CLASTIC HEAVY OIL AND TAR SAND RESERVOIRS (Core Seminar)

Participants are exposed to the spectrum of productive and trapping units found associated with Lower Cretaceous clastic heavy oil and tar sand reservoirs in Alberta (these deposits are directly analogous to beds located in west-central Saskatchewan).

Following a lecture on the geology of the heavy oil-tar sand belt, participants will spend most of two days viewing cores from the general Lloydminster-Cold Lake-Wabasca-Peace River-Athabasca regions. The cores selected will cover the complete stratigraphic spectrum of Lower Cretaceous (Mannville) units as well as the varying types of reservoir architecture, including channel fills, estuarine deposits, and wave-formed shorelines.

CHANNEL RESERVOIRS AND ASSOCIATED DEPOSITS OF WESTERN CANADA (Core Seminar)

Channel reservoirs are difficult to find and understand, but offer assets with high economic impact. In addition to forming prolific reservoirs, channel fills and related deposits also are important in aiding petroleum entrapment within flanking non-channelized units. Furthermore, the complex architecture of some channelized deposits creates torturous fluid flow paths within reservoirs, which greatly influences reservoir development schemes like waterflooding, EOR, horizontal well trajectories, and perforation programs.

The complex stratigraphy and sedimentology of channel fill deposits located within the subsurface of western Canada mandates a sophisticated knowledge of the rocks forming both reservoir and non-reservoir strata. This seminar exposes participants to a large spectrum of productive, prospective and trapping strata. Participants will review deposits of braided, meandering estuarine, and anastomosed systems. They will observe channel fill, point bar and crevasse-splay reservoirs, trapping units in tight channel fill sandstone and mudstones, and reservoir heterogeneities associated with non-reservoir interbeds and intraformational breccia.

GEOMETRY AND KINEMATICS OF SELECTED HYDROCARBON-TRAPPING, NON-CONTRACTIONAL STRUCTURAL REGIMES

This two day lecture series will focus on the geometry and kinematics of tectonic regimes that have been the focus of new hydrocarbon play concepts..

Day 1: *Coupled Shelf Extensional and basin directed "toe-thrust" Systems*. There have been several significant hydrocarbon discoveries in deep water toe-thrust systems, associated with the mobilization of salt and/or shale. The first day of this lecture series will examine in detail both salt- and shale-based toe-thrust systems. Established examples that will be reviewed include West Africa (Niger Delta, Angola), Gulf of Mexico (Gulf of Campeche), East Coast India (Krishna Gadavari), and Brunei (Bram Delta). The MacKenzie Delta and East Coast Africa, two regimes that may yet be classified as toe-thrust systems, will also be discussed.

Day 2: *Strike/Oblique-Slip Fault Zones.* Exploration along strike/oblique-slip fault systems has traditionally focused on mapping structural traps related to en-echelon folding and contractional oblique-slip faults (e.g. southern California). More recently, the association of hydrothermal dolomites with deep-seated strike-slip fault zones (e.g. northern Alberta, northeast BC, Anticosti Basin, Albion-Scipio of Michigan, Ellenberger-Texas) has generated new plays. The key issues are the relationships between strike-slip fault zones, heat-flow anomalies, fluid flow and fracture networks. This second day lecture will examine the kinematics of strike-slip fault zones based on their map patterns of structures of various sizes.

Additional seminars that Petrel Robertson Consulting Ltd. will run on request:

Fluvial Deposits of the Brazeau-Belly River Sequence, Alberta Foothills and Subsurface, West-Central Alberta

TIGHT GAS SANDSTONE RESERVOIRS OF THE WESTERN CANADIAN SEDIMENTARY SHIELD (A Core Seminar)

Until recently, Canadian tight gas production has been dominated by the hunt for stratigraphic "sweet spots", where pockets of conventional reservoir quality can be produced within a tight gas fairway, and which drain some of the encasing tight gas sandstone facies. During the past few years, however, advances in drilling and completions and economies of scale have allowed gas producers to access gas stored in low-permeability, truly "tight" sandstone reservoirs.

Petrel Robertson's Tight Gas Sandstone core review addresses both stratigraphic sweet spot reservoirs (and their encasing tight facies), and tight (sub-millidarcy) clastic reservoirs. Specific core sessions can be assembled to address the specific needs of clients. Examples are drawn from PRCL's non-exclusive study "Comparative Evaluation of Tight Gas Play Opportunities, WCSB", which addresses 13 stratigraphic intervals and 24 play types. These include: Tight, organic-rich siltstones (Montney and Doig Frms); locally fractured calcareous sandstones (Rock Creek member); stratigraphic and fractured sweet spots along extensive conglomerate/sandstone fairway (Cadomin Frm); stratigraphic sweet spots in coarser, cleaner valley-fill sandstone facies (Glauconitic member and Spirit River Frm); stratigraphic sweet spots on conglomeratic shoreline trends (Falher and Notikewin Mbrs, Cadotte Frm); stratigraphic sweet spots associated with early chlorite clay rims and locally fractured tight shoreface sandstones (Cardium Frm).

