



Untapped potentials exploration for deep-marine gas-bearing reservoirs: a case study from the Taranaki Basin

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Abstract

The discovery of huge gas plays in the deep-water geological systems (e.g., eastern Mediterranean, North America, southern Pacific, etc.), along with improving the exploration technique, have encouraged the exploration campaign to resume the exploration activities in similar contexts around the globe. As such, the onshore-offshore Taranaki Basin, which is the sole gas-bearing basin in New Zealand, has an extensive exploration campaign focused on the onshore parts of the basin, whereas the deep-water regions are still poorly explored. Among these petroleum systems, the architecture of the Palaeogene-Neogene reservoirs in the Western offshore Taranaki Basin, and the implication of depositional and diagenetic attributes on their reservoir quality are yet obscure. To address the above uncertainties, we integrate seismic-stratigraphy, well log analysis, and petrographic investigations to define the stratigraphic evolution and reservoir facies distribution, revealing the factors controlling the development of their pore systems. This petrophysical analysis reveals that, the sandstones of Farewell F have the best reservoir quality within the Palaeocene transgressive succession. Furthermore, clastic-dominated shelf conditions continued during the Eocene, where the transgressive sandstones of Kaimiro D reservoir presented the main reservoir within the Eocene succession. However, due to ineffective migration, both reservoirs are tested and considered non gas-producing. Results of this testing suggested that, upwards, a deep-water sedimentation prevailed during the Middle Miocene, resulting in the deposition of basin-floor fan lobes/sandstones of the Manganui Formation and its equivalent Moki Formation, which could host the most potential reservoir targets due to the presence of many sand lobes. Therefore, the present study recommends testing these sand lobes. Finally, our findings highlight the significance of reanalyzing and integrating seismic stratigraphy, well logging, and petrography in exploring the untapped potential reservoir zones in the Taranaki Basin that can be used globally in similar settings.

Keywords Seismic stratigraphy · Petrophysics · Petrography · Palaeogene-Neogene · Reservoir quality · Taranaki Basin

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Introduction

Understanding the depositional and diagenetic controls on the reservoir facies distribution and architecture is crucial for minimizing the hydrocarbon exploration risks, particularly in deep-water geological contexts (Walker 1978; Richards et al. 1998; Elatrash et al. 2021a; Xu et al. 2022; Leila et al. 2022a; Radwan and Nabawy 2022; Li et al. 2023; Zhou et al. 2023; Nabawy et al. 2023a, b). The discovery of huge gas plays in the deep-water geological systems (e.g., eastern Mediterranean, North America, southern Pacific, etc.), along with improving the exploration techniques, have encouraged the exploration campaign to resume the exploration activities in these contexts around the globe (Kuznetsov et al. 2016, 2017; Su et al. 2023).

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