bus drive to airport