Understanding the Evolution of Southern and Central Somalia Offshore Basins and Implications for Hydrocarbon Exploration

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ABSTRACT

Before 2014, understanding of the evolution of the Somalian passive margin had been dependent on low fold legacy 2D seismic and satellite-derived regional potential field data. Newly acquired seismic, gravity and magnetic data have facilitated the development of new theories on the evolution of the Somali passive margin. Offshore Somalia has three main basins: Obbia Basin in the north, Coriole Basin in the centre, and Juba-Lamu Basin extending into Kenya. We note a marked difference in the crustal architecture between the Obbia and Juba-Lamu Basins, and relate these to variations in structural deformation styles generated by the fabric of the rift and ocean-plate transforms. Syn-rift-related normal faulting, creating the basin geometry and accommodation space for deposition of Jurassic source, is followed by drift, strike-slip movement, compression and inversion during multiple plate reorganisations. The variation in nature and distribution of sediments along the margin can be attributed to differences in sediment supply, depositional style, accommodation space and sub-basin tectonics. To understand regional heat flow and source rock maturity, model gravity response profiles have been generated for the Obbia and Juba Lamu Basins. The gravity signature in Obbia is consistent with hyper-extension of continental crust, transitioning through to exhumed mantle and oceanic crust. The hyper-extended continental crust model is associated with high heat flow placing shallow mid-Jurassic syn-rift source in the peak oil-generating window. We describe a number of play-types in the Obbia Basin which are categorized within a system of exploration risk analysis. To the south oceanic crust underlies a thick clastic sequence in the Juba-Lamu Basin; a lower heat flow puts the more deeply buried Eocene, Late Cretaceous and syn-rift Jurassic source rocks in the oil-generating window. Clastic plays are identified in a series of Cretaceous folds near shore, which are overlain by mega-slide fold and thrust belt complexes displaying numerous potential traps. Further offshore, large basin floor fan complexes are identified above Early Cretaceous source rock. The modelling of oil generation in this hydrocarbon system is supported by satellite optical slick analysis. This new understanding of the crustal architecture beneath offshore Somalia is guiding our interpretation and allows us to propose a number of exciting unexplored exploration plays in this truly frontier region.