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3D Simultaneous Elastic Inversion from BroadSeis® Data - A Case Study from Angola

L. Goncalves-Ferreira (Total E&P Angola), Y. Arroub (Total E&P Angola), F. Piriac (Total E&P), D. Pandolfi (CGG), J.-L. Formento (CGG), X. Carriere (CGG), J.-P. Coulon (CGG), T. Al-Romani* (Total E&P Angola)

Summary

Broadband acquisition and dedicated processing can be regarded as one of the most recent innovations in Geophysics. The benefits of a new dataset acquired using broadband technology, BroadSeis®, and the 3D elastic inversion results are used to determine robust high-resolution estimates for P-impedance and Poisson's Ratio volumes leading to a more reliable reservoir characterization. In this study we show the impact of broadband in key stages of the reservoir characterisation workflow (inversion and pseudo-Vclay estimation), for a more quantitative reservoir interpretation.

The main challenges of the area, located deep offshore Angola in the Miocene interval, are the structural complexity associated to salt proximity and steep dips at the flanks of the structure.

Key steps of this elastic inversion were the multi-well-driven deterministic wavelet extraction and the accurate velocity model derived from FWI that allowed enhancing the a-priori model building. This method enables better delineation of the sand bodies' architecture, resulting in an updated geomodel structural grid and reliable litho-seismic attributes for future development well targeting.

We conclude that pseudo-Vclay on BroadSeis® shows more lateral discontinuity (heterogeneity) than on conventional data, as confirmed by recent well analysis. The pseudo-Vclay on BroadSeis® has also confirmed sand quality, as proved by wells results.

Introduction

Broadband acquisition and dedicated processing can be regarded as one of the most recent innovations in Geophysics. It proposes a high S/N for the low frequencies and a much larger bandwidth with respect to conventional acquisition. The benefits of a new broadband dataset, using *BroadSeis*®, and the 3D elastic inversion results are used to determine robust high-resolution estimates for P-impedance and Poisson's Ratio volumes leading to a more reliable reservoir characterization (Lafet *et al.* 2012; Schakel and Mesdag 2014).

In this study we show the impact of broadband in key stages of the reservoir characterisation workflow (inversion and pseudo-Vclay estimation), for a more quantitative reservoir interpretation.

Geological Context

The main challenges of the area, located deep offshore Angola in the Miocene interval, are the structural complexity associated to salt proximity and steep dips at the flanks of the structure. A new seismic data acquisition using broadband technology was aimed to overcome these challenges and to be used as reference baseline for future 4D seismic.

Method & Main Results

Key steps of this elastic inversion were the wavelet extraction and the a priori model building:

- A multi-well-driven deterministic wavelet allowed capturing the very broad frequency bandwidth of the seismic data (from 3Hz up to 90Hz) by extracting the amplitude phase spectra based on seismic data and imposing a constant phase to stabilize it.
- An accurate velocity model derived from FWI until 10Hz allowed enhancing the a-priori model building with consistent lateral variability away from the controlled wells.

Both inverted P-impedances and Poisson's Ratio properties were combined to build a pseudo-Vclay operator which allowed a better delineation of the sand bodies' architecture, resulting in an updated geomodel structural grid and reliable litho-seismic attributes for future development well targeting.

Hereafter a random line comparing the Pseudo-vclay results on *BroadSeis*® *(Fig.1 Left)* with conventional data *(Fig.1 Right)*:

- **Fairway A**: pseudo-Vclay on BroadSeis® shows lateral discontinuity, as confirmed by recent well analysis. On the contrary, pseudo-Vclay on conventional data shows a continuous sand body.
- **Fairway B**: pseudo-Vclay on BroadSeis® shows a better fairway limits definition and confirms sand quality as proved by wells results.

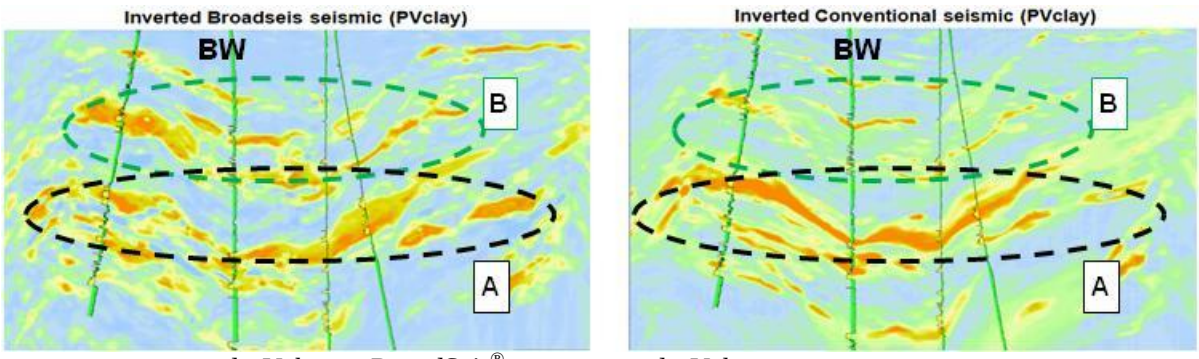

Figure 1 (Left) *pseudo-Vclay on BroadSeis*® ***(Right)*** *pseudo-Vclay on conventional data. (BW=Blind Well)*

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