

The Giant Continuous Oil Accumulation in the Bakken Petroleum System, Williston Basin

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Abstract

The Williston Basin Bakken petroleum system is a giant continuous accumulation. The Petroleum System is characterized by low-porosity and permeability reservoirs, organic-rich source rocks, and regional hydrocarbon charge. Total Bakken and Three Forks production to Dec. 2014 is 1.289 billion barrels (BBO) and 1.3 trillion cubic feet of gas (TCFG) from 12,051 wells. USGS (2013) mean technologically recoverable resource estimates for the Bakken Petroleum System is 7.375 billion barrels oil, 6.7 TCF gas, and 527 million barrels of natural gas liquids.

The Bakken Formation regionally in the Williston Basin consists of four members: upper and lower organic-rich black shale; a middle member (silty dolostone or limestone to sandstone lithology); a basal member recently named the Pronghorn. The Bakken Formation ranges in thickness from a wedge edge to over 140 ft with the thickest area in the Bakken located in northwest North Dakota, east of the Nesson anticline.

The Three Forks is a silty dolostone throughout much of its stratigraphic interval. The Three Forks ranges in thickness from less than 25 ft to over 250 ft in the mapped area. Thickness patterns are controlled by paleostructural features such as the Poplar Dome, Nesson, Antelope, Cedar Creek, and Bottineau anticlines. The Three Forks can be subdivided into three units. Most of the development activity in the Three Forks targets the upper Three Forks.

The upper and lower shale members are potential source rocks and are lithologically similar throughout much of the basin. The shales are regarded as dominantly Type II kerogens. The shales average 11 weight percent total organic carbon.

Measured core porosity and permeability are very low in the Bakken, Sanish, and Three Forks reservoirs (<10% porosity and <0.1 md permeability) in the Williston Basin so productivity is assumed to be due to natural and artificial fracturing. The reservoirs generally require advanced technology to get them to produce (fracture stimulation and horizontal drilling). For this reason they should be considered to be: technology reservoirs.

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