Sequence stratigraphy and hydrocarbon potential of regional Upper Cretaceous limestone units, offshore Nova Scotia

R. Andrew MacRae, John W. Shimeld, and Hans J.B.W. Wielens
Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS B2Y 4A2

Two regionally widespread limestone units form important seismic markers beneath the Scotian Margin and the Grand Banks: the Upper Turonian–Coniacian Petrel Member of the Dawson Canyon Formation and the Upper Santonian–Maastrichtian Wyandot Formation. They are typically composed of intensely bioturbated, fine-grained, coccolith-dominated limestone (chalk) with minor amounts of other lithologies, and vary in thickness from a few metres to 400 metres.

Most information about the Wyandot Formation is from drill cuttings, seismic, and wireline data. Only four wells on the Scotian Shelf have conventional core: Eagle D-21, and Primrose F-41, A-41, and 1A A-41. Based upon the cores, trace fossils are dominated by *Zoophycos*, *Thalassinoides*, and *Chondrites*, and are typical of a deep shelf environment below storm wave base, an interpretation also probably applicable to most of the Petrel Member.

Given the significance of similarly-aged chalk reservoirs worldwide (e.g., the Austin Chalk of the Gulf of Mexico and Chalk Group of the North Sea), the hydrocarbon potential of these units as source and reservoir warrants careful evaluation. Significant gas was discovered in the Wyandot Formation on the Scotian Shelf at the Primrose and Eagle structures, and smaller gas shows were tested in the Sable Island E-48 well. There are wireline indications of potential hydrocarbons in other wells. Organic geochemistry indicates TOC as high as 14% in the Wyandot Formation (South Venture O-59) and hydrogen indices from negligible to as high as 493 (Louisbourg J-47). Data from the Petrel Member are less promising. At some well locations (e.g., Venture B-43 and B-52), vitrinite data indicate that both units are in the oil window. Oxygen indices are generally high, suggesting that kerogens are oxidized — consistent with the degree of bioturbation seen in core.

The Petrel Member and Wyandot Formation have been interpreted by several authors as the product of pelagic carbonate sedimentation during maximum transgression and minimal siliciclastic input to shelf environments. Much of the evidence is consistent with this interpretation, but lateral variations in thickness and lithofacies from well and seismic interpretation suggest development of other facies and significant unconformities within and on top of the limestone units.