Quantifying the Risk on Source Rock Occurrence and Quality with Forward Stratigraphic Modeling — Carson Basin, Canada

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Abstract

Over the past years, Forward Stratigraphic Modeling (FSM) has evolved from an academic and R&D discipline to a mature and efficient tool answering many of the oil and gas industry needs. Initially dedicated to modeling the transport and deposition of clastic and carbonate sediments, FSM now also gives the possibility to simulate the production, degradation, and preservation of organic matter to ultimately predict the presence and quality of organic-rich sediments. This technology has been applied to the Carson basin, located Offshore Newfoundland in Canada, which is a promising frontier area for hydrocarbon exploration. In this mixed sedimentary basin linked to the Atlantic Ocean opening, all the wells are located on the platform, giving very little data to properly characterize the deeper part of the basin where the hydrocarbon kitchen is. FSM was thus used to identify potential source rocks in the area. In this workflow, the primary production of marine organic matter is simulated according to the distance to shore and potential upwelling, as well as its transport throughout the basin. The preservation of this organic matter is computed through the Martin law, linking the degradation of the organic matter in the water column with the oxygen content. The result of this process gives the initial organic content and hydrogen index of all sedimentary layers in the basin and allows identifying the quality and extension of the main source rocks. In this study, Jurassic, Kimmeridgian, Tithonian, and Aptian source rocks were defined and characterized in terms of richness. As almost no data was available for calibration, the uncertainty on these results was relatively high. To

quantify this risk, a response surface based regional uncertainty analysis was performed to measure the impact of the main parameters driving the production, transport, and degradation of the organic matter on its final distribution and preservation. The results of the Kimmeridgian source rock analysis will be presented and discussed. We will see that these regional risk and sensitivity analyses provide relevant and quantified probability maps, critical for the reduction of the exploration risk in such frontier area.