

Geophysical Evaluation of the Kakapo Miocene Prospect, Taranaki Basin, Offshore New Zealand

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Summary

This talk presents a geophysical evaluation of the offshore Kakapo Miocene Prospect in the Taranaki Basin, New Zealand. The relevant regional geology, stratigraphy and paleogeography are presented as a backdrop to the geophysical mapping of the prospect within the basin. The 2D seismic mapping is discussed and AVO analysis presented which specifically addresses issues of areal extent of the prospect, hydrocarbon presence and trapping mechanisms. This talk demonstrates the challenge to define these play elements, using multiple seismic techniques, in a high potential and reward stratigraphic trap type prospect.

Introduction

The Kakapo prospect lies southeast of the giant Maui Field (gas), west of the recently developed Kupe South Field (oil and gas), and east of the recently developed Maari Field (oil). In water depths ranging from 30 to >120 m, a total 137 2D seismic lines, covering 3200 km, were integrated into the seismic interpretation and mapping.

There are no wells drilled on the prospect currently but the seismic grid ties to the Motueka-1 well, drilled in 1990, 70 km southwest of the prospect. The Motueka-1 well encountered fairly clean very-fine- to fine-grained Motueka sandstone beds up to 37 m in thickness as defined by sidewall core analysis and sample cuttings. The Motueka sandstone member is an informal stratigraphic unit which occurs in the middle part of the Middle Miocene Manganui Formation. (Morrison and Rivers, 1991) It is this well and the extensive seismic database that is key to the mapping and defining the Kakapo prospect to the north.

Wells and seismic from the adjacent Maari oil field were used in the AVO analysis as a template for the Kakapo prospect. The Maari Field oil production is also from a Miocene aged formation with similar thicknesses and petrophysical properties as expected in the Kakapo prospect.

Method and Theory:

A key south-north seismic line tying the Motueka-1 well to the remainder of the dataset and the prospect as well as a key west-east dip seismic line through the prospect will be shown.

The synthetic tie to the south-north seismic line formed the basis for the interpretation of the horizons over the seismic dataset. The key horizons of interest were the Motueka SS Top and Base and Top Canyon 1 and 2 surfaces. The Motueka synthetic tie was used as a basis for phase and bulk shift

corrections where necessary, to the remainder of the seismic lines in the database. The data was fair to good quality data and had been recently reworked by Fugro in 2009.

Maps will be discussed that show the closure of the Miocene aged sands against large scale erosional features present in the basin, at variable times throughout the stratigraphic column. The concept of vertical seal is addressed and demonstrated with well control.

The challenge with a stratigraphic play is that the trapping mechanism is more difficult and subtle to define as compared to structural prospects. Historically in the basin, most of the significant hydrocarbon discoveries to date have been defined by structural traps. The use of seismic AVO (Amplitude Versus Offset) analysis was therefore a key tool used to provide a direct indication of hydrocarbon presence and type in the Kakapo prospect.

Examples

Some of the examples shown are results of the AVO analysis within the proposed trap versus outside the proposed trap, at a consistent stratigraphic level (Figure 1). This analysis supports the premise that there is a gas cap present in the trapped portion of the reservoir. Likewise, fluid substitution modelling using well control from the offsetting Maari Oil Field is also used to support the presence of gas in the trapped updip portion of the reservoir.

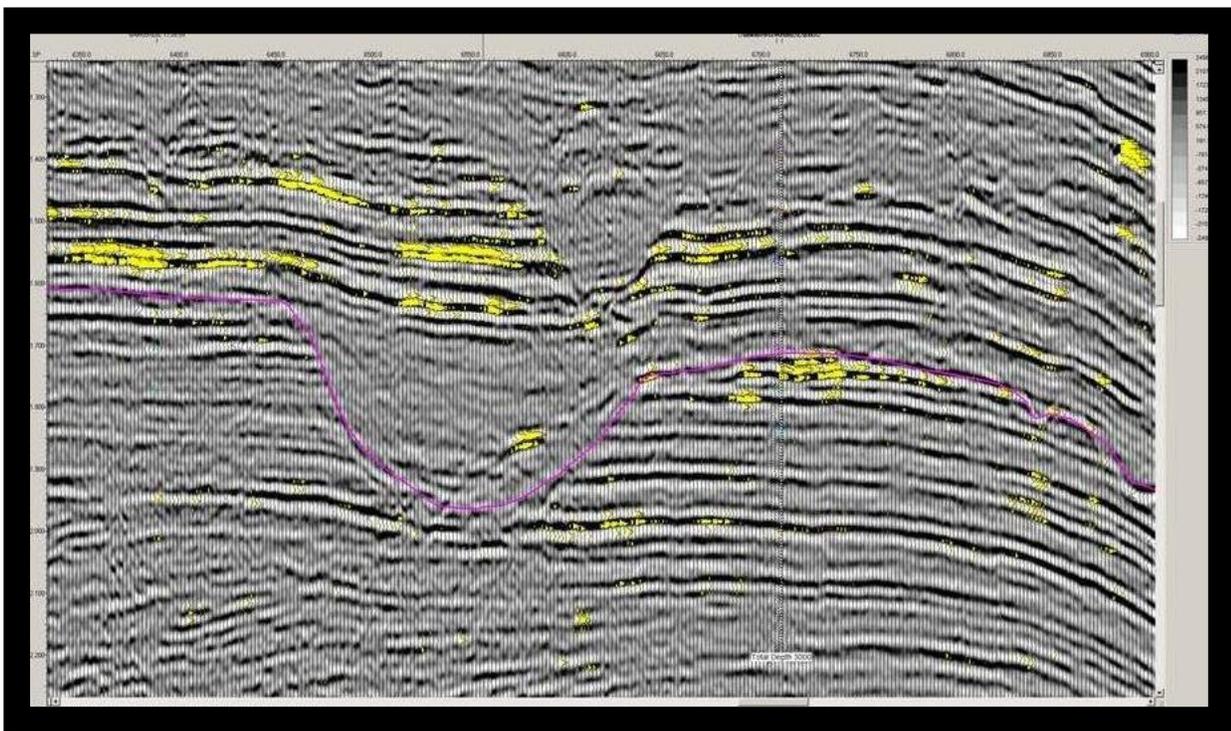


Figure 1: Amplitude anomalies on either side of the proposed trap.

Conclusions

The lateral seal for the Motueka sandstones is defined by the presence of the cross-cutting Canyon 1 sequence, which has been mapped extensively with a dense grid of 2D seismic over the prospect. Due to this large 2D seismic grid, the areal extent of the prospect is definable.

In order for this to be an effective lateral seal the canyon sediments would have to be filled with relatively impermeable strata. As there is no well control on the Kakapo license block, there is a risk that the Canyon 1 sequence would also contain some sands and silts which would provide an inadequate lateral seal.

The risk of an inadequate lateral seal was tested by the AVO analysis performed on the seismic lines over the Kakapo prospect. It was concluded that the AVO anomaly present on the prospect is probably caused by a gas leg just below the Base Canyon-1 unconformity. Furthermore, the lack of an AVO anomaly below the apparent gas cap at Kakapo neither confirms nor denies the possibility of an oil leg.

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References

Morrison, W.K., and T.L. Rivers, 1991. Final Geological Report, Motueka-1, PPL 38406. Report submitted to New Zealand Crown Minerals.