Integrated Assessment of the Niobrara and Mowry Shale Plays, Powder River Basin, Wyoming*

Yanet Cuddus¹, Dave Phillips¹, Celina Will¹, Lee Swager¹, William Ray Moore Jr. ¹, Midowa Gbededo¹, Yanil Del Castillo¹, and Matthew Belobraydic¹

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¹Schlumberger, Houston, TX, United States (YCuddus@slb.com)

Abstract

Over the last 10-years, numerous unconventional resources have become economically viable with advancements in horizontal drilling and completion technologies. The Powder River Basin experienced a 3500% increase in drilling during the 2007-2012 period, particularly for horizontal drilling of the Niobrara Shale formation. The Mowry Shale is an organic-rich play and indicates a promising potential based on other shale play analogs. Exploration of the Mowry was delayed due to the 2015 downturn, therefore limited production data is available today. As the market rebounds, the basin has been revitalized with 21,000 permits currently awaiting approval and almost 3,000 permits ready for drilling. Due to the market interest in the Powder River Basin and the limited understanding of optimized drilling and completion techniques to transform the Niobrara and Mowry to prolific plays, this study aims to add to the basin-wide understanding of these shale plays to support the forecasted increase in production activity. This multiple-disciplinary research utilizes core analysis and well log interpretations over the entire basin to understand the spatial distribution and geometry of the Niobrara and Mowry shale reservoirs. Rock properties were calibrated to wireline logs and core data, upscaled, and distributed to generate a geostatistical 3D model. This 3D basin assessment model is calibrated to production results for basin reservoir characteristics and predictions. The resulting model is a tool that can help identify valuable play areas for future exploration and a reference to help mitigate potential risks associated with drilling and completions.
References Cited


Kenny, R. et al. Reservoir Quality and Stratigraphy of the Frontier to Dakota Interval of the Power River Basin, a Core Log Seismic Exercise. in (Unconventional Resources Technology Conference, 2016).
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Summary

• Production drivers are not singularly tied to hydrocarbon pore volume

• Well performance corresponds to facies and mineral distributions

• Advancements in completion design have driven production increases
3000% increase in horizontal well performance

Month of First Oil Production

- B3 oil horizontal (1,506 wells)
- B3 oil vertical (1,611 wells)
- Moving average
Last seven years of horizontal drilling activity

All Formations
B3 Oil per vintage

Niobrara
B3 Oil per vintage

Niobrara horizontals per vintage

Niobrara Type curves
Shale reservoir characterization

Niobrara Shale

Campanian (87 to 82 Ma)

Carbonate
Mature source rock
Major producer
Type II kerogen
TOC ~2-4%

Thickness ~ 300 ft.

Low porosity (<10%)\(^1\)
Low perm (<0.01 md)\(^{1,2}\)

Mowry Shale

Cenomanian (98.5 to 93.5 Ma)

Clastic
Immature source rock
Not a major producer
Type I kerogen
TOC < 5%
Abundant bentonites
Thickness ~ 200 ft.

Low porosity (<2-8%)\(^3\)

\(S_w\) avg 64%
(range from 55-75%)\(^3\)

\(^1\) Sonnenberg, 2018
\(^2\) Taylor, 2012
\(^3\) Kenny et al., 2016
Basin-scale multidisciplinary research

01 Data audit Organization
02 Core Wells Production
03 Petrophysics Geology Engineering
04 Geomodeling
05 Advanced workflows and results
Reservoir quality tied to well performance
Summary

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Citations


3 Kenny, R. et al. Reservoir Quality and Stratigraphy of the Frontier to Dakota Interval of the Powder River Basin, a Core-Log-Seismic Exercise. in (Unconventional Resources Technology Conference, 2016).