

Mechanical Stratigraphy of the Bakken Formation: Influence on Fracture-Controlled Production, Williston Basin, Mountrail County, North Dakota

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The Bakken Formation is a naturally fractured reservoir within the Williston basin of North Dakota and Montana. It consists of Upper Devonian-Lower Mississippian carbonaceous shale, dolomitic siltstone and fine-grained sandstone with low average porosity (3 to 5 percent) and permeability (0.01-0.05md). The extremely low matrix permeability is enhanced through natural fractures. Natural fractures can develop at numerous scales and in response to a variety of mechanisms. The focus of this study is to determine: 1) the cause of natural fractures in the Bakken, 2) the relationship of fractures to facies, 3) the impact of fractures on oil production, and 4) fracture density using multicomponent 3-D seismic data.

The study area is roughly 900 square miles and encompasses the highly productive Parshall and Sanish fields. During this study I conducted detailed analysis on 13 cores to identify facies of the middle Bakken Formation, followed by identification of the quantity and type of natural fractures in each facies to determine the relationship of fractures to facies. I mapped the areal distribution of facies by tying the core-derived facies to geophysical well log characteristics. Finally, I used multicomponent 3-D seismic attributes to identify fracture density within the Bakken.

The middle Bakken member can be divided into six main facies based on lithology, grain size, sedimentary structures, and trace fossils. Each facies identified in the core was correlated to its associated well log characteristics to provide a model for identifying facies when no core data are present. The highest density of natural fractures occurs in the middle Bakken in the two uppermost facies due to the mechanical stratigraphy of these units. Mapping the fracture density within these units with multicomponent seismic data is potentially feasible with high quality 9-C seismic data.