

Volume Visualization, Fast Track Interpretation, and Interactive Crossplot Analysis Lead to Discovery: A Case Study from Santos Basin, Brazil*

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Abstract

El Paso entered the BS-1 block offshore Brazil in the Santos Basin (Figure 1) in June 2002 in a farm-out from Kerr-McGee. The block expiration date was August 6, 2003. In July, 2003, a gas and condensate discovery was made when a stratigraphic anomaly was penetrated. A fast track interpretation approach was utilized, incorporating AVO attributes and volume visualization techniques to identify leads quickly. An off-structure Itajai-age turbidite sand lobe with an AVO signature similar to that at the nearby Merluza field was chosen as the main prospect.

Workflow examples are demonstrated that allowed a drilling decision to be made in a very short time frame. Initial quick look and identification of areas of interest were prepared by scanning an on-board processed post-stack-migration data volume. This was followed by a more rigorous examination of the pre-stack-migrated volume with surfaces mapped, based on amplitude and waveform criteria. AVO attribute volumes and existing well control were used with volume visualization techniques, coupled with interactive crossplotting to identify pay and non-pay sands. Several leads at different intervals were identified and ranked, based on their AVO signature, spatial continuity, and relationship to a depositional model. This is an iterative process done in real time with the asset team present to facilitate and speed-up the decision-making process.

The coordinated effort resulted in a discovery in a stratigraphic play type and opened the door for more prospectivity in an area that was previously deemed non-commercial.

Introduction

Veritas was contracted by El Paso to acquire and process a 907-km² 3D survey to allow them to make a decision to drill or exit the block. The data were acquired, processed, and interpreted in approximately eight months. Several prospects were identified, risked, and ranked. Recommendations were made, and it was decided that an off-structure

stratigraphic feature would be tested, based on an AVO signature that was similar to known pay at the nearby Merluza field. The well encountered high-quality gas-saturated sands as predicted by the pre-drill analysis.

