AAPG Datapages/Search and Discovery Article #90302 ©2017 AAPG Pacific Section Annual Meeting, Anchorage, Alaska, May 21-24, 2017

Oil and Gas Exploration in Nenana Basin, Interior Alaska: Improved Prospectivity and Structural History from New Seismic Programs

Jonathan L. Konkler[1], G. Thomas Morahan[1], Gerry Van Kooten[1], and Michael Richter[2]

[1]Petrotechnical Resources Alaska (PRA)
[2]Michael Richter Exploration Consulting

ABSTRACT

Gravity/magnetics, earthquake studies and historical seismic data outline the general geometry of the Nenana. As additional new data (seismic and wells) become available, the basin geometry is further refined, leading to more focused oil and gas exploration. For the past 14 years, Doyon, Limited has promoted and financially supported an exploration program that has led to new data and a better understanding of the basin geology. During 2016, Doyon, Limited completed drilling the Toghotthele #1, the third well in this current program. The well penetrated a 2750 foot interval of previously undrilled Oligocene sedimentary units containing excellent reservoir and source rocks, thus adding to the known potential of the overlying Miocene Healy Creek Formation. Doyon, Limited also acquired 172 miles of new 2D seismic data, infilling the pre-existing seismic grid in the northern Nenana basin. Integration of new and existing seismic and well data has resulted in the identification of new exploration targets, a more specific understanding of source rock maturation and migration pathways, and a better comparison of exploration risks between the north and south portions of the basin. The new seismic infill program has allowed a more comprehensive mapping of the thick Nenana gravel, which overlies prospective units within the basin. Several continuous seismic horizons were identified and mapped within this stratigraphic unit. The new mapping work has led to a better understanding of the areal extent and timing of late subsidence in the north Nenana basin. The structural interpretation was used to update the basin-wide geohistory and hydrocarbon endowment analysis by Platte River Associates (VanKooten, 2017). Results of the study suggest that the deep north Nenana basin should have produced and expelled prolific quantities of oil and gas. The Nenana basin is filled by east-dipping Paleocene to Miocene non-marine units deposited within an actively subsiding half-graben, and more recently overprinted by a transtension/transpression structural style (Tape, etal, 2015; Dixit, 2015; Morahan, 2016). The geometric elements of the half graben are a NNE-SSW trending basement ridge on the west, sedimentary fill onlapping the ridge and gently dipping to the east, and a large-displacement basin-bounding fault along the eastern margin. This deep seated normal fault exhibits gradual subsidence from Paleocene to Miocene time. Paleocene-Miocene sedimentary units are overlain by the rapidly deposited late Miocene to Pliocene Nenana Gravel. Mapping the thickness changes of the Nenana Gravel has helped to outline major structural style differences between the north and south Nenana Basin. The Nenana Gravels appear to have experienced significant uplift and erosion (up to 3000 feet) in the south Nenana basin. The north Nenana basin has experienced significant late stage subsidence, with the Nenana Gravel formation to the north reaching thicknesses up to 7000 feet, dropping the Paleocene - Early Miocene succession to depths of 12000-24000 feet, well within the hydrocarbon maturation zone. Continuous structural evolution, accompanied by source rock subsidence into the hydrocarbon kitchen puts the north Nenana basin into a better setting than areas to the south with respect to risk in an exploration program.