

## **Petroleum Geology for the Cambro-Ordovician Anticosti Sedimentary Basin, West Coast of Newfoundland**

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The Anticosti Basin located in Western Newfoundland is one of a succession of Cambrian to Ordovician basins along the Appalachian Orogenic Belt of eastern North America. The rocks of the Anticosti Basin include sandstones and carbonates that were deposited along the continental shelf and slope that bordered the paleo-continent of Laurentia. To the south of the margin stretched the Iapetus Ocean. The closing of Iapetus and continental collision deformed the continental margin into a mountain belt that is present today as the Appalachian Mountain Range. Preservation of the Paleozoic shelf facies and faulting provide the necessary ingredients such as reservoir, source, seal and trapping for hydrocarbon accumulations.

The St. George Group (Early Ordovician) & Port au Port Group (Mid-Late Cambrian) contain predominantly highly porous dolomite reservoirs, often karstified as in the Aquathuna Fm. (Port aux Port #1 well), Watts Bight and Catoche Formations. Labrador Group (Cambrian) contains the Hawke Bay Sandstones at deeper intervals. Other reservoirs contained within the Goose Tickle Group (Ordovician) are the Mainland Sandstones and the carbonates of the Daniels Harbour.

The Green Point Shale (Late Cambrian) is Type I (Marine) source with TOC values of 1.74% to 3.04% (C-NLOPB) but as high as 10% (Fowler 1995). The GPS has been fingerprinted to be source for both Parsons Pond oil seeps and PAP #1 oil well. Thickness average 50m plus and are mature when sampled in outcrop. Currently the GPS is being explored for Oil Shale by Black Spruce Energy (Shoal Point Energy). Another source is the Black Cove-Cape Cormorant shale (Mid-Ordovician) where in outcrop samples average TOC of 1.2% and as high as 8% TOC (Atkinson & Wright, 2006).

Black Cove Shales of the Goose Tickle Group (mid Ordovician) is a top seal in the foreland carbonate platform. Along with this formation there are several shales and evaporitic intervals throughout the offshore of the Anticosti Basin.

In the foreland basin of the carbonate platform the common trapping style are rotated and or inverted horsted fault blocks resulting from plate collisions. The fields will be normally faulted roll over closed features. Basement originated faults penetrate up to the Lourdes Limestone event but not through. All

of these structural styles are evident from 2D Seismic data consisting of about 5000 kilometers offshore. Further West in the Basin an extensive emerging stratigraphic sub-crop play of the carbonate platform may contain significant reserves resembling those within the Western Canadian Sedimentary Basin and North Sea. Within the Triangle Zone the common trapping mechanism is anticlinal stacked thrust sheets.

These ingredients resemble many of the current oil producing Paleozoic Basins along the Appalachia including the prolific Arkoma Basin where similar reservoirs have produced nearly a billion barrel of light crude since the discovery in 1928.

Onshore drilling for hydrocarbons in western Newfoundland (Parson's Pond) commenced in 1867 with production only achieving a few thousand barrels in total. Early exploration was concentrated around known surface oil seeps or shows and in more recent times structural highs observed through surface geologic mapping and seismic surveys.

During the 1990s several large companies (Mobil, Norcen, BHP, Hunt, Talisman, and Pan Canadian) explored for petroleum in the western Newfoundland onshore and offshore areas, along with other predominantly indigenously based junior companies. This exploration cycle included the acquisition of large regional seismic programs in the near-shore area and smaller onshore programs.

In 1995 Hunt Oil and partner Pan-Canadian Petroleum drilled the Port au Port #1 well at the Garden Hill area on the southwest corner of the Port au Port Peninsula – this was the first well location in western Newfoundland to be based on seismic. The well encountered several reservoirs and the Aquathuna Formation (at 3400 metres KB) flowed at 1528 and 1742 barrels of light crude (51 degree API oil) and 2.6 and 2.3 million cubic feet per day of natural gas, respectively, with water. An extended nine day test over one of the zones flowed a total of 5012 barrels of oil and 9.2 million cubic feet of gas during the test period. This significant test from the first modern well in the area created enthusiasm but additional drilling of four deep wells to test the same target zone in the immediate area only encountered shows and based on these results the majors departed Western Newfoundland. However today junior exploration companies continued to operate and explore in Western Newfoundland.

Within the Anticosti Basin Leprechaun Resources, along with its partners drilled the first well since the majors departed in 2009-2010. In early 2012 Ptarmigan Energy prepared to acquire a 1000 square kilometers of offshore 3D seismic data (the first for the Anticosti Basin) and drill a well by 2014. Shoal Point Energy had explored the Port aux Port region for oil shale in the Green Point Shale Formation and had plans to drill an additional four horizontal wells. In 2013 three large concessions were offered for bid by the government of Newfoundland. In early 2014 Black Spruce Energy acquired and consolidated all of the active offshore licenses and the associated commitments into one company.

Recently this exploration activity has been postponed while the CNLOPB (regulatory board) completes its Strategic Environmental Assessment (SEA) and an external review in October 2014 (after an internal review was inconclusive) of fracing within the Anticosti Basin.

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