De-risking Trapping Structures Through Depth Reprocessing in Orange Basin, Namibia

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Abstract

The Orange Basin of Namibia is currently one of the hottest frontier basins in the world. The play-opening Venus and Graff discoveries of 2022 provided the catalyst for initiating a series of multi-well drilling campaigns by TotalEnergies, Shell and GALP in 2023. An additional drilling program by Chevron is anticipated in 2024/2025.

The Venus discovery is an Aptian-Albian deepwater basin floor fan deposited in the oceanic crustal domain of the Orange Basin, directly overlying the Aptian source. One of the main components of the larger Venus play is counter-regional dip in the outboard. In deepwater domains with much subtler depositional structures, the true dipping geometries can only be assessed in depth migrated seismic. The Graff discovery found oil in Cenomanian and Coniacian-Santonian aged slope fans at the distal end of a toe-thrust system, sealed by shales along the thrust detachment. The gravitational system is located inboard of a structural high (Outer High), which likely provided structural control in the form of a backstop during deposition, allowing Upper Cretaceous sands to pond to the east of the Outer High and delimiting the distal extent of the toe-thrusts. Pre-stack Depth Migration (PSDM) imaging is essential in order to de-risk trapping in similar structures and correctly image structural dips beneath the gravitational system.

Detailed play mapping has been carried out based on an extensive regional 2D seismic library in the Orange Basin which includes multiple surveys that have been reprocessed in the last 10 years. With the requirement for more detailed seismic attribute mapping post-discoveries, these surveys are currently being re-imaged to depth, covering the whole continental slope from shelf to deepwater with a regional Kirchoff depth migration in one combined dataset using modern PSDM processing workflows. The new dataset enables a more robust understanding of structural relationships and subtle variations in structural dips and trends across the basin, allowing a more detailed assessment of hydrocarbon migration pathways, charging points and trapping geometries. Additionally, the dataset prevents potential misties between surveys, improving confidence in the regional tie of surfaces between surveys and the seismic attribute interpretation within the fairways. In this study we show the results of PSDM re-imaging and examples of how this dataset is crucial to draw the correct conclusions for regional prospect screening based on the recently proven hydrocarbon retention trends.

Many of the prospects mapped in the Orange Basin rely on stratigraphic trapping (e.g. basin floor fans, sub thrust fans), in which case imaging the reflector dips correctly aids the assessment of seismic attribute and Amplitude Versus Offset (AVO) mapping, improving confidence in their conformance to overall structural trends during prospect mapping.

Innovative new PSDM datasets such as these are key to successfully image and de-risk the subtle stratigraphic and combination traps in the Orange Basin deepwater domain. We show examples of counter-regional dips revealed in PSDM where there was previously no visible closure on the time data, and the impact this has made on prospect mapping in depth versus time. Detailed play mapping on these integrated PSDM data illustrates the potential for sizeable stratigraphic traps, which could appear smaller or be missed on time data alone.