

## **The Unconventional Three Forks Formation of Williston Basin, USA**

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\*Please refer to closely related presentation, the adaptation of which is posted on Search and Discovery [Article #110153 (2011)].

([http://www.searchanddiscovery.com/documents/2011/110153sonnenberg/ndx\\_sonnenberg.pdf](http://www.searchanddiscovery.com/documents/2011/110153sonnenberg/ndx_sonnenberg.pdf))

The upper Three Forks is evolving into a significant resource play in the Williston Basin. Although Three Forks production was established in Antelope Field in 1953, the play has re-emerged because of the horizontal drilling and multi-stage fracturing technologies. The upper Three Forks can be subdivided into three main facies: a) massive to chaotic bedded dolostone; b) interbedded dolostone with green mudstones; c) bioturbated dolostone to sandstone. The bioturbated sandstone and dolostone is referred to as the Sanish. The units represent an overall transgressive sequence ranging from upper intertidal/supratidal to subtidal. A regional marine (?) dolomitic mudstone unit (basal seal) underlies the upper Three Forks. A regional unconformity separates the upper Three Forks from the Bakken Formation. Thinning of the Three Forks occurs towards the flanks of the Williston basin.

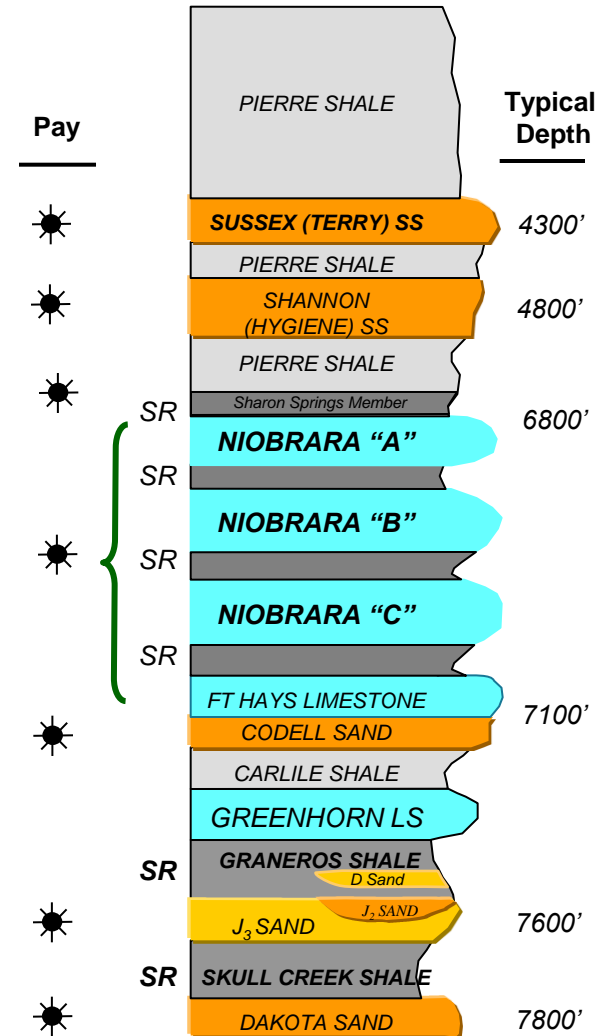
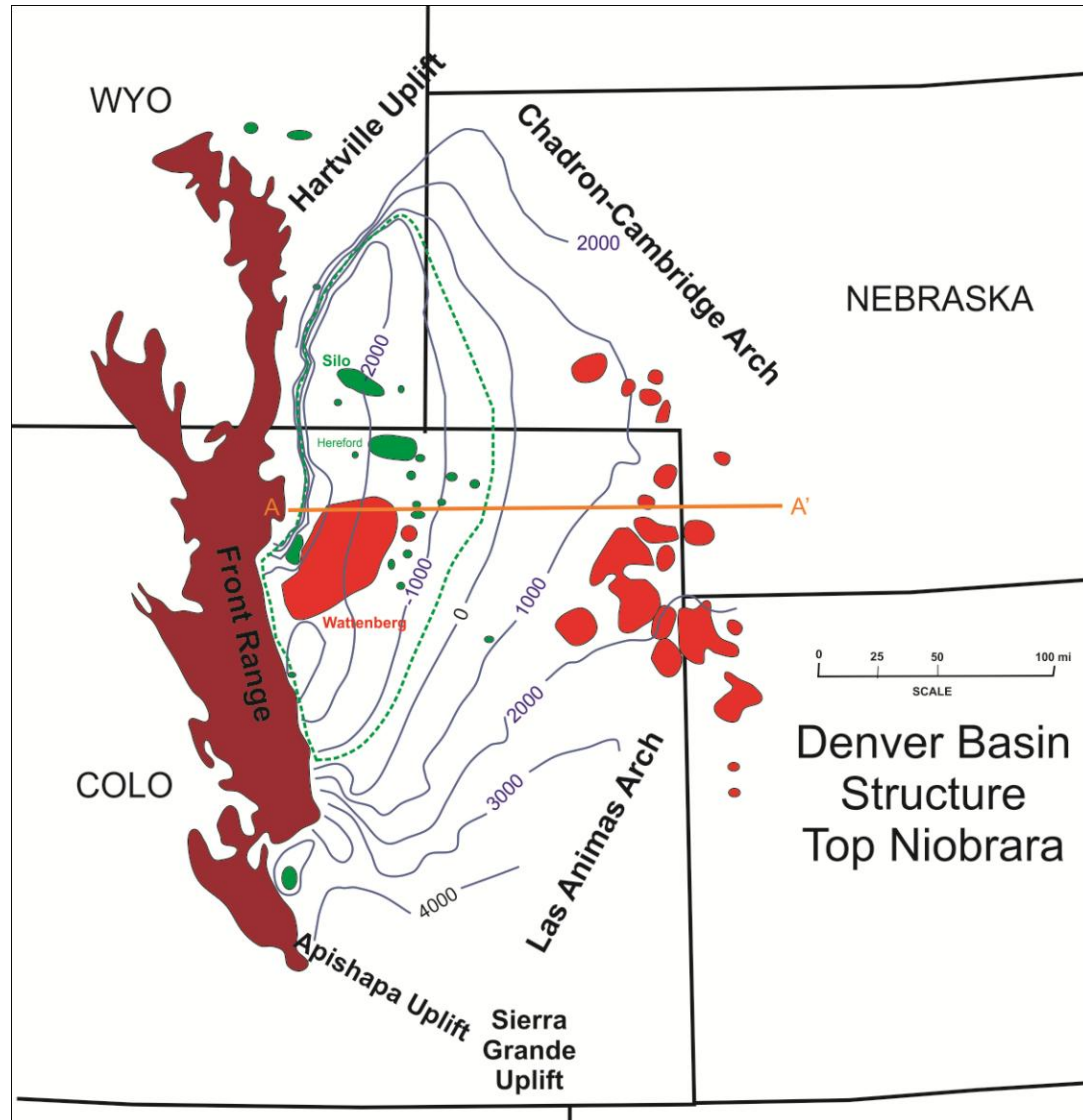
The upper Three Forks has poor reservoir quality with low porosities (generally less than 8%) and low permeabilities (less than 0.1 md). The reservoirs require fracture stimulation to produce economically. Sweet spot areas are related to favorable facies development, natural fractures, and mature Bakken source rocks. The main source rock for the Three Forks is the lower Bakken shale. Where the lower and middle Bakken members thin in the southern part of the Williston basin, the primary source rock becomes the upper Bakken shale. The Three Forks is overpressured and overpressuring is related to hydrocarbon generation. Pay identification in the upper Three Forks requires a refined petrophysical analysis and evaluation of mud-log shows, core fluorescence, and residual core saturations.

