Factors Affecting Productivity in the Cardium Tight Light Oil Play, Alberta, Canada

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Abstract

Although unconventional type hydrocarbon plays are extensive hydrocarbon accumulations with relatively uniform lateral reservoir properties, they are often characterized by significant variations in both initial and cumulative production. While variations in productivity between wells can often be attributed to differences in drilling and completion, subtle changes in reservoir properties can often have a significant impact on productivity. This presentation will focus on identification of sweet spots within the extensive Cardium Tight Oil Play in western Alberta. Cardium shoreface sandstones and conglomerates contain one of largest conventional oil accumulations within the Western Canada Sedimentary Basin with more than 5 billion barrels of oil reserves. The play was revitalized in 2008 with multistage horizontal wells targeting low porosity and permeability muddy, intensely bioturbated sandstone reservoirs around the halo area of legacy pools, with production exceeding 120,000 bbl/d from these new wells.

This study will present a pore to depositional sequence scale reservoir characterization of the unconventional type low permeability, intensely bioturbated muddy sandstone reservoirs. Characteristics of the various halo play areas will be presented and contrasted. Although they contain similar sedimentary facies they 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, fluid content, and reservoir pressure. It will be shown 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 section, SEM analysis, and mercury (MICP) data of the various micro facies, i.e. muddy matrix versus sandy borrow fill. Full core diameter CT scanning was used to characterize the 3-D connectivity of the sandstone beds and sandstone filled borrows for each reservoir facies. Due to the small scale and discontinuity of the sandstones beds and borrow fills, routine plug and full diameter core analysis often underestimate the flow capacity of such intensely bioturbated reservoirs, where sand filled borrows provide flow pathways in 3-D.