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Title: Brookian Topset Stratigraphic Play: Petroleum Systems Elements

Author: Paul L. Decker, Alaska Department of Natural Resources, Division of Oil and Gas

ABSTRACT

Giant oil discoveries in the Brookian sequence on Alaska's North Slope demonstrate the commercial viability of a previously speculative stratigraphic play type with vast unexplored potential. Recent exploration drilling has targeted two major plays in the lower Brookian Nanushuk and Torok Formations. The Nanushuk represents shelfal to non-marine topsets deposited concurrently with deeper water slope and basinal facies of the Torok Formation. Stratigraphically trapped Brookian turbidites are not uncommon, but most turbidite discoveries remain undeveloped, challenged by reservoir quality, compartmentalization, depositional extent, and distance from infrastructure. Explorers are now pursuing stratigraphic traps in topset Nanushuk shallow marine facies, expressed as seismic amplitude anomalies in shelf-margin wedges overlying the Torok slope. Two promising discoveries in this topset play, Pikka-Horseshoe/Narwhal and Willow, contrast starkly with the deepwater play prospects, featuring better reservoir quality, apparent high lateral continuity of reservoir facies, and greater overall strike-parallel depositional extent, and both are located relatively close to existing or pending infrastructure associated with major producing units.

In 2013, Repsol and Armstrong announced a multi-horizon discovery, and in 2015, announced their intent to develop billion-barrel potential in their Nanushuk project. Additional drilling 20 miles to the south on the same Nanushuk shelf margin in early 2017 indicated that the reservoir is in pressure communication along this entire trend, with estimated recoverable resources of 1.2 billion barrels. In 2016, ConocoPhillips drilled two wells in their Willow prospect and in early 2017 announced recoverable resources estimated at 300 million barrels. Though they differ in certain important respects, the basal Nanushuk sandstone reservoirs of the Pikka-Horseshoe/Narwhal and Willow discoveries were both deposited on muddy outermost shelf and upper slope strata as sand-prone deltaic(?) to shoreface shelf-edge wedges during stages of lowered sea level, followed by transgressive deposition of sealing shales, forming effective stratigraphic traps. The discoveries contain light oil from two distinct source rock units, suggesting multiple migration routes, potentially accessing kitchens both south and north of the Barrow Arch crest. Numerous still-undrilled amplitude anomalies in basal Nanushuk shelf-margins settings may similarly represent major conventional accumulations with large oil columns and >10 miles of strike-parallel depositional extent.

BIOGRAPHY

Paul Decker manages the Resource Evaluation section in the Alaska Department of Natural Resources, Division of Oil and Gas, where he has worked as a petroleum geologist since 2004. This team applies geological, geophysical, and engineering expertise to a wide range of petroleum resource management issues throughout the state. Previously, Paul worked in new ventures exploration and development for ARCO, Phillips, and ConocoPhillips after moving to Anchorage in 1988. He earned his Ph.D. and M.S. degrees from the University of Wisconsin – Madison, and a B.S. in geology from Fort Lewis College in Durango, Colorado.