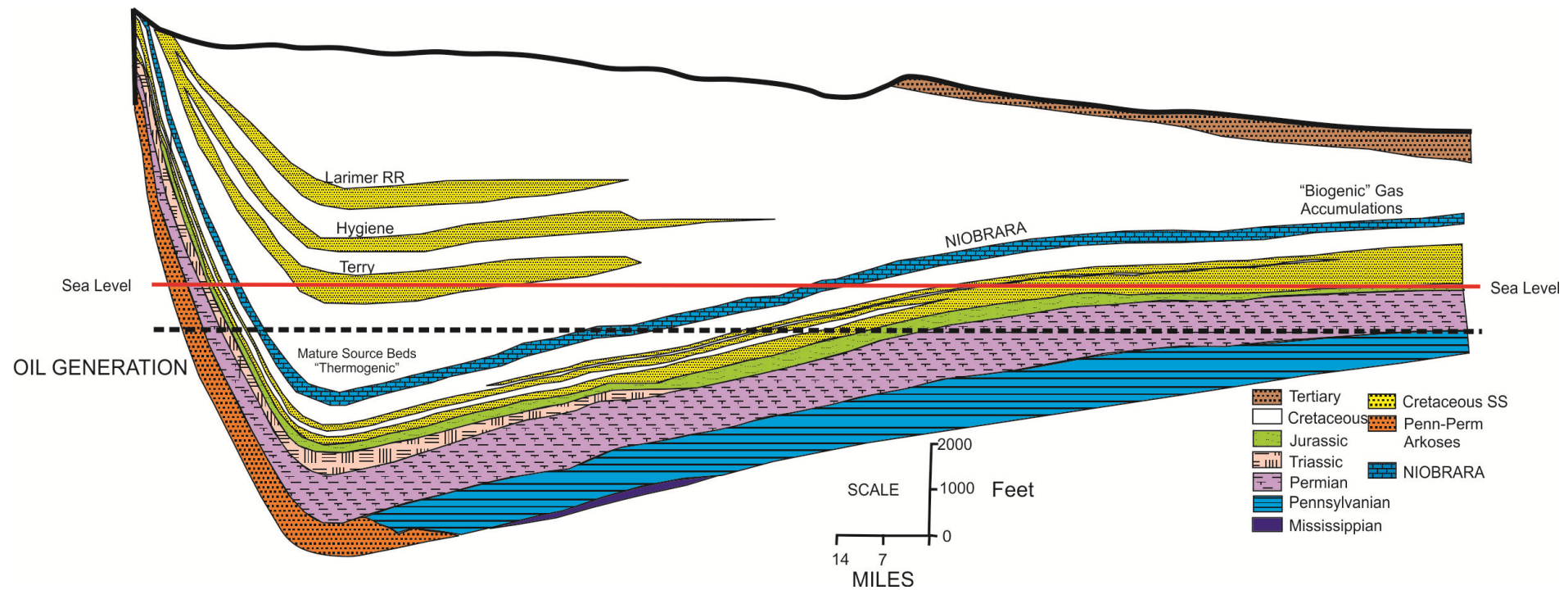
The upper Three Forks does not appear to be in communication with the overlying middle Bakken reservoirs where the lower Bakken shales are sufficiently thick to form a barrier between the producing units. The Three Forks resource potential is estimated to be 2 billion barrels of recoverable oil (USGS and NDIC).