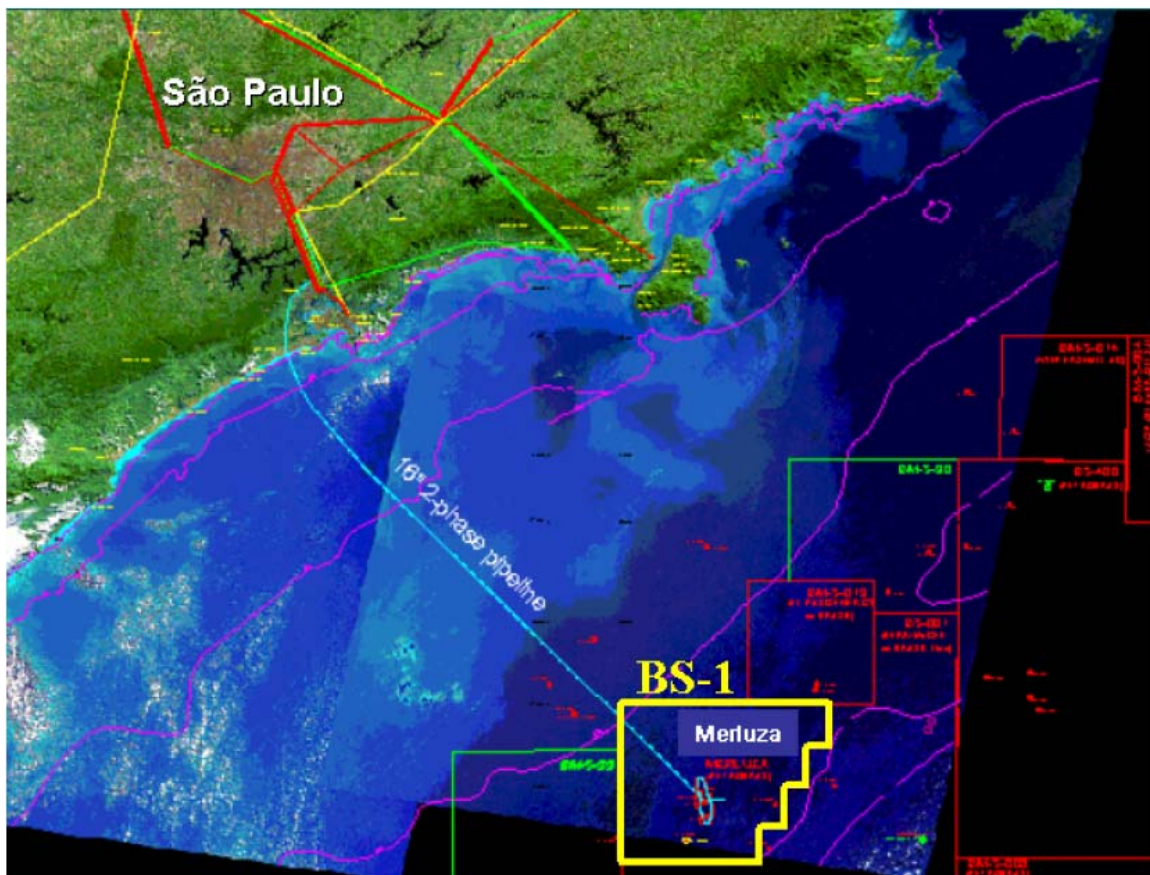


Figure 1. Map showing location of BS-1 Block, offshore Brazil.

Interpretation

An initial meeting was held with client and Veritas personnel to scan through the data to identify exploration objectives. Inline, crossline, and time slice rendering was used along with thin-slab and opacity methodologies to identify structural or stratigraphic potential (Figure 2). Surfaces or horizon zones of interest were identified for further mapping. Interpretation of the pre-stack time migration data was carried out in three weeks, starting in early January. Surfaces were mapped, based on amplitude and waveform correlation criteria. These surfaces were then used for horizon amplitude draping and formation sculpting of the AVO attribute volumes (Figure 3). Interactive crossplot analysis using P-wave and S-wave attribute volumes were used with the existing well control (Figure 4) to identify pay and non-pay sands. Several leads at different intervals were identified and then ranked, based on their AVO signature, similarity to known pay, and fit to a depositional model (Figure 5).

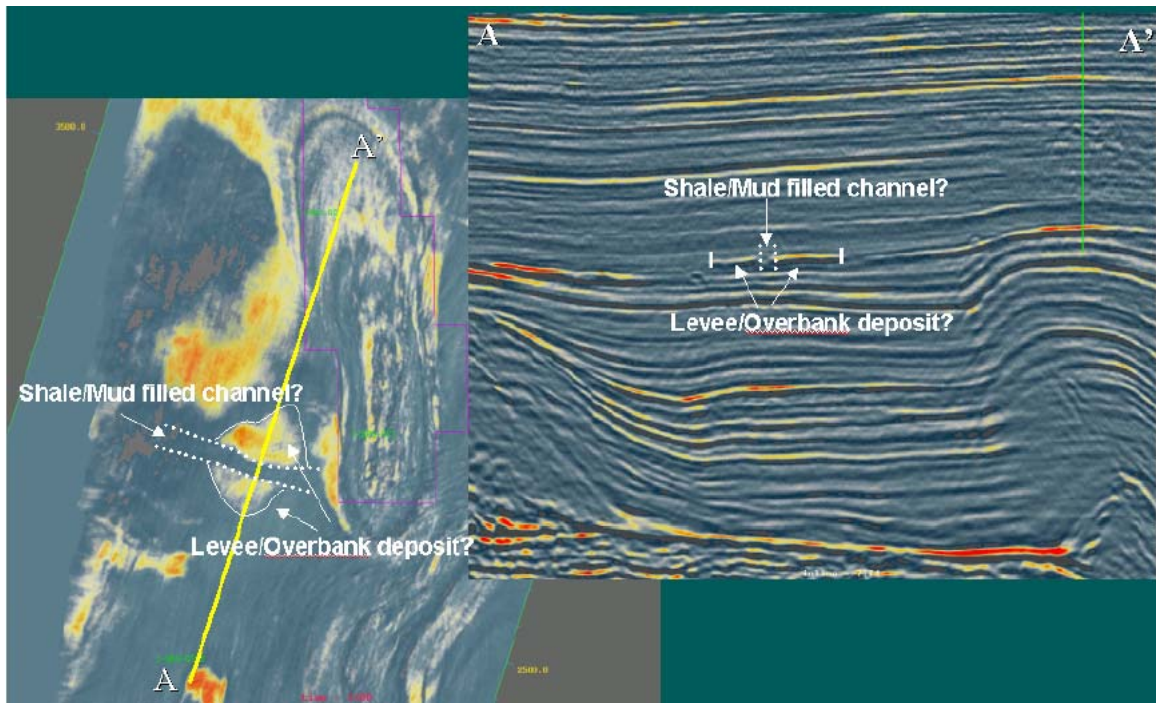


Figure 2. Features of interest were identified on the first day of looking through the data volume.

