The Windsor Group: Overlooked Petroleum Potential Onshore Nova Scotia

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Since the middle of the last century, 100 petroleum wells have been drilled onshore Nova Scotia resulting in non-commercial, significant shows in about one-third of them while the same results have occurred in at least 68 wells drilled for other purposes. The major focus of past exploration has been in the Carboniferous Horton Group clastic rocks due to their similarity to the rocks of the Stoney Creek discovery in southeast New Brunswick. More attention is warranted for the overlying dominantly marine Windsor Group of rocks. A mere six shows have been reported in these rocks to date thus indicating the paucity of wells to evaluate this unit.

The Windsor Group is a regionally widespread unit up to 1000 metres thick. These rocks not only contain a diverse lithology but also display a wide range of structural and stratigraphic components which make it attractive for petroleum potential. A source rock study completed in 1991 concluded that the Windsor Group rocks are richer source rocks than originally thought, and contain greater reservoir potential due to the presence of a greater variety of possible trap combinations than contained in Horton Group rocks.

One area that was identified in the source rock study as having rich Windsor source rock potential is the St. Georges Bay of Nova Scotia. The source rock potential of the Windsor Group around Antigonish and Port Hood suggests that they are Kerogen Type II-IIl or II, lie within the "oil window" (0.5 to 1.3% R0) and are mostly depleted in hydrocarbons due to early generation. Therefore, they are mostly considered as oil-prone source rocks. Similarly, the Horton Group has potential source rocks of Kerogen Type II or II-IIl and because of higher maturity have potential for natural gas generation which can be trapped in Windsor reservoir rocks. The geological and geophysical work undertaken in this area over the last 2 years has resulted in the mapping of at least six separate salt-cored structures which have resulted from the flowage of thick Windsor Group evaporites. Reservoir development could occur on the crest and flanks of these structures capped by evaporites. Other structural and stratigraphic traps could occur adjacent to the salt-cored structures. Migration pathways could include northeast-striking faults, north-to-northwest striking faults and low angle thrust faults.

Within the Windsor Group, there are other areas of interest when exploring for petroleum including reefal buildups, brecciated and karst features, association with base metal deposits and unconformities which can provide the necessary components of a petroleum play.

The Deep Basin - Nineteen Years Later

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In 1978, Canadian Hunter announced that there existed in western Canada a fabulous resource of natural gas in the "Deep Basin". Initial estimates pegged potential gas resources at 440 TCF, with 150 TCF of that recoverable at what seemed, at that time, to be reasonable prices. Hunter mapped the bulk of the potentially recoverable resource in permeable, coarse-grained facies, mostly shoreline conglomerates. These lie within a huge package of fine-grained, low-permeability "tight sands", mostly Cretaceous in age, saturated with gas and lying downip of regional water.

In today's session, we will examine how these initial ideas about the Deep Basin have evolved over nineteen years of intensive drilling and geologic study.

The Deep Basin was originally seen simply as a dynamic balance between downdip gas generation and an updip "leaky seal" which lacked clearly defined physical properties, occurring over a limited area. The essential elements - gas downdip of water, anomalous pressures with respect to regional aquifers, and practically no water production - are now recognized to extend along the foothills front to the U.S. border and beyond. As papers in this session by Putnam and Surdam will demonstrate, we now see a greater range of fluid and pressure behaviors, and we have advanced our understanding of hydrocarbon entrapment in the Deep Basin.

Cretaceous stratigraphy of the Deep Basin has evolved tremendously in the past two decades. Even nineteen years ago, our knowledge of the deepest parts of the foredeep was quite limited by comparison with the overthrust belt to the west and the densely-drilled Plains to the east. Smith's 1984 maps were the first comprehensive reconstructions of Cretaceous paleogeography and deposition across the northern Deep Basin. Significant advances followed shortly thereafter, throughout the Cretaceous section and all along the Deep Basin trend. Most recently, several workers have applied sequence stratigraphic principles to interpret geologic histories far more detailed than possible before; some examples will be presented in this session.

Hydrocarbon resources of the Deep Basin fall far short of the optimistic projections of 1978, partly because low gas prices have prevented access to much of the gas. In the original Deep Basin area, governments recognize about 8.5 TCF of gas in place, of which 5.6 TCF are counted as established reserves. Higher prices and continued advances in geology and industry technology may yet prove the Deep Basin to be the giant originally envisioned.