One- or two-day tight gas core sessions can be customized for any client group.

MESOZOIC RESERVOIR SANDSTONES OF WEST-CENTRAL ALBERTA (Core Seminar)

Prospect development and efficient reservoir exploitation rely upon detailed knowledge of reservoirs, seals, and their relationships in the subsurface. The study of cores remains the most fundamental and powerful tool in developing this knowledge, and provides the basis for application of other subsurface imaging technologies.

The complex stratigraphy and sedimentology of the numerous prospective Mesozoic reservoir sandstones in west-central Alberta makes a comprehensive knowledge of the rocks essential. This seminar exposes participants to a wide spectrum of productive, prospective, and trapping strata located between Townships 30 and 70, west of the fifth meridian. We will review reservoir units deposited in fluvial and estuarine channel, tidal flat, shoreface, and shelfal environments. Trapping strata include cemented sandstones, as well as impermeable overbank, interfluve, and marine deposits.

Petrel Robertson Consulting Ltd.

FIELD AND CORE SEMINARS

Visit www.petrelrob.com for details of our field and core seminars or phone Leslie Sears at 218-1618.

Seminars are not scheduled regularly, but we will run any of these seminars at client request. Focused sessions can be designed to meet the particular interests of a client group.

MODERN AND ANCIENT CLASTIC SHORELINE DEPOSITS, WILLAPA BAY AREA, WASHINGTON

Many productive units in Western Canada are interpreted to be the products of marine shoreline deposition. In this depositional setting, great lateral and vertical complexity is to be expected within and between reservoirs. Understanding their complexities is crucial to effective exploration and reservoir development. In order to understand these deposits one needs to appreciate the depositional dynamics and the distribution of the several sub-environments associated with shoreline deposits. Ideally, one should be exposed to both outcrops and modern depositional systems. In outcrop, one sees the vertical and lateral variability, whereas observation of modern sediments gives insight into active processes and sediment distributions at the surface.

Petrel Robertson's field seminar to the Willapa Bay area of Washington is unique in that participants not only view modern sediments but also analogous Late Pleistocene deposits which are exposed in cliffs found at the shoreline.

Besides the benefits to geologists, this field seminar should also be of interest to both geophysicists and reservoir engineers. Geophysicists will be able to see the relative scale, lateral continuity and complexity of wave-formed and tidal sediments. Engineers will observe the depositional processes associated with marine shorelines and thereby get an appreciation of the number, type and extent of non-random heterogeneities found in shoreline reservoirs.

MODERN SEDIMENTARY ENVIRONMENTS OF FLUVIAL CHANNEL SYSTEMS, UPPER COLUMBIA RIVER, GOLDEN, B.C.

There has always been interest in channel sandstone reservoirs, both as exploration targets and as enhanced oil recovery development sites. In order to understand these deposits, one needs to appreciate the depositional dynamics and the distribution of the several sub-environments associated with fluvial sediments. Ideally, one should be exposed to both outcrops and modern systems. In outcrop one sees the vertical and lateral variability, whereas observation of modern rivers gives insight into active processes and sediment distributions at the surface.

Petrel's field seminar to the Great Falls area of Montana exposes participants to spectacular examples of Cretaceous channel fills in outcrop. The seminar presented here, to the Columbia River valley of British Columbia, complements the Great Falls trip in that the depositional processes associated with modern rivers are viewed.

Besides the obvious benefits to geologists, this field seminar should also be of interest to both geophysicists and reservoir engineers. Geophysicists will be able to see the relative scale, lateral continuity and complexity of channel fills and enclosing sediments. Engineers will observe the depositional processes associated with rivers and thereby get an appreciation of the number, type, and extent of non-random heterogeneities found in fluvial reservoirs.

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OUTCROP AND SUBSURFACE GEOMETRY OF MESOZOIC CHANNEL SYSTEMS, ALBERTA AND MONTANA

A few years ago, the location of channel systems in the subsurface was considered to be the ultimate goal of the exploration geologist and geophysicist. Today, it is known that the ability to merely find a channel will not, in itself, assure success. Channel systems may have a complex internal geometry which results in subtle hydrocarbon traps.

The course is directed toward understanding the occurrence and variation of channel fill deposits within the broader context of Mesozoic sedimentary depositional systems in the Western Canada Sedimentary Basin. Although the focus is on channels, sandstone bodies from equivalents of a number of productive units will be examined, including the Swift, Cutbank, Sunburst, Ostracode, Glauconitic, Bow Island and Belly River.

