N287: Exploiting Clastic Resource Plays in Fluvial Through Shallow Marine Environments: a Modern/Ancient Approach *(Alberta, Canada)*

Tutor(s): Tom Moslow and Jerry Sexton

5 Days	Competence Level: Basic Application
Field Course	
Classroom Elements	
MODERATE	Moderate Physical Demand

Summary

This course presents the key geologic attributes that determine the viability of non-shale clastic reservoirs as potential resource play targets. Facies heterogeneity, permeability anisotropy, areal extent and architecture of clastic reservoirs in a variety of depositional settings are examined to determine reasonable constraints on the lateral variability in clastic facies that will reduce risk, enhance accurate characterization and add predictability in resource plays and reservoir simulations.

Learning Outcomes

Participants will learn to:

1. Analyse the facies heterogeneity, permeability anisotropy, areal extent and architecture of clastic reservoirs in a variety of depositional settings.
2. Generate inputs to predictive models for reservoir simulations and extrapolation to horizontal drilling programs for a variety of depositional settings.
3. Determine permeability anisotropy and demonstrate the concept of reservoir "sweet spots".
4. Generate "facies heterogeneity indices" for clastic depositional environments.
5. Analyse the sedimentary characteristics, patterns of reservoir quality and net:gross ratios of varying depositional environments based on the observation of cored facies in modern and ancient successions.
6. Establish geometries and length-to-width ratios of sand bodies in varying depositional environments.

Duration and Training Method

This is a five-day course, comprising classroom lectures (30%), core workshops (25%) and field work (45%). The core workshop takes place at the AER Core Research Centre in Calgary. The field stops are in the Foothills and Front Ranges of Kananaskis Provincial Park and greater Canmore areas.

Physical Demand

The physical demands for this class are MODERATE according to the Nautilus Training Alliance field course grading system. A good level of fitness is required. On days 4 and 5, participants will spend several hours away from vehicles with walks of up to 3 km (2.4 miles) along generally easy terrain with modest vertical relief (up to 50 m (170 ft)) at elevations between 1280 and 1525 m (4200 and 5000 ft). On Day 5, participants will be away from the vehicles for 4 to 5 hours, will traverse up and down a 40 degree slope with an elevation gain of 150 m (495 ft), and will attain a maximum elevation of 2395 m (7850 ft). 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 SUV mostly on black-top roads with some driving on dirt/gravel roads.

Who Should Attend

Exploration or development geologists, geophysicists, reservoir engineers, reservoir modelers and/or geoscience and engineering managers within companies that are evaluating or exploiting unconventional clastic reservoirs through multi-well horizontal drilling programs.

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Prerequisites and Linking Courses

Familiarity with unconventional plays, as presented in N313 (Evaluating Resource Plays: The Geology and Engineering of Shale, Tight and Coal Seam Gas Plays) or N184 (Unconventional Resources: The Main Oil Systems, Colorado), would be an advantage, but is not essential.

A number of Skilled Application Level field courses treat the sequence stratigraphy and geological modeling of fluvial through shallow marine clastic settings, though none focus on the resource play aspect. These include N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelfal Successions, NW Colorado, USA) and N011 (High Resolution Sequence Stratigraphy: Reservoir Applications (Utah, USA)), N012 (Reservoir Modelling Field Class (Utah, USA) and N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelfal Successions: Deltas, Shorelines and Origins of Isolated Sandstones (NW Colorado, USA)).

To observe modern clastic environments, consider taking the Basic Application Level field course N096 (Recent Depositional and Stratigraphic Analogues for Fluvial and Shallow Marine Reservoirs, South Carolina, USA).

Course Content

Recent technological advancements in the drilling, completion and computer simulation of clastic reservoirs have placed increasing demands on geoscientists to better characterize and predict the attributes of clastic deposits that lend themselves for successful exploitation of such technologies. This has also led to the advent of the "resource play" and the unrealistic pursuit for reservoirs with lateral homogeneity and ubiquitous continuity. Coincident with this is the assumption that the geological characterization of a clastic reservoir presents too many complex variables that are not resolvable to any significant degree. However, while lateral variability and facies heterogeneity are inherent to the nature of deposition in clastic sediments, these attributes are predictable, commonly repetitive and occur in an orderly fashion.

This combined lecture course, core workshop and field trip is designed to provide an overview of the key geologic attributes that determine the viability of clastic reservoirs in a variety of depositional settings as potential resource plays for hydrocarbon exploration and exploitation. An emphasis is placed on characterizing the facies heterogeneity, permeability anisotropy, areal extent and architecture of clastic reservoirs in a variety of depositional settings. Insights from modern environments of deposition and comparison to ancient equivalents provide the basis for placing reasonable constraints on the lateral variability in clastic facies that will reduce risk, enhance accurate characterization and add predictability in resource plays and reservoir simulations.

Other topics to be included:

- Review the basis for developing predictive models in reservoir simulations and extrapolation to horizontal drilling programs in a variety of depositional settings
- Permeability anisotropy and the concept of reservoir "sweet spots"
- "Facies heterogeneity index" for varying clastic depositional environments
- Case examples of resource plays from subsurface ancient reconstructions

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- Review of the sedimentary characteristics, patterns or reservoir quality and net:gross ratios of varying depositional environments based on the observation of cored facies in modern and ancient successions
- Depositional systems reviewed include: fluvial, estuarine, deltaic, barrier shoreline and shelf/shoreface
- Predictive geometries and length-to-width ratios of sand bodies in varying depositional environments

Note that this course does not focus on shales, but rather the coarser grained fraction of the clastic spectrum of sedimentary rock, specifically siltstones, sandstones and conglomerate reservoirs with respect to their potential as "resource plays".

Itinerary (subject to revision)

Days 1, 2 and 3 (AM)
Classroom lectures and core workshops at Energy Resources Conservation Board Core Research Centre in Calgary.

Overnight in Calgary (Days 1 and 2).

Days Days 3 (PM), 4 and 5
Field stops to examine outcrop exposures and modern fluvial environments in the Kananaskis Provincial Park and Canmore areas of Alberta.

Overnight in Kananaskis (Days 3 and 4).

Day 5
Overnight in Calgary for flights home the next morning.