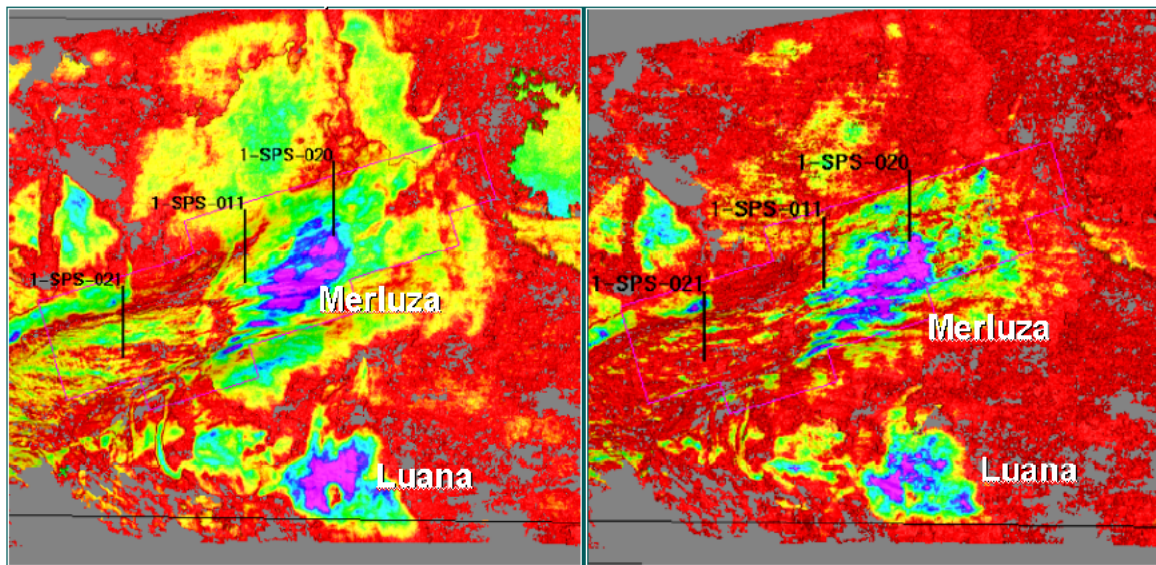


Figure 3. Itajai surface with stack amplitude (left) showing sand distribution, and Fluid Factor amplitude showing potential hydrocarbon distribution (right).

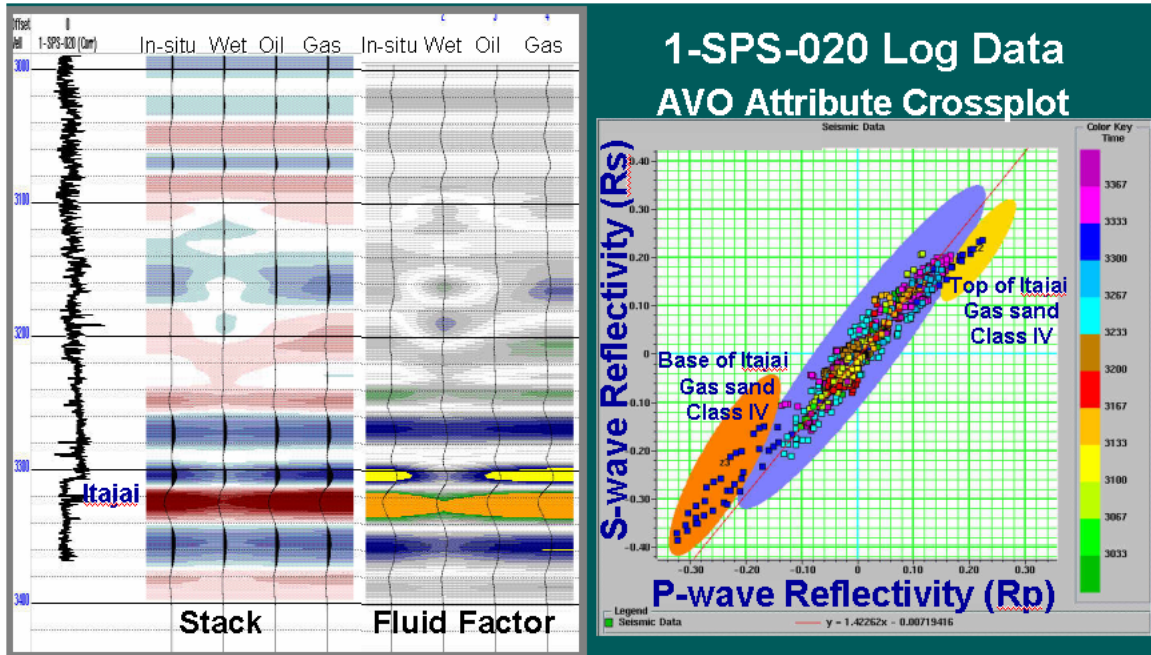


Figure 4. Modeled AVO response for Itajai sand from well in Merluza field.