This field seminar integrates the disciplines of geology, geophysics, and engineering while providing specific information for each area. For the geologist, the emphasis is on the origin, depositional model, and the prediction of channel deposits from analysis of the entire depositional system. For the geophysicist, it is the scale of the channels and inferred contrasts in acoustical impedance as a function of lithology. For the engineer, important facets of channels are internal geometry of reservoir units, and continuity and homogeneity of reservoirs. The course is aimed at finding a common ground for discussion and exchange of ideas in the less formal environment of a field seminar.

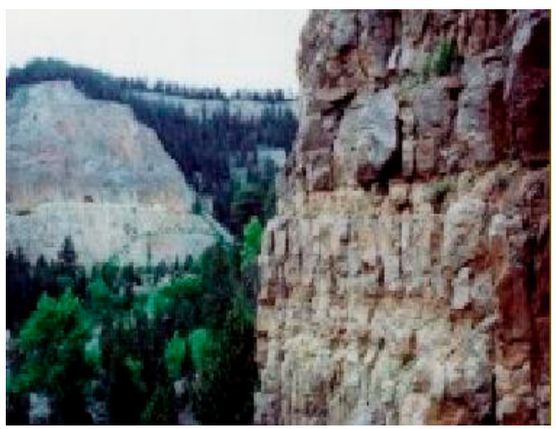
Most of the field outcrops examined are in the vicinity of Great Falls, Montana. These outcrops have special significance because they are the only outcrops of the Lower Mannville or its equivalents in the western plains, other than the McMurray heavy oil deposits that lie over a thousand kilometres to the north. In addition, the exposures are superb and offer a three-dimensional view of channels rarely seen anywhere in outcrop.

MISSISSIPPIAN CARBONATE FACIES AND PALEOKARST, BELT MOUNTAINS, MONTANA

Mississippian reservoirs form some of the most prolific units in the Williston and Western Canada basins. Although laterally widespread deposits, reservoir zones are complicated by fractures and karst features. With the recent common application of horizontal drilling to these units, it becomes increasingly crucial for geologists to understand the lateral complexities within these types of deposits in order to more efficiently exploit these reservoirs. The complications caused by localized faulting and karsting are also relevant to interpretations of three-dimensional seismic data as well as the definition of fluid flow fairways and impediments.

This field seminar addresses the stratigraphy, facies and post-depositional modification processes associated with Lodgepole (Banff) - Mission Canyon (Rundle) units exposed along the flanks of the Belt Mountains in north-central Montana. These rocks comprise analogues to productive units found within the Williston Basin, northwestern Montana, and southwestern and west-central Alberta.

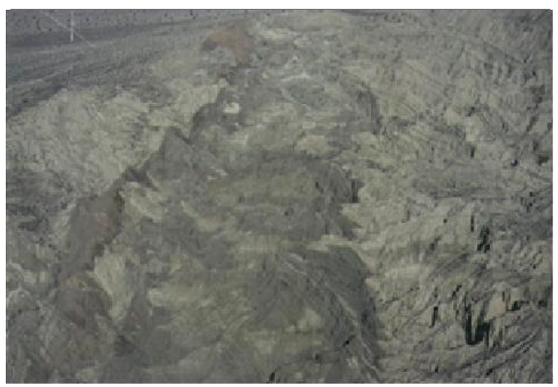
Participants will view Lower Carboniferous sequences, parasequence sets and parasequences; outer ramp (deep water) carbonate mud mounds; middle ramp carbonate sand bodies; inner ramp restricted shoaling cycles; Madison paleokarst; clastic carbonate inner ramp cycles and paleosols.



BASIN FORMATION AND INVERSION IN A STRIKE-SLIP FAULT ZONE, SALTON TROUGH, CALIFORNIA

Structures with significant lateral displacement are difficult to recognize using common sub-surface geophysical tools. Most interpretations under these structural settings require a sound kinematic understanding of the processes involved. This field seminar will cover both theoretical aspects and field examples of expected geometry associated with basin formation and inversion along strike-slip fault zones.

Among the few areas where one can clearly observe the results of basin-forming processes and inversion in a strike-slip fault zone is along a segment of the San Andreas Fault in southern California. Spectacular, easily accessible exposures provide a unique 3-dimensional perspective of various structures that form under this tectonic setting. The first part of the trip covers examples of tectonic-controlled sedimentation along the western margin of the basin where Neogene marine sandstones, non-marine fluvial and alluvial fan deposits, and mass flow deposits with associated folds are exposed. In the second leg of the trip, structures along strike-slip and convergent strike-slip faults, including en echelon and partitioned folds, beheaded canyons, shutter ridges and deflected streams, triangle zones and Palm Tree structures, will be studied. In addition, fault zone rocks and their possible sealing or leaking nature will be discussed, based on exposures along the San Andreas Fault.



This field seminar will greatly benefit both geologists and geophysicists by providing an interpretative guide and a field analogue to various prospects located along oblique fault zones.