Acoustic seismic inversion for turbidite reservoir characterization – Recôncavo Basin, Bahia

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Abstract

Seismic inversion contributes to a better understanding of reservoir properties. This technique was applied in the Massapê Oil/Gas Field in the Recôncavo Basin for characterization of the Caruaçu Mb. (Maracangalha Fm.) lacustrine turbiditic sandstones, deposited during the Neocomian. Caruaçu Mb. is located in a trough formed by shale diapirs and can be subdivided into three turbiditic systems, which are known as CR-1, CR-2 and CR-3. This subdivision is due to relatively thick shale packages, named Acarajé and Abará, that serve as stratigraphical marks. The methodology applied in this study consisted of the preconditioning seismic data, seismic inversion and characterization of turbiditic systems. We attenuated noise using the Structural Smooth and we applied the inverse Q filter to recover effects of attenuation, thus increasing the frequency content of the seismic data. After this procedure, we mapped the Mark 15, representing the seismic top horizon of the Maracangalha Fm., and the top of the Candeias Fm., delimiting the interval occurrence of the Caruaçu Member. After that, we performed the seismic-well ties and realized a study about the distribution of the acoustic impedance and facies. This analysis allowed us to identify that sandstones are related with higher acoustic impedances and shales with lower acoustic impedances. Then, we realized a Model-Based inversion that allowed a better interpretation of the turbiditic lobe-channel complexes present in the Massapê Field, observed in several timeslices. Analyzing the acoustic impedance volume, it was possible to identify that channels are associated with higher acoustic impedances between 11.000 $(g/cm^3)*(m/s)$ - 13.500 $(g/cm^3)*(m/s)$ and, integrating this feature with data from 10 well logs, we confirmed that those channels are located in the same depth of the Caruaçu reservoirs, identified in well logs. The channels deposition seems to occur from south to north at the CR-3 and CR-2 intervals, while on CR-1 the deposition seems to occur from north to south. This behavior may be related to a change of depocenters that was triggered by tectonics activities during the basin's evolution and the shale diapir generation. Acoustic impedance provided better visualization of the turbiditic lobe-channel complexes in amalgamated bodies, providing greater predictability and robustness to the exploratory and development processes of these reservoirs. This workflow can be applied in other similar fields of the Recôncavo Basin, optimizing and reducing production costs.

Key-words: Massapê Oil/Gas Field; turbidite systems; reservoir characterization; seismic inversion.