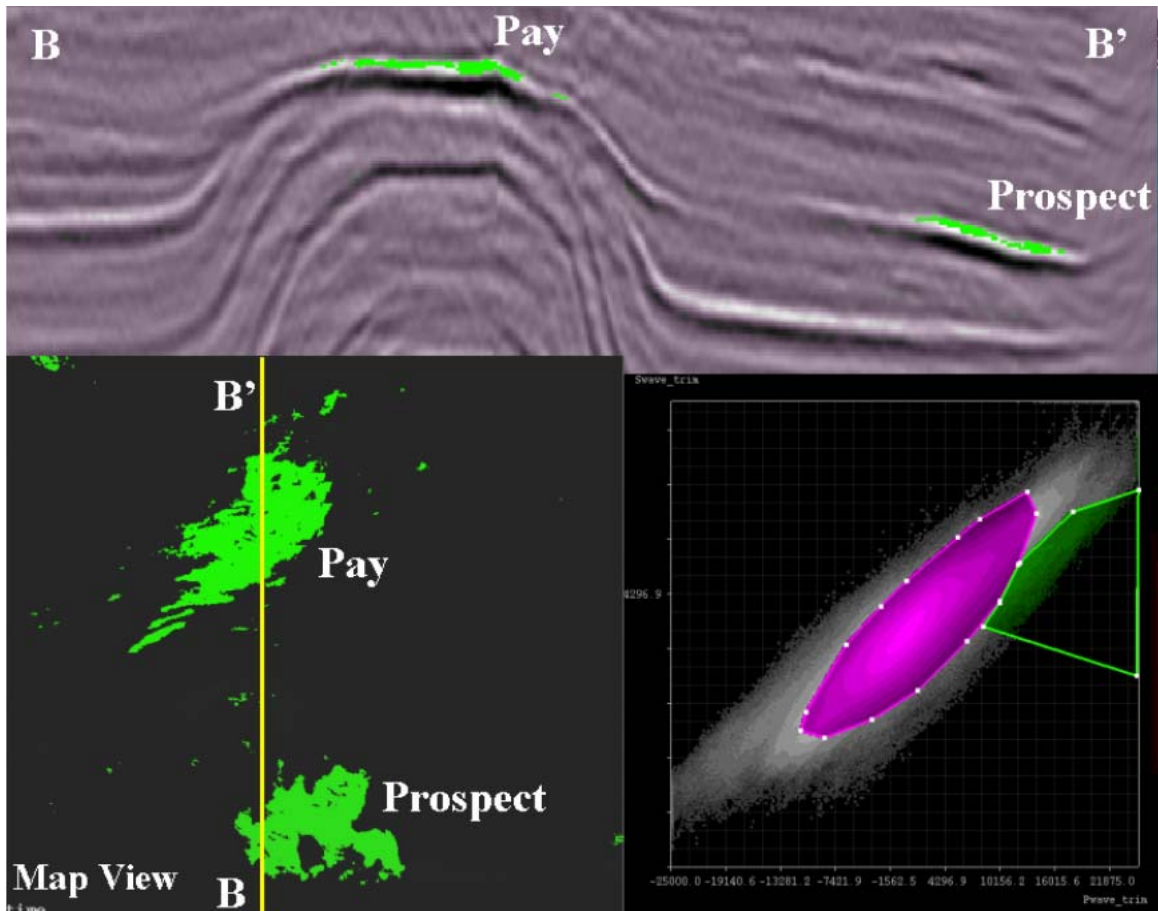


Figure 5. AVO crossplot analysis showing known pay and primary prospect. Green polygon region on R_p/R_s crossplot shows top sand response.

Conclusions

A condensed time frame based on entry into the block and its expiration date required that a fast track approach be taken to acquire, process, interpret, and drill an exploration well in the Santos Basin. Fast track interpretation methodologies along with AVO attributes for calibration were used to identify and high grade prospects quickly. Coordinated efforts between the client and contractor enabled a discovery in a previously undrilled play type in the Santos Basin.

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