

The Pronghorn Basin – A Precursor of the Bakken Basin

Michael H. Hofmann¹, Sarah Edwards², and Riley Brinkerhoff³

¹AIM GeoAnalytics, Missoula, MT

²SM Energy, Denver, CO

³Newfield Exploration, Houston, TX

ABSTRACT

In the Williston Basin, the Pronghorn Member of the Bakken Formation is known to be composed of silty sandstone, sandy siltstones, silty mudstones, and mudstones. Facies and trace fossil assemblages suggest an overall open marine depositional environment. This largely lithostratigraphic correlation limits the Pronghorn deposition to a well-known, thick lithologic succession recognized in the central and southern Williston Basin that pinches out in all directions. Hydrocarbon production from the Pronghorn in North Dakota mimics this Pronghorn thick and is limited to the Sanish, Parshall, and Billings Nose Fields; in other areas the Pronghorn is largely unproductive or untested. We present results of detailed (sub-centimeter scale) facies descriptions from 26 cores from North Dakota and Saskatchewan. This high-resolution stratigraphic framework resulted in the recognition of a thin regional marker horizon (bioclastic lag) of distinctive geochemical, paleontological, and sedimentologic characteristics – reworked phosphatized and pyritized bioclasts – that varies in thickness from several centimeters to just a few millimeters and from which we were able to build a regional Pronghorn correlation. We suggest that the Pronghorn Member was more widespread across the basin and was more lithologically complex than previously recognized. To the south this bioclastic lag overlies the classic bioturbated Pronghorn facies, but to the north, this lag overlies an organic rich mudstone with intermediate TOC content, with some resemblance of the Lower Bakken Shale facies. Thick, lithologically repetitive successions are challenging to correlate regionally because of the recurrence of just a few fine grained rock types. In the absence of recognizing the very thin lag deposit in the middle of a thick stack of organic rich mudstone, the organic rich mudstones of the Pronghorn are naturally lumped together with the Lower Bakken Shale. However, based on our detailed facies work, we suggest that the Pronghorn transitions from a more proximal facies in the southern part of the Williston Basin to a more distal facies in northern North Dakota and into Saskatchewan. There, the contemporaneous organic rich Pronghorn facies underlies the similar looking Lower Bakken Shale facies, only separated by the bioclastic lag deposit. In addition to the generally deepening to the north, the Pronghorn Basin was also influenced by inherited tectonic elements. We observe in some areas where the Pronghorn Member pinches out onto paleogeographic highs that follow well known lineaments in the Williston Basin.