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Tectonics of Chukchi Sea Shelf sedimentary basins and its influence on petroleum systems

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The Chukchi Sea Shelf placed in the East Arctic offshore of Russia between East Siberian Sea Shelf and North Slope Alaska. The Chukchi margin is considered as high petroleum potential play. The major problem is absence of core material from drilling wells in Russian part of Chukchi Shelf, hence strong complex geological and geophysical analyses such as seismic stratigraphy interpretation should be provided. In addition, similarity to North Slope and Beaufort Basins (North Chukchi) and Hope Basin (South Chukchi) allow to infer the resembling sedimentary succession and petroleum systems.

The Chukchi Sea Shelf include North and South Chukchi Basins, which are separated by Wrangel-Herald Arch and characterized by different opening time. The North Chukchi basin is formed as a general part of Canada Basin opened in Early Cretaceous. The South Chukchi Basin is characterized by a transtensional origin of the basin, this deformation related to motion on the Kobuk Fault [1].

Because seismic reflections follow chronostratigraphic correlations, it is possible to achieve stratigraphic interpretation. The main seismic horizons were indicated as: PU, JU, LCU, BU, mBU marking each regional unconformities.

Reconstruction of main tectonic events of basin is important for building correct geological model. Since there are no drilling wells in the North and South Chukchi basins, source rocks could not be proven. Referring to the North Chukchi basin, source rocks equivalents of Lower Cretaceous Pebble Shale Formation, Lower Jurassic Kingdak shales and Upper Triassic Shublik Formation (North Slope) is possible exhibited [2]. In the South Chukchi, it is possible that Cretaceous source rocks could be mature for hydrocarbon generation. Erosions and uplifts that could effect on hydrocarbon preservation was substantially in Lower Jurassic and Early Cretaceous periods. Most of the structures may be connected with fault and stratigraphy traps. The structure formed at Wrangel-Herald Arch to North-Chukchi through similar to well-known structure in Norwegian part of Barents Sea – Loppa High. In South Chukchi basin, the seismic wave shows interesting structures akin to diaper fold. Inversion-related anticlines and stratigraphic pinch-outs traps could presence in Cretaceous-Cenozoic cross section.

As a result, we gathered and analyzed source rocks and reservoir analogs and gained improved sedimentary models in Eastern Russian Shelfs (Laptev, East Siberian and Chukchi Seas). Appropriate tectonic conditions, proven by well testing source rocks in North Slope and high thickness of basins suggest a success of hydrocarbon exploration in Russian part of Chukchi Sea Shelf.

[1] Verzhbitsky V. E., S. D. Sokolov, E. M. Frantzen, A. Little, M. I. Tuchkova, and L.I. Lobkovsky, 2012, The South Chukchi Sedimentary Basin (Chukchi Sea, Russian Arctic): Age, structural pattern,and hydrocarbon potential, in D. Gao, ed., Tectonics and sedimentation: Implications for petroleum systems: AAPG Memoir 100, p.267-290.
[2] Peters K. E., Magoon L. B., Bird K. J., Valin Z. C., Keller M. A. North Slope, Alaska: Source rock distribution, richness, thermal maturity, and petroleum charge AAPG Bulletin, V. 90, No. 2 (February 2006), 2006, P. 261-292.