Analysis of Oil Samples from the Cholula Discovery in the Salinas Basin, Mexico — Implications for Deep Structuration and Migration History

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Abstract

In February of 2019 Murphy Oil drilled the Cholula-1 wildcat well in the Salinas Del Itsmo Basin, southern Gulf of Mexico. The well was positioned slightly off the crest of a complex compressional structure and discovered more than 200ft net gas & oil pay in the Late Miocene. A comprehensive geochemical analysis was carried out on two oil samples from vertically separated pay intervals. The results of this analysis have been integrated with a detailed study of the deep structures below the discovery and compared to published data to ascertain the source, migration path, and timing of the discovered oil. Fluid Inclusion Stratigraphy (FIS) analysis was also carried out to investigate potential charge history of the broader Cholula structure. The Campeche basin has undergone multiple phases of compression, with major orogenic events occurring in the Cenozoic as well as recent compression related to near-shore faulting which have been amplified by the presence of a thick Callovian salt layer. Before these major structural episodes, deposition of the Tithonian source rock occurred across the Gulf of Mexico and provides the source for all the major fields in both the Mexican and US sectors. Seismic interpretation of the Mesozoic section below Cholula suggests a complex history of thrusting and duplexing occurring early in the structures' history and has resulted in two distinct source rock levels comprising Tithonian source rocks. These intervals have been analysed by thermal modelling to determine the likely source of the oil currently trapped in the Miocene stratigraphy above. Different

types of geochemical analyses have all indicated that the discovered oils are low maturity and derived from a Mesozoic carbonate source facies, most likely deposited during the Tithonian stage. Given present-day reservoir conditions it is likely that the charge occurred recently in geological terms. The different analysis results between the oil samples in different reservoirs may suggests that one of the pay intervals has been refreshed and consequently charged more recently than the other. Whilst this charge appears to have occurred recently, the FIS results point towards a complex multi-stage migration history, though given the stratigraphic location of the discovery, PVT reservoir conditions may account for the varying hydrocarbon phases observed in the Cholula structure. When these results are integrated with the seismic-based detailed structural interpretation, the mechanism for charging this structure becomes apparent, and a possible model for the charging of this structure - and other structures in the basin - emerges.