New Exploration Play Concepts in the North Sumatra Basin, Indonesia: Subsurface Insights from Around Timpan-1

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Half of the energy consumption in Indonesia is currently sourced by oil and gas (EIA, 2021). However, Indonesia's proven natural gas reserves totalled 49.7 trillion cubic feet (TCF) in 2021, down more than 50% from 100.4 TCF in 2019, and with a reduced replacement rate of oil reserves (EIA, 2021), there is need for a redoubling of effort for advantaged oil and particularly gas exploration in the region to replenish reserves while also supporting the longer-term energy transition.

The first significant oil discovery in Asia was founded in 1885 at Telega Said oil field, onshore, North Sumatra Basin, Indonesia. Despites its long history, there is still significant undiscovered hydrocarbon potential in the North Sumatra Basin (and Mergui Basin), for example with the recent exploration success of the Timpan-1 gas well in the deep-water Andaman II license block (and the Layaran-1 well in the South Andaman III block).

The Timpan-1 well, a deep-water play opener, comprises Late Oligocene turbidite sands in extensional roll-over structures trapped within an anticline. The sourcing petroleum fluids come from Oligocene deep marine shales of the Bampo Formation. There are more follow up exploration wells planned in 2024 including Gayo-1, Timpan-2, Halwa-1 and Timpan Utara (Craig, 2023), after a significant gas find in the Tangkulo-1 well (March, 2024). Such exploration comes at an increased risk, particularly with the Rencong-1X dry hole in July 2022, which targeted carbonate build-ups on footwall highs, but with a subsequent lack of a charge. Therefore, in this frontier petroleum province, attention must now be re-focused on play-based exploration workflows - identifying where source rocks, reservoirs, and seals, are proven or likely to be present, and where source rocks are mature, reservoir quality is retained, and seal integrity is preserved.

This presentation uses sequence stratigraphic and geodynamic principles, supported by publicly available geoscience data, such as wells and seismic, and regional analogues, to predict new play concepts within the Cenozoic strata of the North Sumatra Basin. This approach provides a spatial and temporal framework which reduces tectonostratigraphic uncertainty and offers predictive capabilities away from data control. Herein, we focus on four important intervals of Cenozoic stratigraphy associated with the following play concepts:

- Middle-Late Eocene: Shallow-marine carbonate build-ups on footwall blocks
- Oligocene: Shallow-marine carbonate build-ups on footwall blocks; turbidite sands in anticlines
- Early Miocene: Shallow-marine carbonate build-ups on footwall blocks; turbidite sands in anticlines
- Middle-Late Miocene: Turbidite sands in anticlines

Given the recent exploration successes and failures in the basin, de-risking the likely extent of the source rock kitchen is a critical component in play-based fairway mapping. By integrating a stratigraphic basin analysis depth framework, current geothermal gradients to produce a maturity map, and the presence of the organic-rich Bampo Formation to produce the extent of the kitchen, identifies the likely extent of the charge for the play concepts identified above. These steps are combined to produce a first-pass, play fairway screening to highlight the hydrocarbon exploration potential in the North Sumatra Basin.

References:

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