Reservoir Heterogeneity of Fairways within the giant Tight Light Oil Play of the Late Cretaceous Cardium Formation, Alberta, Canada

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Continuous type, low permeability hydrocarbon plays although their lateral great extent are often characterized by significant lateral variations in both initial rates and cumulative production. While differences in drilling, completion and production practice between wells have a large impact on productivity, subtle changes in reservoir properties often have a large impact on production from such unconventional type reservoirs.

The Cretaceous Cardium Formation of the Western Canada Sedimentary Basin provides a superb unit for understanding the subtle controls on productivity from low permeability, lateral extensive hydrocarbon reservoirs. Shallow marine clastic reservoirs of the Upper Cretaceous Cardium Formation contain one of the largest light oil accumulations in Canada, which has been exploited since the 1950's, providing a rich data set of wells, core and production data. Since 2008, multistage fractured horizontal wells have revived this large light oil play. Early success in the play set of a frenzy of activity, with large land acquisition and drilling, but with highly variable success, leading to the play falling out of favour.

However, detailed evaluation of areas of success and failure allow insight into the subtle controls on this giant tight light oil halo play. Reservoir characterization of the intensely bioturbated offshore to shoreface unconventional reservoirs of the Cardium Formation requires integration of multiple scales of investigations to successfully differentiate productive from uneconomic reservoirs. Further, late stage gas migration needs also to be taken into consideration, especially along the western margin of the foredeep.

Characteristics of areas within the Cardium halo play fairways will be presented and contrasted. Although areas may have similar sedimentary facies, they often have different reservoir properties due to differences in depositional conditions in the offshore environments, burial depth, timing of hydrocarbon charge and post-depositional faulting which resulted in slight differences in bedforms, mud content and type, tracefossil assemblages, diagenesis, compaction, cementation, pore types, and fluid content. Focus will on how these parameters affect productivity and how sweet spots often appear similar on well logs but detailed core examination and analysis reveal these subtle differences. Detailed core observations were complemented with thin sections, SEM analysis, and mercury (MICP) data of the various micro facies, i.e. muddy sandstones versus sandy borrow fill. To further characterize flow paths, full diameter core CT scanning were used to reveal the 3-D connectivity of sandstone beds and sandstone filled borrows. Hard earned learnings from the giant Cardium hydrocarbon play is directly transferable to many similar continuous type reservoirs in North America and worldwide.