QUANTITATIVE MINERALOGIC ANALYSIS OF THE MIDDLE BAKKEN MEMBER, PARSHALL FIELD, MOUNTRAIL COUNTY, NORTH DAKOTA

by

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A thesis submitted to the Faculty and Board of Trustees of the Colorado School of Mines in partial fulfillment of the requirements for the degree of Master of Science (Geology).

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Date 01 Nov. 10

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ABSTRACT

The Bakken Formation of the Williston basin has become a very important unconventional play in the Rocky Mountain region. It is a low-permeability system that has produced a total of 2.6 billion barrels of oil. The USGS has estimated that there is 3.65 billion barrels of undiscovered technically recoverable oil remaining within the Bakken Formation. Exploration and development of the middle Bakken began in Montana in 2001 and expanded in North Dakota with EOG Resources discovery of Parshall field in 2006.

The Bakken Formation is made up of three units: upper and lower organic-rich shales, and a highly variable middle member which is comprised of interbedded siltstones and sandstones. The middle member serves as the primary reservoir and has low matrix porosity and permeability. Porosity ranges from 2-12% with permeability averaging 0.02 millidarcies.

This study utilizes a new approach to assess the impact of mineralogy and microfractures on fluid flow by integrating mineralogy and porosity analysis using SEM-based mineralogy analysis on two drill cores from Parshall Field, North Dakota. Due to the high resolution (30 μm and 2 μm) even the smallest fractures and pore spaces can be detected.

Quantitative mineralogy shows that the Middle Bakken Formation within Parshall Field consists of silt- to sand-sized grains of 14.9-65.6 % quartz, 2.8-49.1% dolomite, 0.9-76.0% limestone, and 1.9-10.1% feldspar with minor amounts of clay. This indicates marine depositional environment with water depths ranging from shallow (within wave base and tidal influence) and deep neritic.

Results of quantitative mineralogy analysis show that there is a relationship between mineralogy and porosity/fracturing. Porosity is found in areas where there is a high percentage of quartz and dolomite grains and where the mineralogy is homogeneous in distribution and grain size. Porosity is not found in areas where authigenic cements

and clays are occluding the pore space. Fracturing occurs along planes of weakness such as in zones with a high clay percentage.

This study demonstrates that the use of SEM-based mineralogy analysis, used in conjunction with thin section and XRD analysis can be powerful tools in determining if there is a relationship between mineralogy and porosity/fracturing. It is also a powerful tool in characterizing lithofacies and developing a relationship to diagenesis.

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