

1D and 2D petroleum system modelling of potential Lower Jurassic source rock on the Scotian Margin, offshore Nova Scotia, Canada

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The Scotian Basin is a passive margin with an area of approximately 280 000 km². Five potential Mesozoic source rocks intervals (Aptian, Valanginian, Tithonian, Callovian and Early Jurassic) have been identified in the Scotian Basin. However, the Early Jurassic source interval has never been penetrated by drilling and is inferred from the Moroccan and Portuguese conjugate margins. The characteristics of the Lower Jurassic source rock have large uncertainty. Building 1D and 2D models can reduce these uncertainties and lower the risk in hydrocarbon exploration.

In this study, 28 1D models and four 2D models were created and analyzed in PetroMod™ (Schlumberger). Compared to previous models of the petroleum systems for the Scotian Margin, our 1D models have greater lithostratigraphic resolution and these results are incorporated into the formulation of the 2D models not previously completed along the margin. The high resolution of lithostratigraphy is based on the extensive well cuttings database provided by Canadian Stratigraphic Services and correlated with seismic and well data. The 1D models show the impact of salt structures on thermal maturity. The wells within salt diapiric area of the central Scotian Margin have higher temperature and higher source rock maturity.

The 2D models are based on dip lines of the ION NovaSPAN™ geophysical dataset (NVR1-5100, NVR1-5400, NVR1-5420, and NVR1-5300). Variable source rock properties (Hydrogen Index and Total Organic Carbon) were incorporated reflecting the potential range that may be encountered during deposition and subsequent maturation of organic-rich intervals along the Scotian margin. The transformation ratio is related to the Hydrogen Index (HI) number with higher numbers giving to a higher transformation ratio, and the potential for the formulation of oil. These source rock properties are based on the data from the High and Middle Atlas basins of Morocco. Our results suggest the potential Lower Jurassic source rocks have different ranges of maturity in the Scotian Basin and are within the oil window in the north and transition to the gas window in the south.