

Geological Setting and Petroleum Potential of the Paleozoic Hudson Platform, Northern Canada

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Introduction

The Hudson Platform covers an area of 970,000 km² and represents one of the largest Paleozoic sedimentary basins in Canada (Sanford, 1987). The Hudson Platform encompasses parts of northern Manitoba, Ontario and Quebec, and southern Nunavut, with two thirds of the area covered by waters of Hudson Bay and James Bay. The Platform contains the large Hudson Bay Basin and the smaller satellite Moose River and Foxe basins to the south and north, respectively (Fig. 1). The Hudson Bay, Moose River and Foxe basins are surrounded and underlain by Precambrian metamorphic and intrusive rocks of the Canadian Shield. The northern limit of Hudson Bay Basin is the northwest-trending Bell Arch, characterized by a series of fault-bounded basement blocks that separates the Hudson Bay Basin from the smaller Foxe Basin. The Cape Henrietta Maria Arch, a broad positive basement structural element, separates the Hudson Bay and Moose River basins. The Hudson Bay Basin contains north-trending faulted basement uplift, called the Central Uplift or Mid-Bay Shoal.

The Hudson Platform is the least studied intracratonic basin in North America; its surface area rivals that of other intracratonic basins such as the Michigan and Illinois basins (Fig. 1) although it is characterized by a significantly thinner preserved sedimentary succession. The origin of the broad depression is still controversial and the central part of the Hudson Bay itself is interpreted to be the site of a major SW-NE suture zone between various Precambrian terranes (Eaton and Darbyshire, 2009).

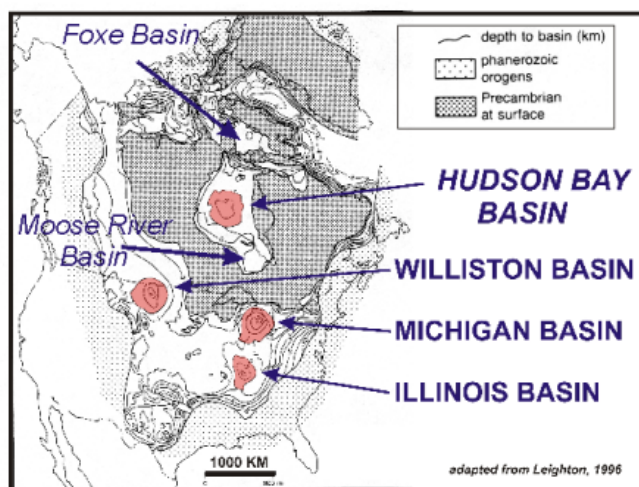


Fig. 1: General location of the Hudson Bay, Moose River and Foxe basins in North America.

Sedimentary Setting

The sedimentary succession of the Hudson Platform consists of gently dipping strata of Ordovician to Cretaceous age, with a maximum known preserved thickness of about 2500 m in Hudson Bay (Fig. 2). The Paleozoic succession includes Upper Ordovician to Lower Devonian shallow marine carbonates, reefs and thin mudstones with a thick succession of Upper Silurian evaporites, deposited during widespread Paleozoic marine inundation of the Canadian Shield. Lower to Upper Devonian marine carbonates, reefs, evaporites and mudstones deposited in saucer-shaped, isolated basin depocentres are recognized. There is no record of late Paleozoic sedimentation in the region (a hiatus of about 100 my), perhaps related to cratonic uplift accompanying the Alleghenian Orogeny. Paleozoic strata are unconformably overlain by thin, erosional remnants of Middle Jurassic and Lower Cretaceous nonmarine sandstones, mudstones and lignite seams (Moose River Basin) and Lower Cretaceous marine sandstones and mudstones (Hudson Bay Basin). The Mesozoic sediments were derived from uplifted areas of the Shield to the south.

