Lean Salt Architecture in the Gulf of Mexico - Where Have all the Diapirs Gone

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Abstract

Each advancement in exploration technologies resulted in a shrinkage of the salt budget in the subsurface of the Northern Gulf of Mexico (GOM). This is primarily due to the improvements in seismic acquisition technologies and the achievements in seismic signal processing from modern pre-processing (e.g. deghosting) to high end Full Waveform Inversion and least-squares migration. Despite these technology leaps, the final seismic product strongly depends on the implemented salt model as this directly contributes to the imaging quality of the sub-salt architecture, which remains a major exploration objective in many salt basins including the GOM. Salt models have traditionally been influenced by the classical diaper approach that favors large deep rooted salt stocks and neglects salt emplacements due to lateral displacements in the deltaic passive margin sequence such as the Mississippi delta of the Northern Gulf of Mexico. The lateral displacements are associated with structural elements such as low angle detachments, lystric normal faults and compressive structures such as folding and thrusting. The structures may nucleate at existing salt bodies while their principal displacement direction are gravity-driven and a function of the load distribution. The latter may vary in magnitude and location over time and thus leads to stacked displacement complexes and associated salt systems throughout the sediment column. Superb examples are the RoHo systems along the Flex Trend of the Northern Gulf of Mexico, where individual RoHo basins interfere spatially and temporally throughout the Neogene and are associated with multilayers of tectonized salt bodies. Resolving the multilayer nature of the salt bodies is key for satisfactory seismic imaging of the sub-salt domain including the primary basin and has a direct impact on the success of hydrocarbon

exploration. We utilize a lean salt approach that avoids large salt bodies occupying the depth section too early in the model building process. Several techniques and workflows delineate individual salt bodies in the shallow section and enables separation of underlying salt geometries that would otherwise be hidden in voluminous salt bodies and thus would otherwise preclude imaging deeper sections. The lean salt approach enables imaging of the complete Cenozoic section underneath the shelf break of the GOM and resulted in a considerable reduction in the salt budget. Along the Flextrend and its RoHo basin domain the remaining salt bodies are arranged along structural layers that originated from individual salt sheets or salt tongues and often reveal welded, inclining salt feeders. Ultra deep mini basins in this area lack flanking salt bodies and appear to be controlled by deep-rooted gravitational spreading processes.