# INTEGRATED LITHOFACIES CHARACTERIZATION AND INTERPRETATION OF DEPOSITIONAL ENVIRONMENT OF THE BAKKEN PLAY IN THE WILLISTON BASIN, NORTH AMERICA

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Abstract

The utility of different petrophysical and chemostratigraphic approaches to shale lithofacies classification will be examined and evaluated with examples from the Mississippian-Devonian Bakken play in the Williston basin of North Dakota. The proposed study will demonstrate applications of core and advanced well logs on computing general log based stochastic multi-mineral solutions to build detailed lithofacies model and integrate with chemostratigraphy to better decipher depositional and diagenetic controls on mineral composition, pore development and organic matter content in the shale members, which play a significant role in hydrocarbon production.

Relations among trace element geochemical data and total organic carbon (TOC) coupled with well log derived solutions will be explored to understand vertical and areal heterogeneity of the shale members, in terms of paleo-redox condition and productivity. A comprehensive methodology based on mineralogy and TOC derived from log and core data will be proposed for depositional and/or diagenetic facies classification in the Bakken mudstone units. Moreover, electron microscopy will be performed to classify different pore facies and build a stratigraphic column of the Bakken interval based on pore structure, geometry and its relation to mineralogy and TOC. Preliminary results show that Bakken shale members are heterogeneous, in terms of mineralogy, pore type and TOC, which can be classified as five different lithofacies, reflective of changes in depositional and diagenetic environment. Highly organic-rich shale facies (TOC>12 wt%) units are interpreted to be deposited in euxinic (highly sulphidic oxygen-depleted) environment, whereas relatively organic-poor shale units (TOC<12 wt%) were deposited in anoxic and dysoxic conditions.

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