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Albacora Leste 4D Seismic Inversion and interpretation

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Introduction

Albacora Leste deep-water offshore oil field (ABL) is located in Campos Basin with water depths ranging from 800 to 2.000 meters. The field has been in production for almost 20 years. The reservoir comprises Miocene turbidite sandstones with high porosity and permeability that produce from 4 different zones, two main zones are responsible for 94% of all volume in place. The field development strategy consisted under early water injection through horizontal producer and injector wells, to maintain pressure support while increasing oil recovery.

1-D Time-Lapse seismic feasibility studies demonstrated that changes in water saturation and reservoir pressure over time could be detected through changes in acoustic impedance. These feasibility results supported the plan of conducting a time-lapse (4D) seismic monitoring study that consisted of the acquisition of a monitor seismic survey in 2022 to be compared to an existing survey from 2005. The qualitative and quantitative analysis of amplitude and acoustic impedance from the 4D seismic data along with production/injection history of the wells, was aimed to support the optimization of production and injection for an overall revitalization of the ABL field.

Method

The 4D seismic acquisition consisted of a Baseline survey, acquired in 2004/2005 by a vessel towing a dual source array and 12x6000 m conventional cables streamer, and a Monitor survey, acquired in 2022 with similar acquisition configuration by a vessel towing a dual source array and 12x6000 m cables configuration, and second vessel acting as source vessel during undershooting to ensure subsurface coverage under platform facilities.

The acquisition and processing of both the Baseline and Monitor data ensured proper migration aperture and full fold coverage for reliable imaging and adequate seismic amplitude in both surveys. The resulting 4D migrated stacked volumes were inverted for acoustic impedance to aid in the 4D integrated interpretation.

Results and Conclusions

The Interpretation of 4D amplitude anomalies allowed to delineate areas where pressure was depleted below Oil Saturation Pressure, resulting in soft anomalies (decrease of acoustic impedance) and areas where water injection was effective and generate hard anomalies (increase of acoustic impedance)

The acoustic seismic inversion of baseline and repeat surveys allowed to quantify the changes in acoustic impedance over time. Quantitative analysis allowed a better understanding of the effect of saturation and pressure on 4D response of the reservoir due to production and injection. The integrated interpretation of 4D signals together with production data and facies distribution has concluded in a catalog of areas with potential for infill drilling or re-entries opportunities but also provided valuable information regarding the reservoir extension, compartmentalization and producing mechanism.

All this information will be used to optimize the drainage grids of producer and injector wells, to locate future wells (producers/injectors), to increase the recovery factor of the field, and enable assertive conclusions regarding the maintenance of reservoir pressure and slowing down its depletion.