

Petroleum Prospectivity of the Houtman Sub-Basin, Offshore Perth Basin, Australia

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ABSTRACT

The Houtman Sub-basin is an under-explored region of the northern Perth Basin, offshore Western Australia. Interpretation of Geoscience Australia's regional 2D seismic survey GA-349 reveals that this frontier depocentre contains up to 19 km of sediments. Regional correlation of the interpreted seismic stratigraphy across the offshore Perth Basin indicates that this includes up to 16 km of Permian–Early Cretaceous succession, with the potential to contain multiple source rocks equivalent to those identified in the adjacent producing depocentres, including the regionally extensive late Permian–Early Triassic Kockatea Shale. Multiple possible play types have been identified, including Permian–Early Triassic stratigraphic traps and Jurassic–Cretaceous tilted fault blocks. This study uses pseudo-3D petroleum systems modelling and a comprehensive review of the all offshore northern Perth source rocks to investigate the maturity and charge history of 10 potential Permian–Jurassic source rocks in the northern Houtman Sub-basin. A regional pseudo-3D petroleum systems model was constructed using the new seismic interpretation and sequence ages were assigned based on a newly developed regional tectonostratigraphic chart. The thermal history of the basin was modelled using lithospheric structure changes through time and was calibrated using corrected temperature and maturity data from 9 Perth Basin wells located along strike in equivalent tectonic settings. Source rock properties were assigned based on an extensive review of TOC, Rock Eval and kinetic data from all offshore Perth Basin wells. Results predict that large cumulative hydrocarbon volumes have been generated from Permian–Triassic source rocks across the study area, whilst Jurassic sources remain mostly immature. The spatial distribution of each potential source kitchen varies depending on burial depth, heat flow associated with rifting and the amount of Valanginian erosion. Potential source rock yield is also highly dependent on source characteristics. The most promising potential source rock is the oil prone Hovea Member of the Kockatea Shale. If present, this has the potential to have generated large volumes of oil along the inboard margin of the sub-basin. The majority of generation and expulsion occurred prior to Valanginian break-up. Therefore the relative timing of expulsion and migration versus trap formation, along with trap preservation, remain key exploration risks.