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Introduction to the Bakken Formation, U.S. and Canada (or How Far Does the Fairway Fly?)

The Bakken Formation is one of the oldest producing formations in the Williston Basin. Bakken oil was discovered in Antelope Field, North Dakota, in 1953, only 2 years after the Williston Basin discovery well. A Bakken well opened Elkhorn Ranch Field, Billings County, North Dakota in 1961. Production was established from a middle member Bakken sand in Rocanville Field, Saskatchewan in 1957. Montana's first Bakken producer came in 1970, in Salt Lake Field. Bakken production was established at a depth of only 3100' (955m) in Daly Field, Manitoba from a middle member Bakken sand in 1985. To date, the formation has produced over 21 million barrels of oil from the two states provinces.

Shows in the Bakken have been ubiquitous throughout the basin in the quest for deeper reservoirs, but largely ignored until the recent horizontal drilling boom. It is the authors' opinion that the Bakken has been ignored because of a lack of understanding of this tight shale reservoir, especially regarding formation damage to fracture systems, rather than a lack of actual potential.

A regional well log study of the Bakken was begun in 1985 by the authors in Richland County, Montana and Billings, Golden Valley, and McKenzie Counties, North Dakota, along what is now being labeled the "Bakken Fairway". A study of successful vertical Bakken completions along this "fairway" indicates a combination of resistivity log analysis and drill stem test pressure data can be used to identify naturally-occurring fractured reservoirs in the Bakken.

Wide separation between the Microspherically Focused Log (MSFL) and Deep Resistivity Laterolog within the Bakken Shale is an indication of formation damage. This damage occurs when overpressured, salt-based mud is injected into naturally-occurring fracture systems during drilling operations. Drill stem tests in the Bakken often record abnormally high increases of shut-in pressures (5000-7000 psi FSIP) when a well has encountered a naturally-occurring fractured reservoir.

Numerous cases exist of potentially productive Bakken wells in both Montana and North Dakota which have been passed up for deeper reservoirs or completely plugged and abandoned. Much of this formation damage could have probably been "cleaned up" with a moderate artificial fracture treatment, at a lot cheaper cost than drilling a horizontal well. To date, the best Bakken producer along the "Fairway" is a vertical well which has produced over 300,000 barrels of oil (BO) since its completion in 1985, and was still flowing 170+ BOPD as of the end of January, 1990.

An additional result of this regional Bakken study was the evaluation of the middle member Bakken siltstone as a reservoir itself. In some places, porosity within the middle member increases to greater than 10%. Log calculations within the middle member reveal a regional increase in water saturations as one goes downdip along the fairway. What is now being used as the downdip limit of the Bakken "fairway" corresponds well with a 50% water saturation line in the middle Bakken member.

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