Bakken and Pronghorn geology of Montana: Comparing the Williston, South Alberta, and Sappington Basins

John C. Hohman[1], John M. Guthrie[2], Aaron P. Rodriguez[2], Nicholas J. Hogancamp[2], P. Ted Doughty[3], and George W. Grader[3]

[1]Retired, Houston, TX
[2]Hess Corporation, Houston, TX
[3]PRISEM Geoscience Consulting, Spokane, WA

ABSTRACT

Montana is located in a crucial geographic position for studying the greater Bakken-Pronghorn stratigraphic section. This distinctive section is characterized by a succession of late Devonian to early Mississippian siltstones alternating with black shales that host a prolific petroleum system and unconventional oil play. Three principle accumulations of these deposits converge in Montana, including the Williston Basin in the east, the South Alberta Basin in the northwest, and the Sappington Basin in the southwest. Comparing observations from all three of these basins allows for a greater appreciation of the breadth of this distinctive depositional succession and a more comprehensive understanding of the stratigraphy and sedimentology associated with the Bakken-Pronghorn and its laterally equivalent sections. The key to this comparison is the construction of a sequence stratigraphic framework that links the basins together. Continuous rock information, such as cores and outcrops, provides the critical information that leads to the identification of a progression of correlative depositional sequences and systems tracts that comprise the greater Bakken-Pronghorn section. In the Williston Basin, the sequences in ascending stratigraphic order include the Lower Pronghorn, Upper Pronghorn, Lower Bakken, Lower Middle Bakken, Upper Middle Bakken, and Upper Bakken. In the same ascending order, the Sappington Basin sequences include the Knoll, Trident, Lower Sappington, Middle Sappington and Upper Sappington (Cottonwood Canyon), while the South Alberta Basin sequences include the Knoll, Trident, Lower Exshaw, Upper Exshaw and Banff. Linking the basins, the Lower Pronghorn correlates westward with the Knoll while the Upper Pronghorn correlates with the Trident. Similarly, the overlying Lower Bakken correlates westward with the Lower Sappington and Lower Exshaw. However, the Lower Middle Bakken appears to only correlate with the Middle Sappington and Upper Exshaw. At present, an equivalent sequence to the Upper Middle Bakken which is common in the Williston Basin has not been observed westward in the Sappington or South Alberta Basins. The Upper Bakken is correlative to the Upper Sappington (Cottonwood Canyon) and Banff. This presentation displays Montana cores from each of the Williston, South Alberta, and Sappington Basins to illustrate how these sequences and systems tracts that comprise the Bakken-Pronghorn section are expressed regionally throughout the state. It includes and describes examples of both the surfaces and facies successions that define the sequence stratigraphic units in each of the three basins. Of particular significance, note the recognition of the unconformities that define the sequences. These inter- basin surfaces help establish the chronological context of deposition both within and between the basins while illuminating the missing sections that characteristically complicate Bakken-Pronghorn stratigraphy. Examining the differences and similarities encountered in the greater Bakken-Pronghorn section within a multi-basin framework of chrono-stratigraphically significant sequences and systems tracts provides a comprehensive context for maximizing the understanding of its depositional history.