# Niobrara Petroleum System - Denver Basin

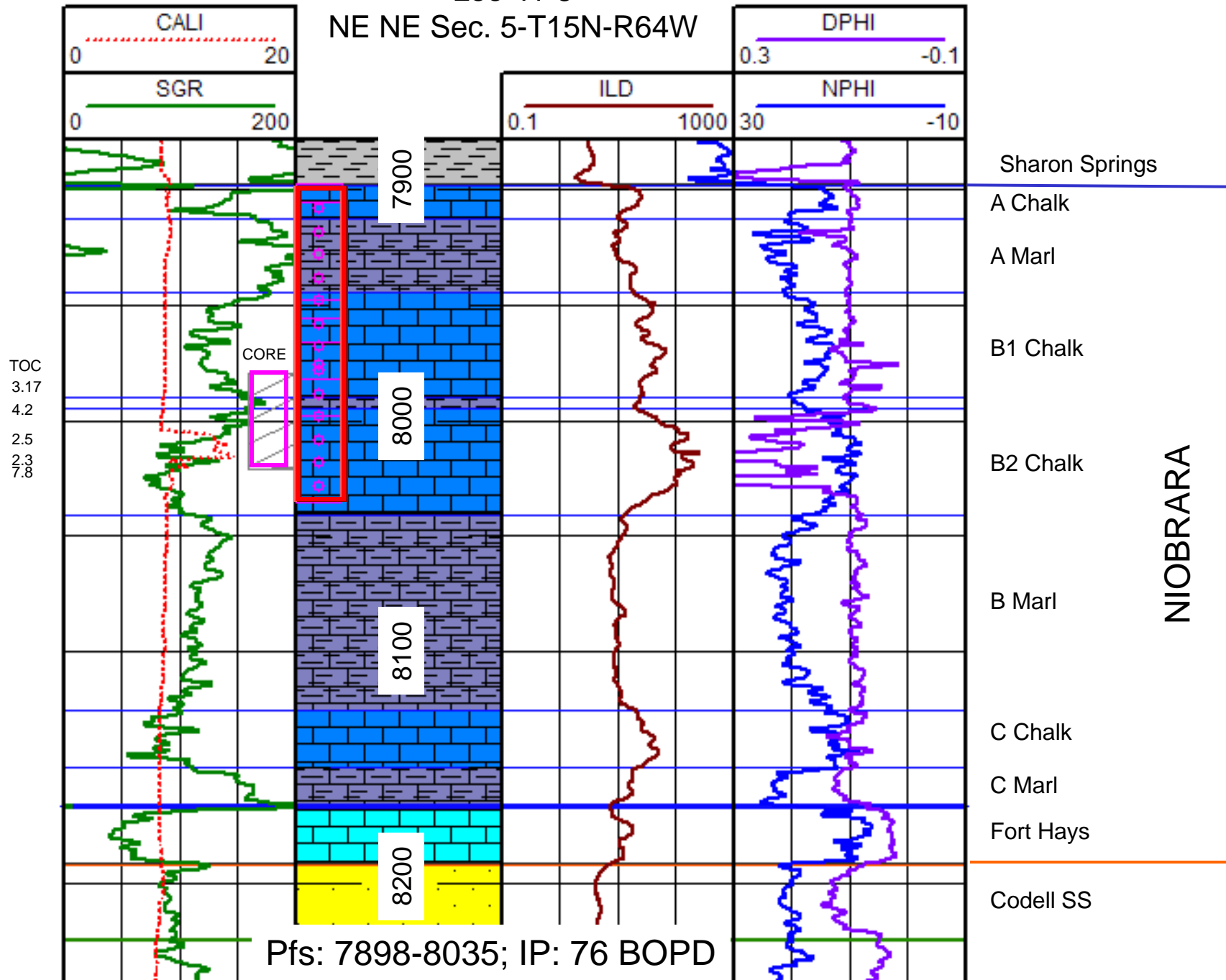
## Shallow Biogenic Gas

## Deep Thermogenic Oil and Gas





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## References

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LeFever, J.A., 1991, History of oil production from the Bakken Formation, North Dakota, *in* W.B. Hansen (ed.) Guidebook to geology and horizontal drilling of the Bakken Formation: Montana Geological Society, Billings, Montana, p. 3-17.