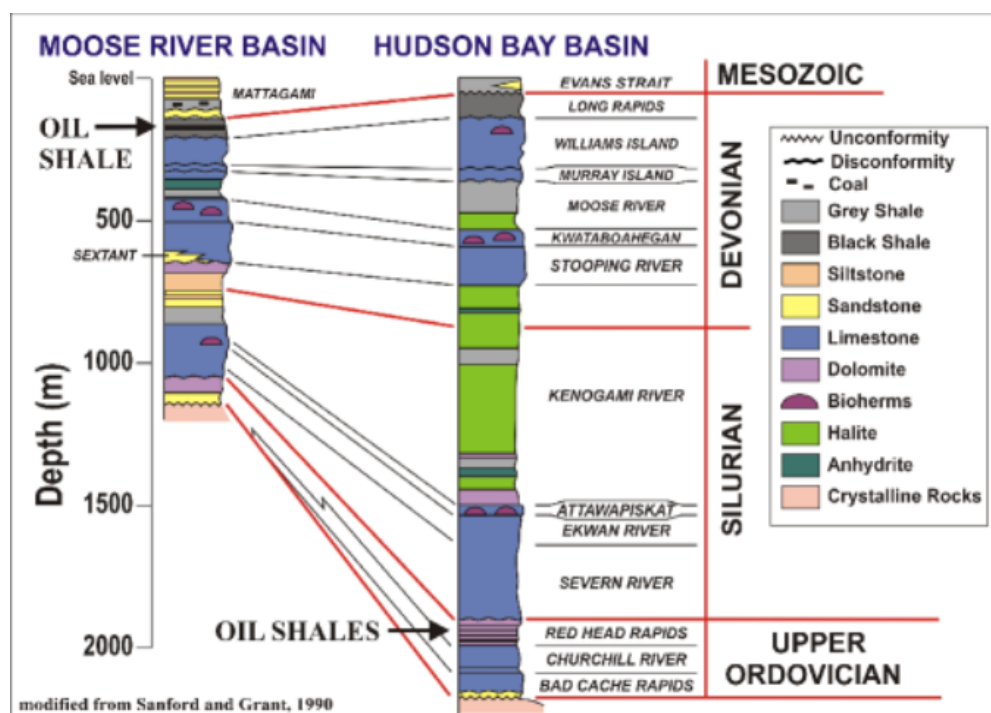


Fig. 2: Stratigraphic succession of the Hudson Bay Platform with the position of known oil shale at surface.

Hydrocarbon potential

The hydrocarbon potential of the Hudson Platform is poorly constrained and the area is currently viewed as a frontier prospect (Hamblin, 2008). In the first and only phase of exploration in the Hudson Bay itself, over 46 000 linear-km of low quality seismic were acquired and 5 exploration wells drilled. The seismic and drill holes were shot and spudded in a relatively small area in the central part of the bay (Fig. 3). A limited number of onshore wells have also been drilled in Manitoba and Ontario. Bitumen has been reported in some wells, however all the wells came up dry and the area deserted by the exploration companies in the 1980s.

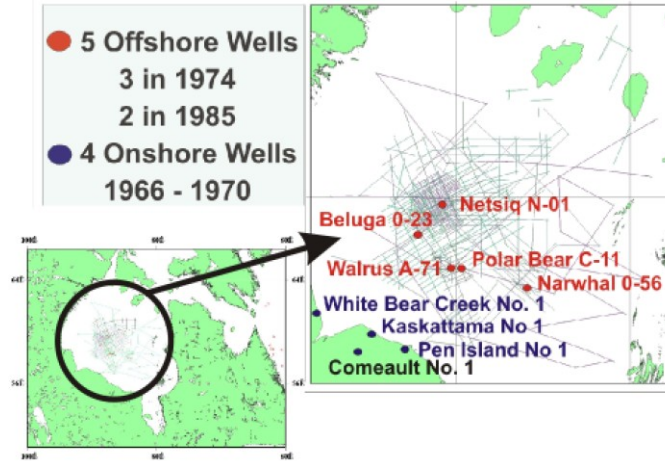


Fig. 3: Historical seismic coverage and well locations in the Hudson Bay Basin.

