Outstanding Potential Identified in a Newly Recognised Mixed Turbidite Contourite Reservoir System, Offshore Papua New Guinea

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ABSTRACT

Since the turn of the century there has been an acceleration in the research and recognition of contourites and mixed-hybrid, turbidite contourite systems. This new focus has been sharpened by prolific hydrocarbon discoveries, such as the Coral and Mamba systems, offshore Mozambique. It has been recognised that the synchronous interaction of turbidity and contour currents (hybrid) and the asynchronous reworking of turbidite sands by bottom current activity (mixed) can vastly improve reservoir parameters such as net to gross ratios. Despite the emphasis for hydrocarbon exploration, plus vast improvements in seismic imaging, there are few published seismic examples of large scale 'sandy' mixed turbidite contourite systems.

Recent proprietary and regional multi-client 2D seismic data, offshore Papua New Guinea, transformed the understanding of the tectonostratigraphic evolution of the region and uncovered the presence of large scale turbidite fairways and submarine fan complexes, deposited during the Mid-Miocene, linked to active tectonism and the formation of the proto–Owen Stanley Range. New high-resolution, broadband, FWI guided Q-PSDM, 3D seismic data, acquired in 2023 by Larus Energy and Searcher has now revealed the synchronous interaction and subsequent reworking of these turbidite systems by strong contour currents.

Seismic attributes and facies analysis illustrates a wide spectrum of features associated with hybrid and mixed turbidite contourite systems. Hybrid asymmetrical channel levees on the middle slope make way to high concentration sandy channel and lobe complexes towards the base of slope and basin floor. Periods of moderate-high current activity have distinctively reworked the slope channel and basin floor lobe complexes, forming furrows, sub-circular depressions, channels, sandy sediment waves and dune features.

Basement highs due to underlying rift structure formed bathymetric high grounds in the Miocene, which both ponded and diverted the course of the submarine fan and locally influenced the direction and strength of the contour currents, thus exhibiting a spatial control on the preservation of turbidite channel-lobe fabric, and on the distribution of erosional and constructive contourite reworking features. It is also observed that bottom currents also provide a mechanism to redistribute coarser grained material up-slope and beyond the limits of the traditional turbidite fairway.

The reservoir units are overlain by thick intervals of hemipelagic shale and involved in 4-way, thrust anticline traps which post-date deposition. High quality seismic data has imaged fluid escape features linked to breached reservoir units. Deep water, cold-seep, chemosynthetic reefs can be observed in the areas effected by fluid escape. Seismic hydrocarbon indicators combined with geochemical analysis of offshore drop cores and onshore light-oil seeps indicates the presence of a working petroleum system.

Seated as it is in the new era of seismic imaging, the large scale of the thrusting and structuring in this area, has been integrated with sophisticated unconventional petroleum systems models and the detailed analysis of a newly recognised sand rich, turbidite contourite play fairway. The exciting opportunity presented by integrating these elements in an unexplored basin, is that it generates the opportunity for the size of material discoveries that will make a difference on a globally significant scale.

State of the art seismic acquisition and processing has delivered the foundation for high-end geophysical and geological studies. Optimised data and enhanced understanding, combined with challenging conventional wisdom and the determination to continue exploring during uncertain times, has provided the keys to unlocking the huge potential of this frontier basin.