RESERVOIR CHARACTERIZATION OF THE CARDIUM FORMATION, GARRINGTON, ALBERTA

Raymond C Van, Per K Pedersen
Department of Geoscience, University of Calgary
rcvan@ucalgary.ca, pkpeders@ucalgary.ca

Summary

The Cardium Formation in the Garrington Field is subdivided into the Cardium A zone and Cardium B zone. Sandstone and conglomerate reservoirs from the Cardium B zone were exploited in the early 1960's to 80's (Berven, 1966, Duke, 1985, Wadsworth and Walker, 1991). Technological advancements have opened more prospects in previous uneconomic areas and stratigraphic intervals; one being the Cardium A zone in the Garrington Field. The Cardium A is a regional sand-sheet with varying thickness, comprised predominantly of intensely bioturbated, offshore, muddy, sandstones. The study is divided into two areas; Township 32 Range 3 West of 5, and Township 34 Ranges 3-4 West of 5, located northeast of Calgary, Alberta. These two areas in the Garrington Field are unique because even though proximal to another and having the highest production rates in the Garrington Field, production rates in Township 32 are noticeably higher than production rates in Township 34. Aside from drilling and completion technologies, Cardium A production rates are controlled by facies distribution, shown in well-log and core cross sections. Sequence stratigraphic correlations highlight lateral discontinuity of reservoir sandstone bodies, and the connectivity of genetically related hydrocarbon bearing units; the latter being important for implementing enhanced oil recovery programs, such as water flooding.

Sedimentary facies observed in cores are classified according to bioturbation index, sand:mud content, trace fossil assemblage and lithology. The predominant facies representing the Cardium A is offshore muddy sandstones, which are the main hydrocarbon reservoir in the Cardium A. The reservoir is intensively bioturbated by sand-filled trace fossils, providing the main flow conduits for hydrocarbons in this highly heterogeneous reservoir. Thin section analysis provides a thorough assessment of micro-scale properties, including clay type, micro-scale flow barriers, diagenesis, and other features affecting porosity and permeability. The maximum, minimum, mean, median and variance porosity and permeability (KMax) values for the Cardium A zone in the Garrington Field are 25.4%, 0.9%, 9.05% (Harmonic), 8.1%, $1.58x10^{-3}$, and 696mD, 0.01mD, 21.47mD (Arithmetic), 0.345mD, 4896.71, respectively. Majority of porosity and permeability measurements are from plugs, and some values are measured from full diameter samples.

Acknowledgements

We would like to thank Tight Oil Consortium (TOC) at the University of Calgary for providing funding for this project. Thank you also to geoLOGIC, iHS and Schlumberger for providing software and support.

References

Berven, R.J. 1966. Cardium sandstone bodies, Crossfield-Garrington area, Alberta. Bulletin of Canadian Petroleum Geology, 14: 208-240

Duke, W.L. 1985. Sedimentology of the Upper Cretaceous Cardium Formation in Southern Alberta, Canada. Unpublished Ph.D. thesis, McMaster University, Hamilton, Canada. 724 pp

Wadsworth, J.A. and Walker, R.G. 1991. Morphology and origin of erosion surfaces in the Cardium Formation (Upper Cretaceous, Western Interior Seaway, Alberta) and their implications for rapid sea level fluctuations. Canadian Journal of Earth Science, 28: 1507-1520

Walker, R.G. 1983. Cardium Formation 3: Sedimentology and stratigraphy in the Garrington-Caroline area, Alberta. Bulletin of Canadian Petroleum Geology, 31: 213-230