

# THE DEPARTMENT OF MINERAL RESOURCES ASSESSMENT OF THE BAKKEN FORMATION

By Ed Murphy

On the first day of the 16th Annual Williston Basin Petroleum Conference and Prospect Expo (April 27, 2008) and before a crowd of 1,400 people, Lynn Helms (Director of the ND Department of Mineral Resources) released the results of the DMR's assessment of the oil potential of the Bakken Formation in North Dakota. Lynn announced that the DMR had determined the North Dakota portion of the Bakken Formation contains up to 167 billion barrels of oil (oil in place) and approximately 2.1 billion barrels of that oil (the estimated ultimate recovery) can be produced using early 2008 technology (Bohrer and others, 2008). The 2.1 billion barrels of estimated ultimate recovery represents only 1.4% of the original oil in place (167 billion) and is likely to increase with future advances in drilling and completion technology (fig. 1).

The Bakken Formation can be easily split into three basic lithologies. The Middle member is a dolomitic sandstone or siltstone that is sandwiched between upper and lower black, organic-rich shales (known as the Upper and Lower shales). The Bakken vertical well play in the late 1970s and the horizontal play in the early 1990s both targeted the Upper shale. In the 1990s, available technology limited the length of the horizontal legs to a few hundred feet.

Technological advances since then have pushed horizontal lateral lengths to 10,000 feet and companies have been completing the horizontal wells in the Middle Bakken during this horizontal play. Anyone who has looked at rock cores of the Bakken Formation in North Dakota understands why the percentage of oil currently being produced is so low. The general consistency of the Middle member is often likened to concrete (fig. 2). This is why oil companies are spending millions of dollars per well to fracture the Middle member and the shales thus enabling a small fraction of the oil to flow into the well bore. In contrast, ultimate recoveries from carbonate reservoirs in the Mission Canyon Formation in the Williston Basin typically range from 20-40% of the oil in place.

The DMR assessment estimated the amount of oil that is currently present in the Bakken Formation and the amount of oil we could produce using current technology. What we did not estimate was the amount of oil that had been generated in the Bakken Formation over time or what is called the generated oil. Several previous studies had done so with values ranging from 10-500 billion barrels (Dow, 1968; Webster, 1984; Schmoker and Hester, 1983; Price, unpublished; Meissner and Banks, 2000; Flannery and Kraus, 2006). In many circles, the best known of these reports is, ironically, the one that was never published - the paper by Leigh Price. Price estimated the Bakken had generated between 271 and 503 billion barrels of oil, but died before his paper went through final review at the US Geological Survey.

Two weeks prior to the conference, on April 10th, the US Geological Survey released the results of its assessment of the Bakken Formation. The USGS assessment team estimated that the Bakken Formation contains 3.6 billion barrels of undiscovered producible or recoverable oil resources in the Montana and North Dakota portions of the Williston Basin (Pollastro and others, 2008). They also estimated that 1.8 trillion cubic feet of gas and 150 million barrels of natural gas liquids could be produced from the Bakken using current technologies. The USGS Bakken assessment is the largest it has ever undertaken in the lower 48 states and the largest continuous oil accumulation they had ever assessed.

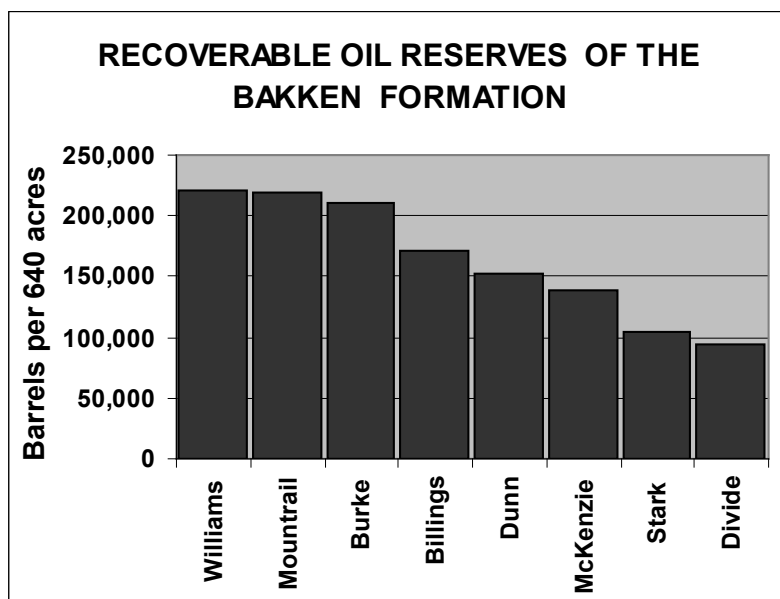


Figure 1. The mean values of the estimated ultimate recovery (EUR) of oil from the Bakken Formation as determined by the DMR assessment (Bohrer and others, 2008). The DMR assessment calculated EUR and original oil in place for each of the three Bakken members on a county by county basis to make the numbers as accurate as possible and easier to update in the future.

