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Demonstrating the Benefits of Dual-Sensor GeoStreamer(R) Broadband on the Characterization of the Caswell Sub-basin

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SUMMARY

The objective of this paper is to illustrate both the qualitative and quantitative impact of interpreting dual-sensor towed streamer seismic from the perspective of the reservoir geoscientist by focusing on a new 9224 km² 3D survey over the Caswell Sub-basin in the Northwest Shelf of Australia.

This case study investigates the broad bandwidth seismic improvements for structural and stratigraphic interpretation, including prospect delineation at the Mesozoic level. It will also highlight the AVO fidelity for future AVO and pre-stack simultaneous seismic inversion work. Furthermore, deeper Triassic plays have been clearly imaged for the first time in the survey area and reservoir property estimation is demonstrably improved due to the contribution of enhanced low frequency amplitude and phase stability across the offset/angles.

Introduction

For many years, conventional streamer (hydrophone-only) seismic data, as an interpretation tool, has been a cornerstone of successful oil and gas exploration. Its application to prospect de-risking has proven invaluable given its significantly lower cost base to that of a well. However, with shrinking acreage opportunities and a challenging economic climate, the need to reduce the geological-geophysical and commercial uncertainty prior to final investment decision (FID) has become more imperative. Industry now offers a number of broadband solutions improving the quality of the seismic image, but the crucial progression into Quantitative Interpretation (QI) has been led by dual-sensor towed streamer acquisition technology (GeoStreamer[®] developed by PGS in 2007).

This provides E&P companies with the resolution (Figure 1) to “explore new stratigraphic traps and delineate subtle structural closures, and enhance reservoir development and hydrocarbon recovery with more information about local facies variations and reservoir compartmentalization” (Duval, 2012). Dual-sensor streamer seismic extends the useable frequency range (lows and highs) without compromising integrity in the pre-stack domain and consequently, AVO behaviour. The fundamental concept that value is obtained not only in the full-stack image but in the pre-stack seismic response will be demonstrated throughout.

Figure 1 Triassic depth slice with coherency attribute & RGB to enhance fault interpretability and potential reservoir compartmentalization.

Objectives

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This case study investigates the broad bandwidth seismic improvements for structural and stratigraphic interpretation, including prospect delineation at the Mesozoic level. It will also highlight the AVO fidelity for future AVO and pre-stack simultaneous seismic inversion work. Furthermore, deeper Triassic plays have been clearly imaged for the first time in the survey area (Figure 2) and reservoir property estimation is demonstrably improved due to the contribution of enhanced low frequency amplitude and phase stability across the offset/angles.

Figure 2 Crisp imaging of the deep Triassic framework shows the interpretation benefits of the strong S:N low frequency component of dual-sensor streamer seismic in depth.

Method

Evaluation of the interpretation confidence provided by dual-sensor streamer seismic is focused around mapping of the prospective Early Jurassic Plover Formation and the Early Cretaceous Upper Vulcan Formation, in which evidence of channelization can be demonstrated. The analysis incorporates all available well data in both the pre- and post-stack domains for validation/calibration of the broadband seismic response. There are currently limited penetrations below this level in the survey area due to the poor quality imaging from legacy datasets; however, high resolution examples from the Caswell MC3D help to promote the untapped potential of the deeper Triassic interval by means of reservoir characterization using volume attributes.

Conclusions

This case study showcases the impact of towed dual-sensor streamer seismic on all aspects of the G&G workflow and the uplift is most evident in terms of the improved penetration and imaging of the deep Triassic targets, combined with the improved fidelity of the pre-stack elastic attributes extracted from the pre-stack simultaneous seismic inversion work.

References

Duval, G. [2012] How broadband can unlock the remaining hydrocarbon potential of the North Sea. *First Break*, **30**(12).