A modern re-evaluation of the petroleum systems and energy resource potential of the Hudson Bay Platform is the focus of a new Geological Survey of Canada research initiative. In the Hudson Bay Basin, many prospective petroleum reservoir and trap types, potentially including hydrothermal dolomite (Fig. 4), are suggested by geological and geophysical data. Recent stratigraphic and geochemical studies indicate Upper Ordovician oil shales (Fig. 2) are widespread and may have generated hydrocarbons in the deepest parts of the Hudson Bay Basin (Zhang, 2008). The stratigraphic record indicates two or more periods of uplift and erosion, an important consideration in evaluating thermal history of potential hydrocarbon source rocks. New high resolution bathymetric surveys in northern Hudson Bay have led to the recognition of circular sea-floor depressions similar to fluid escape pockmarks, possible evidence of hydrocarbon migration.

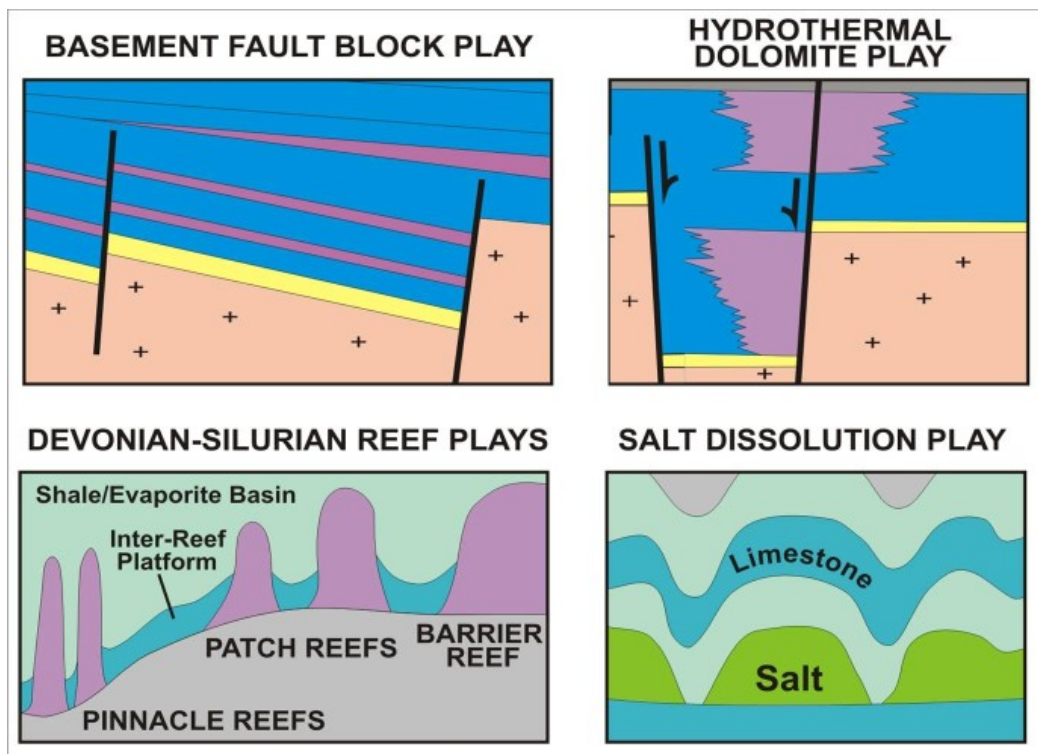


Fig. 4: Some potential hydrocarbon plays in the Hudson Platform

Conclusions

Over the upcoming years, new geological marine and onshore information will be acquired as well as new potential field data in strategic areas in order to upgrade our understanding of basin architecture and evolution. Modern geothermochronologic numbers will be acquired in order to determine the thermal history of the basin. The newly acquired geoscience will be integrated with historical data in the synthesis of hydrocarbon systems and plays leading to a modern resource assessment of this area and will eventually help in identifying areas with higher potential in this large sedimentary basin.

References

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