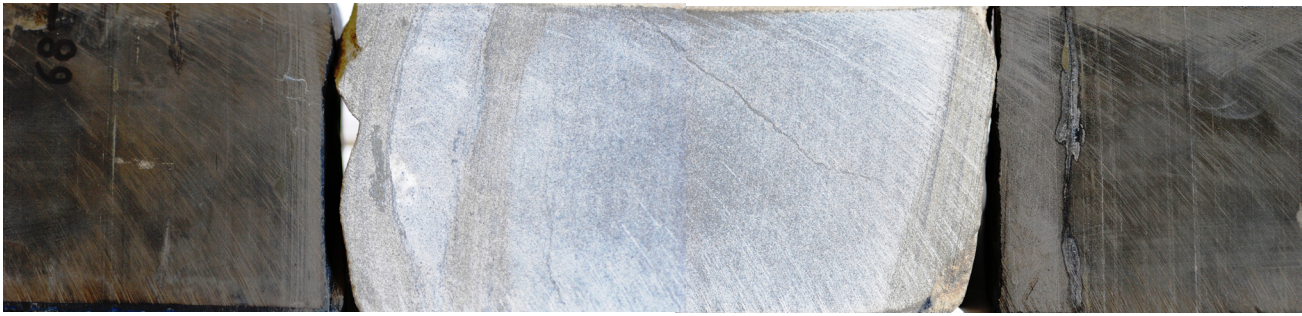


Figure 2. Left to right: Segments of core from the Upper shale, Middle member, and Lower shale of the Bakken Formation in North Dakota. Core of the Middle member is six inches long. Each of the shales has a maximum thickness of about 60 feet and the Middle member a maximum of 90 feet.

The results of the DMR and USGS assessments come surprisingly close given that they were done independent of each other using somewhat different data and very different assessment techniques. I recalculated the USGS Bakken estimate based upon the segments of their assessment units that are within North Dakota and arrived at 2.6 billion barrels of oil. You could argue that 2.6 and 2.1 billion barrels are almost 20% apart, but we were relieved that the results were the same order of magnitude given the number of educated assumptions that these assessments require. In addition, we were well aware that a 1995 USGS assessment of the Bakken concluded that it contained only 151 million barrels of producible oil. Of course, that assessment was completed at a time when horizontal drilling and fracturing techniques were not as advanced as they were in 2008.

Judging from the newspaper stories, journal articles, and television and radio interviews, it is safe to say that both of these assessments brought more attention to the Williston Basin than we have seen since the discovery of oil in the Clarence Iverson no. 1 in 1951, a distant second being the original horizontal play in the upper Bakken shale during the early 1990s. Just the announcement on April 8, 2008 that the USGS Bakken assessment would be released later that week generated a number of front page newspaper articles across the country. That led one website, specializing in investment opportunities in the energy sector, to lead with an editorial entitled “Less than 48 Hours Left to Get a Piece of the Bakken.” By happenstance, the release of the DMR and USGS Bakken assessments were perfectly timed for maximum impact on the industry. The rising price of crude oil, coupled with some exceptionally good Bakken wells in Mountrail County, already had a number of energy companies and investors looking at the Bakken. It appears that the results of these assessments spurred some of these people to act.

While the USGS producible oil number is the one most frequently quoted in the media, based upon the inquiries to our office from investors and investment houses throughout the world, the results of both of these assessments have brought a significant amount of venture capital into North Dakota, likely measured in the billions of

dollars. This venture capital has come in a variety of forms, including increased leasing interest, which translated into higher average lease bonuses, companies either locating or expanding offices in North Dakota, investment in local companies, and company acquisitions to gain a foothold in the Bakken play.

## References

- Bohrer, M., Fried, S, Helms, L., Hicks, B., Juenker, B., McCusker, D., Anderson, F., LeFever, J., Murphy, E., and Nordeng, S., 2008, Bakken Formation Resource Study Project: North Dakota Department of Mineral Resources Report, 23 p.
- Dow, W.G., 1974, Application of oil-correlation and source rock data to exploration in Williston basin: American Association of Petroleum Geologists Bulletin, v. 58, p. 1253-1262.
- Flannery J. and Kraus, J., 2006, Integrated analysis of the Bakken petroleum system, U.S. Williston basin: American Association of Petroleum Geologists Search and Discovery Article no. 10105.
- Meissner, F.F. and Banks, R.B., 2000, Computer simulation of hydrocarbon generation, migration, and accumulation under hydrodynamic conditions – examples from the Williston and San Juan Basins, USA: American Association of Petroleum Geologists Search and Discovery Article no. 40179.
- Schmoker, J.W. and Hester, T.C., 1983, Organic carbon in the Bakken Formation, United States portion of Williston basin: American Association of Petroleum Geologists Bulletin, v. 67, no. 12, p. 2165-2174.
- Pollastro, R.M., Cook, T.A., Roberts, L.N., Schenk, C.J., Lewan, M.D., Anna, L.O., Gawirth, S.B., Lillis, P.G., Klett, T.R., and Carpentier, R.R., 2008, Assessment of undiscovered oil resources in the Devonian-Mississippian Bakken Formation, Williston Basin Province, Montana and North Dakota: U.S. Geological Survey Fact Sheet 2008-3021, 2 p.
- Webster, R.L., 1984, Petroleum source rocks and stratigraphy of the Bakken Formation in North Dakota, in Woodward, J., Meissner, F.F. and Clayton, J.L., eds., Hydrocarbon source rocks of the Greater Rocky Mountain Region: Rocky Mountain Association of Geologists, Denver, CO, p. 57-81.