Oligocene Kugmallit Sequence in the Beaufort-Mackenzie Basin: Regional Sequence Stratigraphic Framework, Potential Controls on Sedimentation Cycle and Basin Fill Patterns

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Summary

The Oligocene Kugmallit Sequence is one of the most important offshore oil and gas exploration targets in the Beaufort-Mackenzie Basin. Sequence stratigraphic analysis of Kugmallit Sequence in both onshore and offshore areas reveals the presence of two distinct prograding delta systems in the southwest and southeast, separated by tectonic highs, with different paleo-drainage systems and provenances. The delta system in the southeast covered a broader area, with thicker sediments than that in the southwest. Only distal facies are preserved in the southwest, whereas proximal and distal facies are present in the southeast delta system. It is suggested that orogenesis in the southwest removed the proximal delta facies and changed the paleo-drainage. An understanding the origin of the delta system is vital to understanding the context of the whole basin and especially to the distribution of reservoir rocks in the Oligocene sequence.

Sequence stratigraphic analysis indicates that the Oligocene Kugmallit Sequence is divisible into four regional sub-sequences, controlled by base-level cycles, paleogeography and tectonic episodes. The nature of the subsequence boundaries varies in different parts of the basin. In the southwest the sequence boundaries were generated by tectonic uplift with extensive large scale submarine erosion, whereas in the southeast they are relatively conformable. In the deep-water sediments of the north-central part of the basin, deeply eroded boundaries of the subsequences can be recognized on seismic data. A mechanism to explain these subsequence boundaries is related to activity on the Tarsiut-Amauligak Fault Zone. Rapid subsidence on the hanging-wall side of the growth faults resulted in the largest sediment accommodation space and the thickest accumulation of the oldest subsequece, decreasing in the younger sequences. During sedimentation there was reduced movement on the faults and the erosion occurred if accommodation was less than zero. Farther north there was uplift which led to less accommodation space and thin deposits. The thickest accumulation of deep-water sediments occurs on the hanging-wall side of the growth faults as do the associated deeply incised, sequence-boundary channels.

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References

Dixon, J., Dietrich, J. R., and McNeil, D.H., 1992. Upper Cretaceous to Pleistocene Sequence Stratigraphy of the Beaufort - Mackenzie and Banks Island Area, Northwest Canada; Geological Survey of Canada.

Lane, L. S., and Dietrich, J. R., 1995. Tertiary Structural Evolution of the Beaufort Sea-Mackenzie Delta Region, Arctic Canada: Bulletin of Canadian Petroleum Geology, Vol. 43, No. 3, P. 293-313.

Morrell, G.R.and Schmidt, U.B., 1988. Subsequences of the Kugmallit Delta Front, Beaufort-Mackenzie Basin; Sequence, Stratigraphy, Sedimentology: Surface and Subsurface. Proceedings of A cCanadian Society of Petroleum Geologists Technical Meeting, Calgary, Alberta, September 14-16, 1988

Embry, A.F., Johannessen, E, Owen, D, Beauchamp, B. and Gianolla, P., 2007. Sequence Stratigraphy as a “Concrete” Stratigraphic Discipline; Report of the ISSC Task Group on Sequence Stratigraphy