

RMS-SEPM Talk, October 1st, 2013

Basin-Scale Controls on Oil Accumulations in the Niobrara Formation of the Denver-Julesburg Basin: Basement Tectonics, Stratigraphic Evolution, and Timing

By: William R. Drake, Pioneer Natural Resources, Denver, Colorado, Sarah J. Hawkins, USGS, Lakewood, Colorado and Scott G. Lapierre, Pioneer Natural Resources, Irving, Texas

Speaker: William R. Drake

ABSTRACT: The distal carbonate ramp setting of the Upper Cretaceous Niobrara Formation of the Western Interior Seaway offers insight into how depositional processes, seafloor morphology, and basement tectonics can impact a petroleum system. In the Denver-Julesburg (D-J) Basin, the Niobrara records late Turonian to early Campanian climate and orbital cycles and tectonic events. Cyclostratigraphic analysis, biostratigraphy, geochronology data, and subsurface maps reveal an anchored chronology of paleobathymetry, basement uplifts, and shifts in their organization through time. The role of changing stratigraphic architecture and basement structure in the distribution of petroleum accumulations can be assessed using sequence stratigraphic-based mapping techniques together with basin-scale petrophysical analysis.

The four third-order transgressive-regressive events of the Upper Cretaceous Niobrara Cyclothem were major controls on the character of the pelagic and hemipelagic sedimentation of the Niobrara Formation of the D-J Basin. These cycles provide the foundation for a sequence-stratigraphic framework that more accurately reveals the architecture of key depositional packages than does the common use of strict lithostratigraphy. Based on correlations using wire-line logs from >2,000 wells, we present a series of time-slice isochore maps and schematic cross sections to illustrate the evolution of subtle seafloor topographic features. To evaluate the vertical and horizontal nature of thermogenic hydrocarbon accumulations, we performed petrophysical analysis of the Niobrara section in >200 wire-line logs from wells across the basin. We discuss reconnaissance-scale original oil in place for three chalk intervals in the context of the following stratigraphic observations and interpretations.

Organized stratigraphic thinning represents examples of a) subtle submarine channel forms and b) sediment draping over seafloor paleohighs. Stratigraphic thickening trends represent systematic compensational infilling of channel forms by younger sequences as well as areas with long-lived available accommodation space. Comparison of our stratigraphic and petrophysical maps suggests that benthic processes and tectonic/geomorphic features were important controls on the distribution and facies of source-prone and reservoir-prone intervals of the Niobrara Formation. The pronounced basement uplifts that initiated along basement shear zones during the middle Santonian disrupted submarine channels and were key to the collocation of favorable facies and maturity trends. Basin-scale petrophysical evaluation indicates trends in oil saturations associated with seafloor paleohighs, suggesting a link between paleoseafloor morphology and facies, thermal maturity, and hydrocarbon accumulations.

SPEAKER BIOGRAPHY: Bill is currently a geologist for Pioneer Natural Resources in Denver. His professional interests include exploration of Cretaceous and Paleozoic systems in the Rockies and western Midcontinent. He previously worked in environmental consulting in California and Arizona, as well as at the Arizona Geologic Survey. Bill holds a B.S. in Geological Science from the University of California, Santa Barbara and a M.S. in Geology from Northern Arizona University, where his graduate research focused on extensional tectonics, structural analysis, stratigraphy, and isotope geochronology in Baja California Sur, Mexico.

Back to the [RMS-SEPM Luncheon Page](#)

Back to the [RMS-SEPM Luncheon Abstract Archive](#)