Insights from Structural Restoration and Petroleum Systems Modeling to Unravel Charge Mechanism: A Case Study from the Walker Ridge Area, Gulf of Mexico

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Abstract

The Gulf of Mexico is a proven basin with multiple play concepts that have evolved over the past 50 years as the industry moved from the shallow water, diapiric shelfal plays to the deeper water turbidites. Multibillion-dollar discoveries exist for the Miocene plays when compared to the relatively less explored lower Tertiary trends often referred as the Paleogene/Wilcox plays. Although, large structural footprints exist for the Paleogene trends, the pressure regime and fluid properties are often viewed as critical challenges to developing these assets. Current study attempts to underpin the interplay between structural evolution and its impact on migration pathways and fluid distributions for the Paleogene fields from the Walker Ridge protraction area. Analyzing multiple sub-regional 2d structural restorations connecting Julia, Tucker, St. Malo and Das Bump shed light on salt evolution and its effect on trap geometry and migration pathways through time. The 2d-structural models suggest the timing of welding played a crucial role for petroleum migration from the deeper Tithonian sourced intervals. The 2d-structural restorations suggest that trap geometry evolution started with downbuilding and deflation of the Mesozoic allochthonous salt which progressively shortened to form the present day four-way traps at St. Malo and Das Bump whereas Tucker formed as a three-way trap against the salt stock. Current study points towards a progressive younging of welding direction from the NW to the SE direction supported by shifting of the younger depocenters in the same direction. An integrated approach was taken to

bridge the gap between structural evolution at St. Malo, Das Bump and Julia and the observed fluid properties for these fields. Basin modeling suggest that the hydrocarbon generation started during the Oligo-Miocene time post-dating the trap formation. Early trap formation and late expulsion timing from the basin models suggest capturing majority of early charge (low GOR oils) for these fields. The low GOR oils discovered in these fields also confirms the robustness of the models and shows the value of integration to predict fluid quality for the Paleogene fields. Furthermore, the structural models suggest that the salt weld near Julia took place before the St. Malo region and could help explain the subtle differences in fluid quality between the two fields.