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Investigating Potential Charge Mechanisms in the Levantine Basin Using 1D Basin Modelling

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The Levantine Basin holds some of the largest deepwater gas discoveries of the last decade. These accumulations are widely reported to have a biogenic source; however, reports of minor condensate yields from fields, such as Tamar, suggest there is a thermogenic contribution. Furthermore, wells located in the shallower Levantine Basin (Yam-2 and Yam-Yafo-1) have recorded both light oil shows and gas with a thermogenic isotopic composition in Middle Jurassic carbonates. This evidence of a working thermogenic kitchen raises the possibility of reservoirs deeper than the existing biogenic fairways receiving a charge.

This study uses basin modelling to investigate the maturity and timing of generation in potential source rocks and assesses the possibility of a thermogenic charge in the Levantine Basin. Data inputs were developed by integrating publicly available data with regional geological interpretations. A 1D basin model of the Tamar_4 well, calibrated using reservoir temperature measurements, is used to evaluate potential source rocks in the Early Triassic, Early Jurassic, and Oligocene epochs. The timing of the biogenic charge is also assessed. The heat flow that thermally calibrates the Tamar_4 model is then used as an input for a 1D model of a pseudowell on the flank of the Zohr discovery. Additionally, a second, lower heat flow scenario is tested at the Zohr_Flank model location.

Tamar_4 well modelling indicates potential source rocks in Triassic or Jurassic stratigraphy could have generated thermogenic gas following the mid-Miocene Syrian Arc trap formation, accounting for reported low condensate yields at Tamar. However, the majority of the charge is likely to have predated the mid-Miocene trap forming event. Deeper traps that formed earlier (e.g., Mesozoic carbonate build-ups on basement highs) potentially received a greater portion of this charge.

When potential Triassic and Jurassic source rocks are modelled on the Zohr discovery flank, a wet gas charge to the Zohr reservoir after Messinian trap formation is predicted. If the Zohr field gas contains no thermogenic contribution, as suggested by the reports to date, it can be inferred these source rocks are absent in the Zohr catchment. This could imply that Triassic/Jurassic source rock presence is restricted to the basin center. As a result, deeper plays could only be prospective where they are in proximity to the deepest parts of the Levantine rift (Fig. 1). The high level of thermal maturity within the basin center implies any discoveries within a deeper fairway are likely to be gas-rich. The Oligocene is predicted to be immature at both modelled locations.

Results of this study indicate that biogenic charge to the Tamar reservoir predates the Messinian lowstand. In the absence of significant thermogenic contribution after this event, any escaped gas, spilled as the result of gas expansion during the Messinian drawdown, would not have been replaced. Consequently, underfilled structures and corresponding fill level could pose a significant risk to smaller prospects with a similar burial history to Tamar.