Structural and Stratigraphic Reconstruction of the Whiting Dome Salt Structure in Viosca Knoll-Mississippi Canyon, GOM, Using 3-D Seismic Data*

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Abstract

The understanding of salt tectonics and the complex structural ramifications therein are one of the most important factors regarding seismic interpretation of stratigraphy, structure, and geomorphology in the Gulf of Mexico. Evaluating the processes affecting modern mobilization of salt can help provide analogues for older, similar occurrences, thereby shedding light on questions about potential timing and migration issues of hydrocarbons. Cenozoic progradation of delta front and shelf to slope transitional sediments is currently deforming allochthonous salt (Whiting Dome) in the Viosca Knoll and Mississippi Canyon protraction areas of the Gulf of Mexico. This deformation appears to be somewhat analogous to Mesozoic rafting events found in the eastern Gulf of Mexico. Intensive study of the area, interpretation of 3D seismic data, and palinspastic restorations of the interpretation results should afford enough information to refine the effect differential loading had on mobilization of salt, said mobilization's effect on the overlying strata's structure and depositional setting, and the amount of future loading needed to cause further deformation of the salt body. This study was primarily conceived in response to recent literature detailing the evolution and migration of the Mesozoic aged rafts that have spawned the Norphlet deep-water play. While there are a great many similarities between the Norphlet rafts and the late Miocene-early Pliocene raft system described here, a few distinct differences must be noted. Unlike the Mesozoic rafting events, the salt tectonics of the Whiting Dome are completely controlled by the movement of allochthonous salt. Due to inherent nature of the allochthonous salt, rafting occurs both laterally and vertically in this study, whereas the Norphlet raft movement was primarily, if not entirely, lateral. In many aspects, the current stage of the rafting process more closely resembles that of the Kwanza Basin in Angola. Interpretation of the 3D seismic data was completed using IHS Kingdom 15. Forward and reverse modelling and palinspactic restoration was performed using Midland Valley's Move 2016 application. The three-dimensional seismic data used in this study was generously provided by TGS. All well information and well log data was pulled from the Bureau of Ocean Energy Management's public data domain.

Selected References


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STRUCTURAL AND STRATIGRAPHIC RECONSTRUCTION OF THE WHITING DOME SALT STRUCTURE IN VIOSCA KNOLL-MISSISSIPPI CANYON, GOM, USING 3D SEISMIC DATA

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Abstract

Understanding the complexities of salt tectonics are one of the most important factors regarding seismic interpretation of stratigraphy, structure, and geomorphology in the Gulf of Mexico. Evaluating the processes affecting recent mobilization of salt in the shallow well, imaged section can help provide analogues for older, similar occurrences in the deeper section, thereby providing structural models for the authochthonous salt and its affect on stratigraphy and even potential timing and migration issues of hydrocarbons.

Progradation of delta front and shelf to slope transitional sediments has expulsed and emplaced an allochthonous salt structure (Whiting Dome) in the Viosca Knoll and Mississippi Canyon projection areas of the Gulf of Mexico. Multiple salt mobilization concepts were employed in order to more specifically define the different stages of this salt structure. In a chronologic order, these include Rho (expulsion and initial emplacement), shelf and slope-deposited salt withdrawal minibasin and detachment (early development), whole cell gravity gliding (late development), and reactive halokinesis influenced diapir creation (catastrophes). A model was developed that describes the interplay between salt tectonics and sedimentation throughout by organizing a geologic history of the area, interpretation of 3D seismic data, stratigraphic mapping outboard and above the major salt structures, and conceptual restorations.

Interpretation of the 3D seismic data was completed using a 3D Kingdom 9.5. The three-dimensional seismic data used in this study was generously provided by TGS. All well information and well log was sourced from the Bureau of Ocean Energy Management’s public data domain. Strata is delineated using well log data and the MMS Biostratigraphic Chart publicly available through the BOEM.
salt was dominated by Pleistocene. Deposition of PUU strata outboard of existed was heavily truncated during the end of salt structure during PUU; what little deposition along the inner western flank of the minibasin. Middle and late Pleistocene deposits are the first significant, single chronosome (PUU) deposits. This marks the rising dominance of the Eastern Mississippi depositional axis. Strata in this chronosome are mostly slope layers and fan sediments. Continuing progradation of the shelf margin further evacuates allochthonous salt and most likely results in the first salt welds in the study area.