Hydrocarbon Contribution from the Lower Bakken Shale in Horizontal Wells Drilled in the Three Forks Formation in Divide County, ND

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Abstract

In recent years the Upper Bench of the Three Forks formation has proven to be a prolific development target in Divide County, North Dakota. Near the US/Canada border the Upper Bench is characteristic of properties demonstrating good reservoir quality. However, the interval is relatively thin (5-15’) compared to producing intervals in the basin center (in excess of 30’). Given the moderate thickness of this zone and current production ranges seen to date, the recovery factor appears to be anomalously high compared to other analogous unconventional reservoirs. The underlying Middle Bench of the Three Forks reservoir may contribute to some minor extent but typically exhibits properties characteristic of much lower reservoir quality. Geochemical data collected from cuttings in the Lower Bakken Shale, directly above the upper bench of the Three Forks suggest that the shale is in the early stages of oil generation. The focus of this study is to test the hypothesis that a significant proportion of the production from horizontal wells targeting the Upper Three Forks Formation comes from the overlying Lower Bakken Shale. An attempt to demonstrate this is made through the interpretation of ion milled SEM images, comparison of isotope analyses of produced oils and Upper Bench extracts to that of Lower Bakken Shale samples, modeling of mechanical rock properties to derive a fracability index of the interval, and integration of geologic mapping from wireline logs, core data, and capillary pressure data. This study not only provides insight into the specific intervals contributing to hydrocarbon production in Three Forks wells in Divide County, but also provides a model for oil production contribution from source rocks adjacent to reservoirs in horizontal unconventional oil plays.