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The Lower Congo Basin: Expanding play fairways and exploring the deeper potential

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Summary

The Lower Congo Basin is a mature exploration province but has significant remaining potential, where existing plays can be extended into areas of greater geological complexity. Modern seismic acquisition and processing techniques are enabling new play elements to be imaged, which are likely necessary for exploration success.

Introduction

The Lower Congo Basin (LCB, Figure 1a) has for decades been an area of significant focus for oil exploration and production. The 1960s saw the first offshore wells drilled in the shelfal domain before efforts moved to the deep-water in the mid-1990s, opening a petroleum province where over 15 billion barrels of reserves have been discovered to date.

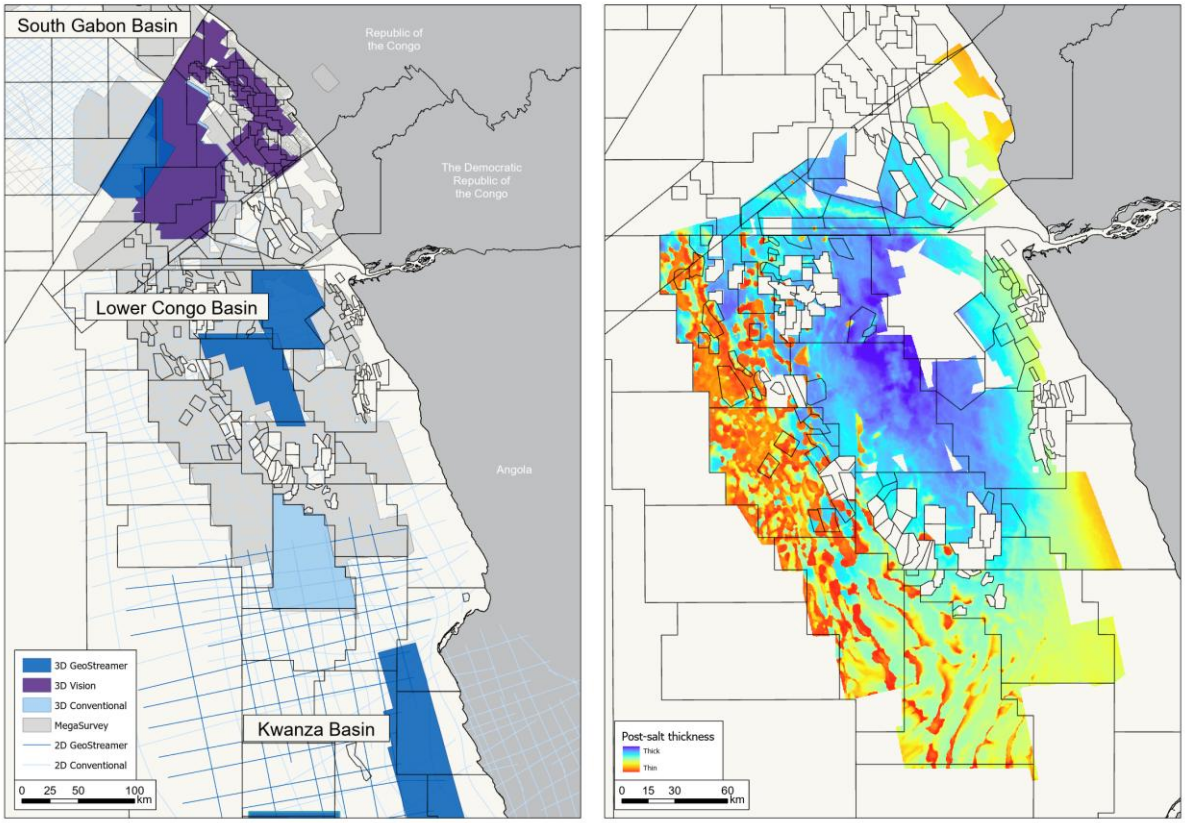

Figure 1: *(a) Lower Congo Basin location map and seismic coverage utilized in this study and (b) regional post-salt thickness map derived from MegaSurvey data (culture from S&P Global)*

Geology and Prospectivity

The deep-water environment of the LCB is characterized by a thick Oligo-Miocene clastic section (Figure 1b) that has been deposited within an extensive salt basin. The rapid deposition of up to 7 km of sediments within the last 33 million years has loaded and mobilized the Aptian salt, resulting in numerous allochthonous bodies that generate challenges in seismic imaging, but also play a key role in the success of the basin.

