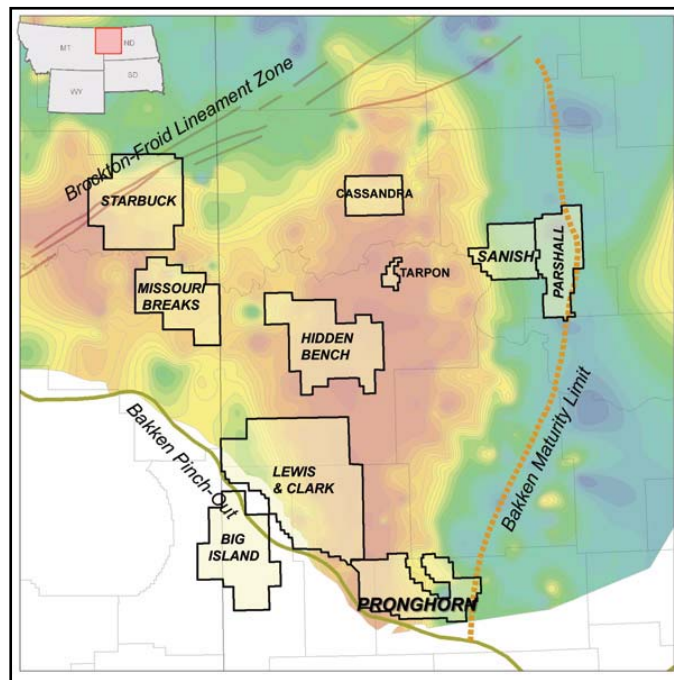


Discovery of the Pronghorn and Lewis and Clark Fields

On October 3 at the RMAG lunch meeting, Orion Skinner of Whiting Petroleum presented the steps that the firm took in proving the potential of a new Pronghorn petroleum play in the Williston Basin of North Dakota. The talk was sponsored by Geotech Consulting and Gustafson Associates. Mr. Skinner received his bachelors and masters degrees from the University of Wyoming in 1980 and 1982. He now oversees eighteen rigs for Whiting Petroleum. When Mr. Skinner joined the staff at Whiting eight years ago, he was afforded time and resources to analyze the regional geology of the Bakken Formation to determine whether resources in addition to those from the well-proven middle member of the Bakken Shale were present. He began his talk by stating that the [core library](#) in North Dakota was indispensable, and continued to emphasize this point throughout the presentation.

The stages of the project included correlating core, making a prediction of the sweet spot, and an open-minded analysis of the regional stratigraphy, with concomitant investigation of the source rock quality, reservoir quality, and fractures. Whiting was hoping to find reservoirs similar to those that made the Elm Coulee and Nesson fields in eastern Montana so productive. A discovery well drilled in the first half of 2010 indicated that dolomite was the key reservoir facies in the Pronghorn member.



Courtesy of AAPG. The named areas are Whiting's acreage.

A regional core correlation was necessary to match formation and member surfaces and thus determine the location of the Pronghorn member of the Bakken, which lies above the Three Forks Formation and below the lower Bakken silt. The Pronghorn member had been informally known as the Sanish sand, but had been redefined as Pronghorn by Julie LeFever in 2011. The unit ranges from 0-120 ft in thickness but is not extensive, and it includes a recognizable shallow high energy marine deposit with vertical

burrows. Mr. Skinner examined 200 cores and worked on correlating this information to 4500 wells to develop a global stratigraphic picture that would reveal where new sections might be present or sections were missing. The core control was the Bakken-Three Forks boundary, a second order angular unconformity recognized as a lag deposit. The stratigraphic analysis required that members that were once lumped as lower and middle Bakken be separated as Middle Bakken (0-87 ft in thickness), lower Bakken shale, lower Bakken silt, Pronghorn lime, and Pronghorn dolomite. The lower Bakken shale is anoxic and is considered a high quality source rock, the lower Bakken silt, less so.

Pronghorn facies were designated A, B, C, D, and E, with A being the highest energy intertidal facies, B being the dolomitic facies (the best reservoir rock), moving progressively offshore to E. The lime facies was key to correlation. The dolomite in the Pronghorn is detrital rather than precipitate and is the chief reservoir facies. Whiting used its own lab with a scanning electron microscope to evaluate the rock types.

Evidence indicates that sediments in the northern part of the Williston Basin were derived from a northeastern siliciclastic source (type section occurring in the Antelope field). In contrast, the Pronghorn dolomitic sediments in the southern part of the basin were shed from the southwest Cedar Creek paleostructure. Nisku time was represented by a broad open marine limestone environment that extended for over 500 miles and that is widely preserved. The Pronghorn in North Dakota correlates with the Big Valley unit in Manitoba, where the upper contact is erosional. The Pronghorn is present farther south than any preserved lower, middle, and upper Bakken deposits.

Based on the stratigraphic analysis, Whiting jumped ahead of other firms to acquire 1 million gross and 680,000 net acres where the thickest section of Pronghorn dolomite is extrapolated. Whiting currently has 20 rigs in the area and has completed 3.3 million linear feet of drilling, with 5 million feet projected by the end of 2012. The company has drilled more than 80 wells to define the "Pronghorn" and "Lewis and Clark" fields in Stark, Billings, and southernmost McKenzie counties, North Dakota. The IP of the initial wells averaged 2,021 BOPD and have been as high as 3,611 BOPD. The take-away message from this successful project is that geology matters!