Delineation Of Hydrocarbon Migration Sweet Spots In Shales Through 3d Basin Modeling, High Resolution Sequence Stratigraphy And Bitan (Bitumen Anomaly) Mapping Of The South Texas Lower Cretaceous Eagle Ford

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ABSTRACT

1D, 2D, and 3D basin modeling analysis integrated with 3D seismic, high resolution sequence stratigraphy, and BITAN (Bitumen Anomaly) mapping of 27 boreholes penetrating the Lower Cretaceous Eagle Ford Formation of South Texas provides new insight into intrashale hydrocarbon migration dynamics and helps delineate "sweet spots" of accumulation. Based upon gamma ray motif trends, the Eagle Ford can be divided into five distinct parasequence sets which remarkably correspond one to one with observed fluctuations in the global eustatic sea level curve. However, determining depth and horizontally thermally dependent liquid gas boundaries through constrained basin modeling kinetics contradicts over-simplistic paradigms of transgressive system tracts (TST) dominating organic richness. Indeed, of the five regionally mappable parasequence sets, regressive systems tract 1 (RST 1) and transgressive systems tract 2 (TST 2) provide the highest measured total organic carbon (TOC) and bitumen (S1) contents. Within the confines of particular parasequence sets, these bitumen accumulations are also spatially heterogeneous. To address the cause of these stratigraphically confined heteorgeneties, a novel approach to basin modeling was performed: BITAN mapping.

The BITAN method calculates S1 anomalous values by empirically dampening maturity, TOC, and organofacies effects. When superimposed upon 3D basin fluid flow models constrained by seismic structural interpretation and thermal modeled kinetics, BITAN mapping of the Eagle Ford helps delineate positions of depleted intra-formational source pods, migration pathway vectors, and enriched unconventional and conventional reservoir accumulations. While BITAN maps of parasequence sets indicate a numerous organic "sweet spots," the transgressive systems tract 4 (TST 4) provides the highest observed bitumen anomalies in the region.

This novel integration of 3D basin modeling, high resolution sequence stratigraphy, and BITAN mapping may have potential for the designation of intrashale migration in unconventional shales elsewhere.