The dominant play of the deep-water setting comprises Oligo-Miocene slope channel sands charged by hydrocarbons generated from rich, post-salt marine source rocks of Upper Cretaceous to Lower Tertiary age. The reservoir fairways have been mapped in detail by Anderson et al (2012), principally as confined slope channel complexes whose distribution and thickness have been controlled by actively evolving salt structures. These clastic systems can be clearly identified on extensive seismic data, extending into underexplored areas.

To continue to have exploration success within the basin, there is a need to better understand the deeper stratigraphy in the deep-water environment. Maturity of the post-salt source rocks has not always been a certainty when exploring the Oligo-Miocene play, and so consideration needs to be given to the potential of deeper petroleum systems in the pre-salt, as proven in the shelfal environment (Burwood,

1999), along strike in the neighbouring Kwanza Basin, and on the conjugate margin in Brazil. The pre-salt section is currently untested in the deep-water LCB.

A review of exploration drilling has been performed that reveals further justification to study the older stratigraphy in more detail. Significant finds have been made in recent years within the deeper post-salt section, below earlier drilled targets that displayed hydrocarbon shows or were previously declared as uncommercial discoveries.

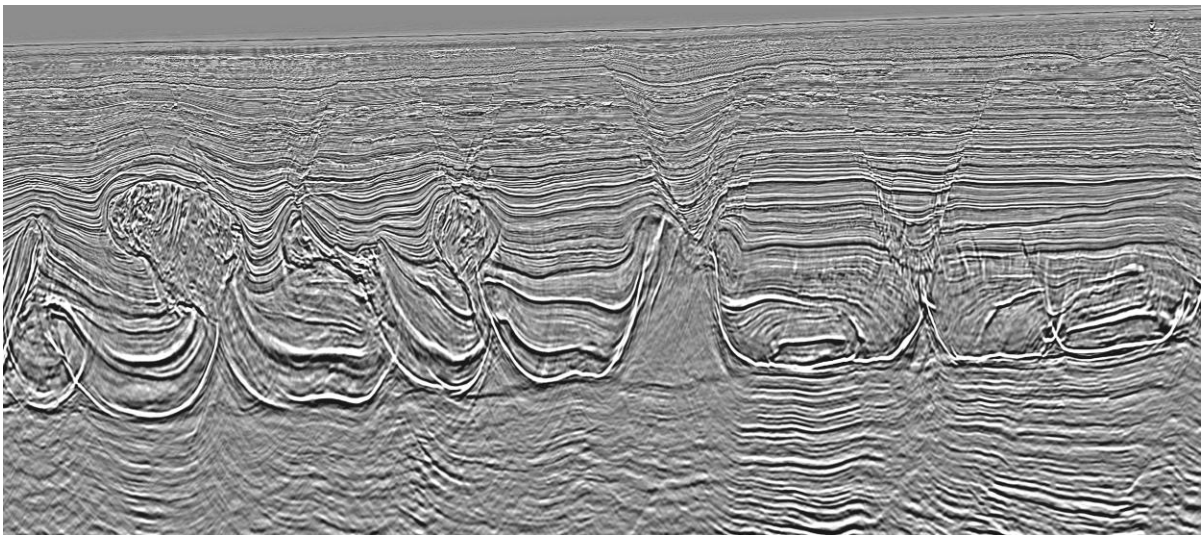

Figure 2: *Reprocessed (2023) West African legacy data acquired with 4-4.5 km streamers, displaying improved image throughout, especially in the sub-salt environment.*

The initial drive in deep-water exploration relied heavily upon 3D seismic to de-risk prospects. Closures were identified in relatively simple trapping configurations and drilled with great success. Turbidite channel systems draped salt-cored anticlines in combination traps, formed structural closures in fault-bound three-ways and on the flanks of salt structures. Effective seismic imaging of these traps, whilst advanced for the 1990s, is straightforward by modern standards. More complex trapping geometries that are considered as the next targets within the basin require more advanced processing solutions and these have been seen to give excellent results in the region, even when reprocessing short-cable legacy 3D seismic (Figure 2).

Conclusions

Despite being a mature basin, significant potential remains in the deep-water LCB and with seismic examples, we demonstrate how this can be revealed with the use of modern technology in complex geological situations.

References

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