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Deepwater Turbidite Reservoir Delineation utilizing Quantitative Seismic Characteristics in Multi-Azimuth and Broadband Survey, Offshore Malaysia

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SUMMARY

We acquired 3D multi-azimuth and dual-sensor broadband seismic data in such an area to achieve step-change quality in seismic images and subsequent exploration risk mitigation.

Legacy 3D data contained limited seismic bandwidth and poor seismic illumination insufficient to image the steeply dipping structures, and dual-sensor broadband technique and multi-azimuth shooting along three oblique orientations were thereby employed to boost the seismic description, based on illumination analysis. Among several options, the dual-sensor method was essential to acquire broadband pre-stack data preserving AVO characteristics.

Crisp resolution images from broadband data processing, including Kirchhoff PrSDM and MAZ stack, clearly visualized geological details of the deepwater deposits and folding structure, including channelized turbidite fans, chaotic Mass Transport Complex (MTC) packages, erosional unconformity at the structural crest, and imbricated thrust sheets. These seismic geomorphological patterns recognition, along with regional well data, led to turbidite sands fairway delineation.

Besides, in line with high porosity and rather compliant elastic rock properties in offset wells, rock physics modelling indicated seismic AVO attribute dependence on reservoir fluid. Seismic AVO anomalies extracted on the structural traps were hence utilized to mature prospects.

High definition 3D seismic data from new multi-azimuth and dual-sensor broadband technique delivered crucial inputs to exploration risk mitigation and prospect maturation, by revealing structural and sedimentary details and enabling advanced seismic analyses, in deepwater fold and thrust belts.

Introduction

Deepwater fold and thrust belts offshore Malaysia embrace prominent oil and gas exploration potential, while active tectonics and complex turbidite reservoirs distribution impose explorationists tough technical challenges. We acquired 3D multi-azimuth and dual-sensor broadband seismic data in such an area to achieve step-change quality in seismic images and subsequent exploration risk mitigation.

Method and Results

Legacy 3D data contained limited seismic bandwidth and poor seismic illumination insufficient to image the steeply dipping structures, and dual-sensor broadband technique and multi-azimuth shooting along three oblique orientations were thereby employed to boost the seismic description, based on illumination analysis. Among several options, the dual-sensor method was essential to acquire broadband pre-stack data preserving AVO characteristics.

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Besides, in line with high porosity and rather compliant elastic rock properties in offset wells, rock physics modelling indicated seismic AVO attribute dependence on reservoir fluid. Seismic AVO anomalies extracted on the structural traps were hence utilized to mature prospects.

Conclusions

High definition 3D seismic data from new multi-azimuth and dual-sensor broadband technique delivered crucial inputs to exploration risk mitigation and prospect maturation, by revealing structural and sedimentary details and enabling advanced seismic analyses, in deepwater fold and thrust belts.

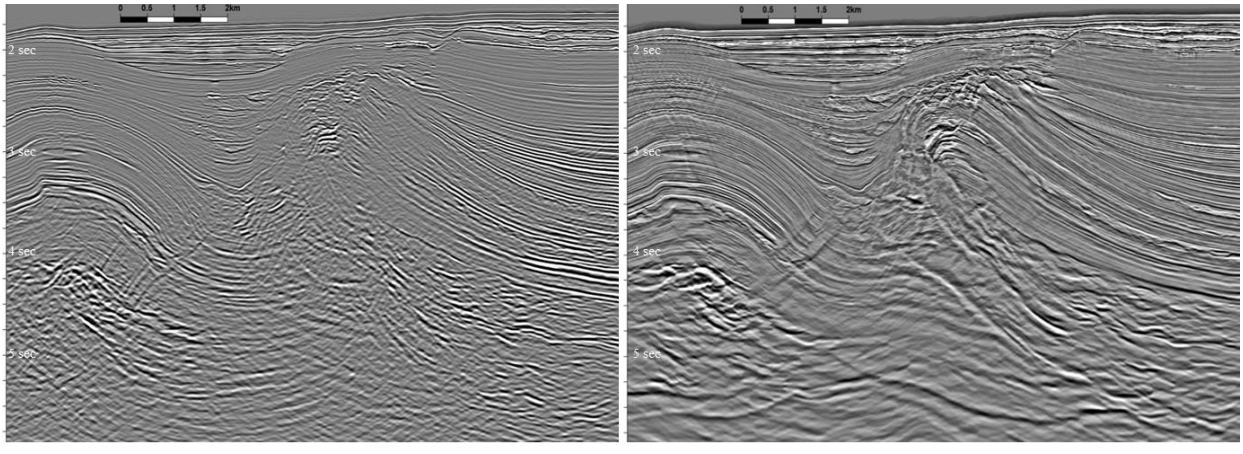

Figure 1 *Legacy 3D seismic data (a) and MAZ Broadband seismic data (b), across folded anticlines accompanied with thrust faults, demonstrating major image quality improvements.*