

Petrophysical Properties of the Tight Bakken Reservoirs, Southeastern Saskatchewan, Canada

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Abstract

The Bakken play is a tight oil resource play that has been a major drive for exploration and development in the southeast Saskatchewan since 2005. The Bakken reservoir in southeast Saskatchewan was considered as tight reservoirs with low permeability. The main lithology consists of siliciclastic siltstone with mixture of carbonate rocks. A proper description of the petrophysical parameter (e.g. porosity, permeability, and pore throat) is critical for design and implement the production strategies.

Traditional petrophysical analytical methods (e.g. mercury injection capillary pressure analysis), however, would not be able to fully characterized Bakken reservoirs because of its low permeability and small pore throat. In this study, isotherm analyses were performed on selected Bakken samples from southeast Saskatchewan. This new method would allow us to characterize pore throat in nano meters. The porosity and permeability of these samples were measured under the different pressure conditions in order to calculate porosity and permeability under actual geological environment.

Our analyses show that Bakken reservoirs have excellent porosities from 7% to 22%; their permeability, however, was extremely low. Ten of 12 samples have permeability from 0.002 to 0.16 ($10^{-3}\mu\text{m}^2$). Ten samples were analyzed for isotherm with multi-point BET method and BJH method in this project. Although there are large variations in pore diameter from 2nm to 1100nm, the average pore size for each sample is in 3-4 nm range. Such a small pore size explains the corresponding extremely low permeability, 0.002 to 0.16 ($10^{-3}\mu\text{m}^2$).

The porosity and permeability of Bakken reservoirs are closely related to and/or controlled by lithofacies. Dolomitic rocks generally have higher porosity and permeability than other lithofacies. Dolomitic fine sandstone has the highest porosity and permeability but it occurs as localized thin layers in the Middle Bakken. Dolomitic siltstone and silty wackestone have good porosity but very low permeability. Mud-siltstone and mudstone generally have low porosity as well as low permeability. To our surprise, bio-oid grainstone has the lowest porosity and permeability due to well-developed calcite cements.