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Pore Pressure Evolution and Distribution Across a Tectonostratigraphically Complex Basin, Taranaki Basin, New Zealand

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ABSTRACT

The Taranaki Basin (TB) is New Zealand's only hydrocarbon producing basin, and lies onshore and offshore in the central-west of the North Island. The polyphase nature of the basin led to a complex pore pressure history, generating significant variations in present day vertical and lateral distribution of overpressures. Cretaceous to Early Miocene Formations can be found both normally pressured (near or at hydrostatic) and significantly overpressured (>1500psi/10MPa) at the same depth in separate parts of the basin. 1D burial history modelling and wireline pore pressure prediction has shown that thick marine mudstones are overpessured on the Stable Western Platform in the offshore Taranaki, but this is not supported by direct wireline RFT pressure measurements from the corresponding reservoirs, which are close to hydrostatic. Direct wireline measurements in the Cretaceous of the Western Platform clearly display a reduction in overpressure with depth, which is indicative of a downward hydraulic flow also known as lateral drainage. These long drainage pathways can stretch great distances, as shown by the depletion of Palaeocene reservoirs in the Tui Field from production in the Maui Field 20km away. In comparison, rapidly subsided narrow fault bounded grabens In the Northern Taranaki, filled with thick undercompacted marine mudstones and thin shallow marine sandstones, act as independent pressure compartments. Sealing faults and thick competent top seals inhibit lateral and vertical drainage leading to maintenance of significant overpressures, and in one such graben a well experienced a 4000psi (28MPa) kick calculated to be 730psi (5MPa) below leak-off. In the Southern Taranaki, thin sand stringers within thick undercompacted mudstones are stratigraphically isolated, and can display formation pressure increases of 1705psi (11.8MPa) in only 154mTVD, which poses a significant drilling hazard. This study highlights the need to understand the nature and distribution of pressure compartments and fluid migration pathways in order to accurately predict formation pressures and assess potential enhanced porosity and reservoir quality.