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

Diving into the Deep End of Arctic Alaska - Geology, Tectonic Origin, and Petroleum Potential of the North Chukchi Basin

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ABSTRACT

The North Chukchi Basin (NCB) straddles U.S., Russian, and international waters beneath the outer Chukchi and East Siberian shelves. Although minimal geophysical and geological data for this region historically have been available, recently collected multi-channel seismic (MCS) data can be integrated with potential-field and sparse well data to present (1) an overview of the geology of the NCB, (2) an interpretation of its tectonic origin, and (3) an initial evaluation of its petroleum resource potential. The NCB extends more than 950 km from the North Chukchi High (U.S.) to the De Long High (Russia). The basin widens from 150 km (U.S.) to 450 km (Russia) and covers more than 300,000 km2. Strata commonly exceed ~20 km thick along the basin axis. The basin fill comprises sediment derived mainly from the Chukotkan and Brooks Range orogens, and routed generally northward across the basin. These strata onlap the low-accommodation Chukchi Borderland along the northeastern basin margin, and downlap (via prograding shelf-margin depositional systems) the high-accommodation Chukchi Abyssal Plain (likely underlain by oceanic crust) along the northwestern basin margin. The stratigraphy of the NCB includes: (1) Hauterivian(?) strata, only locally present and likely comprising condensed, basinal deposits. (2) A Lower to middle Cretaceous succession comprising thick clinothems in the east, which subsequently were deformed, and that thin westward into a thin condensed basin-floor deposit. (3) A middle Cretaceous to Paleogene succession comprising thick clinothems in the west, which thin to the east by onlap onto deformed unit 2. (4) A Paleogene to Neogene succession comprising a single, giant clinothem. (5) Upper Neogene and Quaternary strata comprising thin glacio-marine and deposits. Based on stratigraphic and structural evidence, we interpret the NCB as a rift basin whose opening occurred no later than the Hauterivian, approximately coeval with opening of the Canada Basin. The widest part of the NCB (Russia) may be floored by either exhumed mantle or oceanic crust (Granath et al., 2015, AAPG Search and Discovery Article #10811), whereas the narrower part (U.S.) likely is floored by extended (transitional) continental crust. The overall geometry of the basin and deformation recorded near its eastern end suggest that basin opening was accommodated by clockwise rotation. Petroleum potential of the NCB depends mainly on the presence of oil-prone source rocks and their thermal history. Based on the age and distribution of known source rocks across the western Arctic and acoustic character in the NCB, it is likely that source rocks were deposited during Hauterivianâ€“Early Cretaceous, middle Cretaceous, and earlyâ€“mid Paleogene. Preliminary thermal maturation modeling indicates that any source rocks in the Cretaceous are now over mature. Any preservation of oil generated from these older strata would require vertical migration over a distance of several km, likely along abundant normal faults, as younger strata were deposited. Potential source rock intervals in the Paleogene likely entered the oil window during the mid-Cenozoic and reside in the lower part of the oil window today. Optimum oil potential lies in Eocene to Miocene strata in the giant clinothem, where source-

rock potential likely exists in a basal condensed section and reservoir-trap potential exists in overlying basin-floor fan, slope channel and lobe, and shoreface to deltaic deposits.