Statistical Analysis of Depositional Cyclicity within Point Bar Deposits, McMurray Formation, Northeastern Alberta

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The Cretaceous McMurray Formation is the most volumetrically important source of in-situ bitumen in the Athabasca Oil Sands of northeastern Alberta. It is comprised of highly heterogeneous strata, and point bar units account for a significant proportion of reservoir deposits in the formation. During the examination of cores and gamma radiation logs, depositional cyclicity was apparent within 30 m thick point bar successions defined by systematic interbedding of sandstone and mudstone. The objectives of this project are to: (i) geostatistically validate the cyclicity; (ii) interpret the environmental and sedimentological nature of the cyclicity, and; (iii) assess how the cyclicity varies in strength and wavelength throughout the point bar deposits.

The study area comprises 9 Sections that have been defined using high quality three dimensional seismic data. Presently, 128 wells have been drilled in the study area, 70 of which penetrate a point bar developed from downstream accretion in the middle part of the McMurray Formation. Three dominant lithofacies are present in the point bar deposits and include massive sandstone with local mudstone rip-up clasts and drapes, cross-stratified sandstone with local mud drapes, and variably bioturbated and laminated siltstone. Statistical analyses of numerous wells were carried out by constructing correlogram plots from gamma radiation log curves. The results show strong rhythmicity within the inclined heterolithic strata that comprise the middle McMurray Formation, and several orders of cyclicity may be inferred from the data. Tidal imprints are not visible on the scale of the correlogram plots, however they are visible in core as double mud drapes and flaser bedding. Larger scale cyclicity is seen in the correlogram plots as high amplitude peaks with correlation coefficients that approach 0.5 and with varying wavelengths from 1.0-1.5 m and 2.0-3.0 m. It is possible that these record seasonal shifts in point bar sedimentation or possibly inter-annual climatic variations with periodicity on the order of <10 years. These controls could affect reservoir characteristics such as vertical permeability and lateral extent of baffles to fluid flow.