Conceptualising trapping frameworks and prospectivity trends using stratigraphic forward modelling

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Stratigraphic forward modelling (SFM) is a sedimentary process simulation that reproduces the development, transport and accommodation of sediment supply. SFM enables the prediction of lithofacies in areas where data are sparse, unevenly distributed, or at inappropriate resolution. It is particularly relevant in underexplored frontier sedimentary basins to reduce lithofacies distribution and architecture uncertainties. This approach is classically used to improve prediction of distribution and quality of lithofacies such as reservoir and source rocks in petroleum systems.

We used SFM to conceptualise the structural trapping framework and highlight hydrocarbon prospectivity trends in the Late Cretaceous marine and deltaic interval of the underexplored Ceduna Sub-basin. We sampled lithofacies, net-to-gross and shale volume distributions from a high resolution SFM over the Tiger and Hammerhead delta systems to evaluate reservoirs and seals juxtaposition patterns, quantify fault membrane seal and predict structural trapping opportunities.

The SFM for the Ceduna Sub-basin highlights a first order stratigraphic trend controlling the basin-scale reservoir and top seal prospectivity. It also predicts enough vertical variability within the sequences to create a wide range of stacked reservoir-seal couplets and to support local prospectivity from the central to the deeper offshore part of the sub-basin. We derived prospectivity trends from triangle juxtaposition diagrams and fault seal quantification performed on SFM dataset. These highlight a restricted WSW-NE prospectivity trend with the best reservoir and seal couplets in the Tiger and lower Hammerhead as well as a E-W prospectivity trend in the upper Hammerhead delta where thicker sand intervals are predicted, and structural trapping associated with juxtaposition seals and membrane fault seal is expected. Our conceptual trapping framework also underlines major risks for trapping potential in the central Ceduna, consistent with the findings at the nearby Gnarlyknots-1A dry well.

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