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Total Bi Wats Case Study- From Survey Design to Interpretation

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Summary

Block 32, deep offshore Angola, is located in an area of the Lower Congo Basin heavily affected by the salt tectonism: salt domes or canopies are extensive. As a consequence having a good seismic image is critical in terms of exploration but also development of discoveries.
Over the past decade the focus has moved towards the sub-salt play and the use of conventional seismic has reached its limits.
As a consequence, Total E&P Angola embarked in 2012 in a project to address complex subsalt challenges in the Central North East part of the Block 32, using innovative technologies: from survey design, to acquisition, processing and imaging. The objective was to deliver interpreters a state-of-the-art and fit for purpose solution in a timely and cost-effective manner.
This project is known as the Block 32 CNE Bi WATS.
This abstract aims to give a full overview of the project, from its genesis to its execution, and finally present some of the results

Introduction

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Survey Design

In such a complex geological environment, 3D finite difference modelling is a key step to propose a fit-for-purpose survey design. From past experience, 3D finite difference modelling was performed from realistic velocity and density model.
Several scenarios, from standard wide azimuth towed streamers (WATS) to ocean bottom nodes designs, were investigated.
With cost efficiency in mind, the broadband Bi WATS design was retained (2 WATS surveys shot perpendicularly – see figure 1).

Acquisition

Following the survey design study and call for tender process, the acquisition was launched in October 2013 and finished in July 2014, using 3 vessels (1 master 12 streamers of 8km & 2 sources).
CGG broadseis technology (Variable Depth Towed streamers) was used.
Despite logistical and operational challenges, this survey was conducted in a timely and safely manner.
A production of almost 130,000 Super Shot Gathers (1 Super Shot being equivalent to a Shot Point of 72 streamers of 8,000 m, 46,600 traces covering almost 57 km², 235 Million of Samples acquired each 10seconds) of good quality have been acquired.

Processing and Imaging

An optimized, state of the art and cost effective pre processing was run with CGG centre in Crawley, UK.
The latest broadband and demultiple technologies available at that time enabled to get a good result within a relatively short timeframe.
Then, Total embarked internally in an enhanced imaging project.
From velocity model building using reflection tomography and advanced full waveform inversion, with heavy interpretation efforts for salt modeling, an optimized velocity model has been created, allowing the use of advanced migration algorithms.
The best results were achieved with optimized RTM angle stacks.
Due to the amount of data involved, Total allocated a significant CPU resources (most of its Pangea HPC was mobilized for this project), allowing unprecedented data quality in the area (see figure 2 for comparison of vintage dataset compared to final Bi WATS image).

Interpretation and Conclusion

The final RTM optimized migration was delivered to interpreters in 2016 and has allowed a detailed interpretation of the area at the exploration scale, confirmed the presence of several deeply buried salt mini basins and allowed for the re-evaluation of several prospects and undeveloped discoveries on the Block.

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Figures:

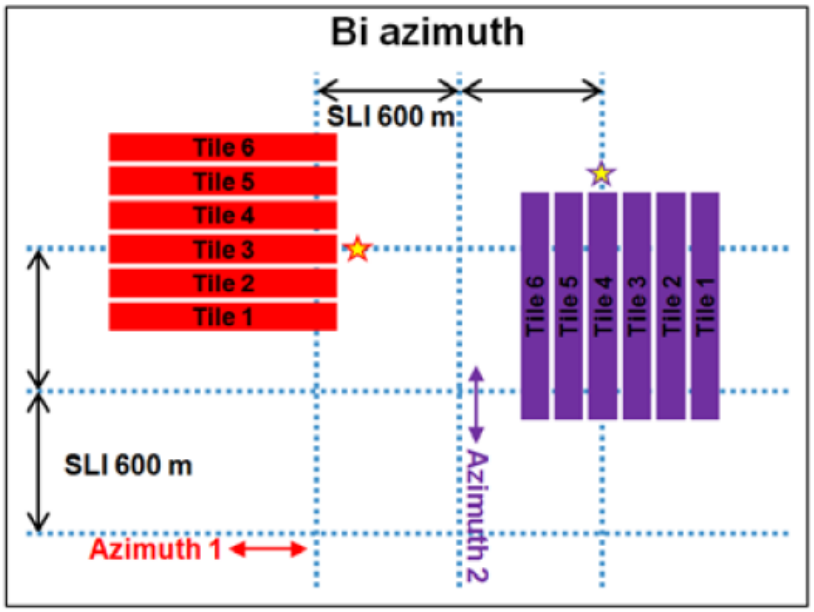

Figure 1 *Final design retained.*

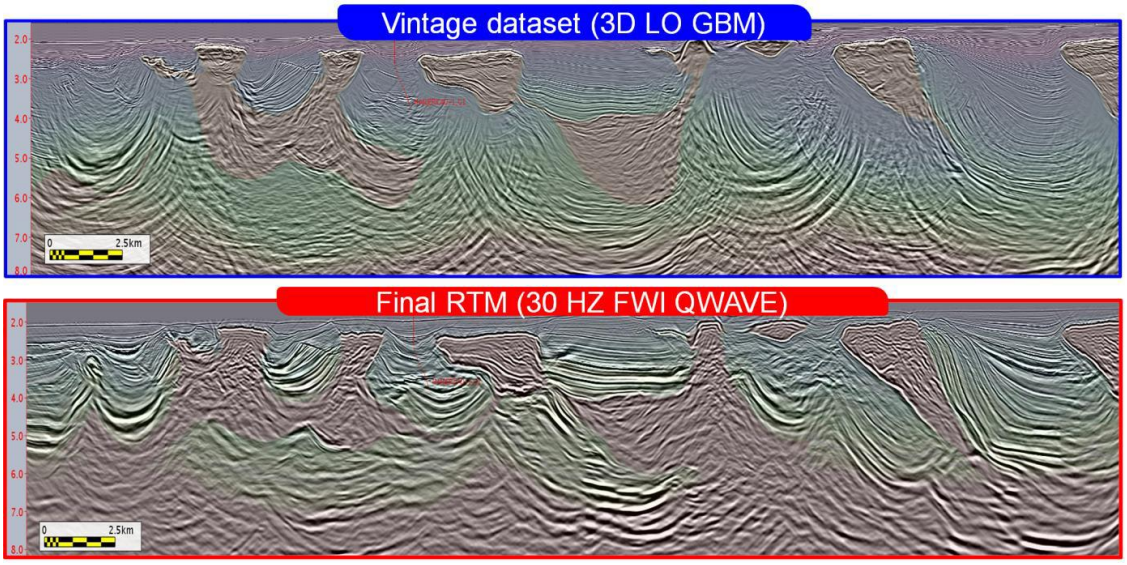

Figure 2 *Final Bi Wats results vs Final vintage image.*