

Breaking Open the Bakken: A Data Analytical Approach

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Abstract

The Williston Basin is in the mature period of its, and operators reaped the benefits of extracting hydrocarbons from multiple intervals throughout its stratigraphy. Data analytics help provide a framework to determine how much resource remains in the basin, where there is room for maintenance activities, and what areas are better left untouched. The Williston is an intracratonic basin that spans an area of 250,000 km² across Manitoba, Saskatchewan, North Dakota and Montana. Its deepest extent is centered in McKenzie County, North Dakota. Operator activity in the basin is focused on the Late Devonian to Early Mississippian Bakken petroleum system, with the Middle Bakken Formation as the main target reservoir. Characterized by variable lithology ranging from dolomitic siltstones to fine-grained sandstones, this formation is bounded by the carbon-rich darkshales of the Upper and Lower Bakken Members. The Three Forks Formation below the Lower Bakken also acts as a reservoir in this petroleum system, characterized by a mix of carbonate, siliclastic and evaporitic units. This study utilizes machine learning in combination with geological, completions and historical production data to delineate the boundaries of Bakken and Three Forks prospectivity. Using a random forest regression analysis, geological, completions and spacing attributes were input into a model where the target variable was lateral-normalized oil EUR. The analysis showed geological parameters with the most influence on the target variable were resistivity, depth and thickness. As a result of the evaluation, which involved an integrated map of all parameters with diagnostic cut-offs applied, it was determined that the most promising acreage positions are in McKenzie and Dunn counties in North Dakota. In addition, the boundaries of core prospective reservoir were delineated in both the Middle Bakken and the Three Forks formations, providing

insight into expectations of prospectivity for those intervals as interest moves to fringier areas of the basin. This mature basin continues to produce at a market level that is competitive with other popular plays across the lower 48. Utilizing data analytics as a diagnostic tool can help maintain and prolong the productive life cycle of this basin for years to come.