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Abstract

Introduction

The geology of the case study area in Offshore Sarawak consist of a series of complex structural formations with combinations of faulting, thrusting, folding, unconformities, carbonate platforms and pinnacles with variable thickness and presence of shallow gas anomalies trapped either within shallow channels or bounded by faults. Water depth ranges from 40 – 90m with some rugosity. To solve the main pre-carbonate imaging issue related to illumination, two additional narrow azimuth~~s~~ datasets with shooting directions of 45 and 135 degree were acquired to complement the illumination of the legacy 90-degree narrow azimuth acquired data. The focus of this paper is on the novel 3D MAZ imaging, in which the various datasets were pre-processed individually before being integrated in the velocity model building and migration processes.

Methods and Results

Seismic acquisition adopted the triple source configuration to acquire this survey. Despite the advantages of having smaller crossline sampling and efficiency during operation, the wide spread of the streamer separation has been causing challenges in the seismic data processing especially in predicting the water bottom multiples at far offset and imaging the shallow water subsurface. Therefore, an effective 3D shallow water demultiple was applied (de Melo et al., 2016), opening the possibility for imaging the multiples in this project.

In the velocity model building process, both high frequency refraction and reflection Full Waveform Inversions (FWI) up to 24Hz were utilized, followed by numerous reflection tomography iterations. The FWI and velocity modelling for Azimuth 1, Azimuth 2 and vintage reprocessing data were ran simultaneously towards a consistent velocity model. To address gas anomalies and compensate for the wipe out effect, Q- tomography was included during velocity model building and Q-TTI (Tilted Transversely Isotropic) Kirchhoff Depth (Q-KDM) have been running individually for all 3 datasets to properly address the amplitude, frequency and phase distortions (Figure 1).

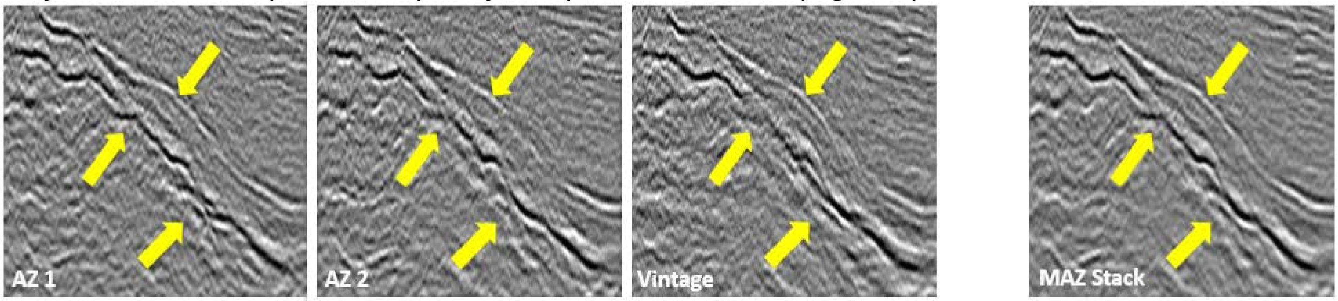

Figure 1:From left-Kirchhoff PSDM stack in two-way time of Azimuth 1 only stack, Azimuth 2 only stack, vintage reprocessed stack and MAZ weighted stack.

Imaging with multiples was also conducted, which proved to be effective in improving shallow imaging through laterally extended illumination coverage (Figure 2). The application was done using double mirror migration workflow, providing new insights to the shallower section of the seismic data (Chowdhury et al., 2019).

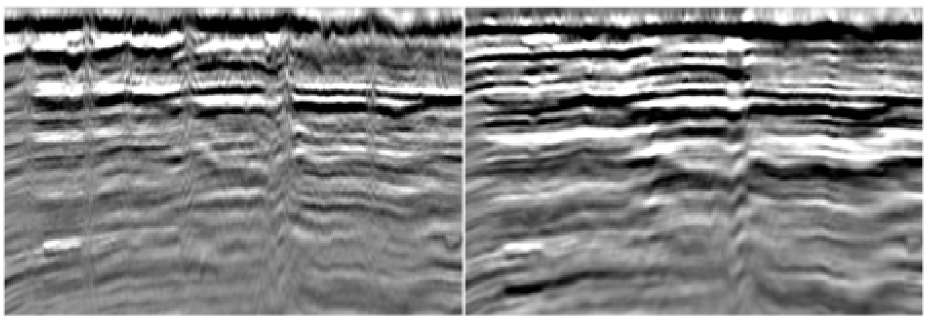

Figure2: Left-crossline stack of primaries. Right-crossline stack using receiver-side multiples.

Conclusion

The MAZ imaging, with Q-FWI approach and tomography iterations managed to capture the velocity variations and produce a more geologically consistent velocity model. The Q-KDM managed to capture a more defined geology and produce sharper faults positioning, in addition to a compensated image that was earlier, suffering from absorption issues due to gas anomalies and carbonate reservoirs in the shallower sections due to gas anomalies.

The MAZ weighted stacks also produce a more meaningful volume in which it integrates contributions from all 3-azimuths dataset into one improved signal to noise stack, addressing the illumination issues. At shallow section, multiple imaging gives a big impact and manage to image the shallow section well.

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