Fluid contacts and net-pay identification in three phase reservoirs using seismic data

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Abstract

An integrated interpretation of 3D seismic attributes, spectral decomposition and pseudo impedances, led to the identification of fluid contacts within heavy oil reservoirs in Block II of the Uracoa Field, in Monagas Sur area, Eastern Venezuela. The study was run by Petrodelta, a PDVSA-Harvest Vinccler joint venture in Venezuela.

The final product is a breakthrough for Petrodelta development plan, result of a multidisciplinary interpretation and workstation capabilities. Those results led to setting two new drilling locations.

Introduction

The Uracoa Field is located in the Monagas Sur area, nearby the Orinoco Belt, Eastern Venezuela.

As a result of latest studies a PSTM processing was run for the 165 km2 seismic dataset in 2008 by Fusion Petroleum Technologies for Petrodelta. The field development plan (FDP) included a few more locations within the mature field, avoiding the shallower -drilled- free gas areas, and the deeper -modeled- water contact.

The challenge for the subsurface team was to reveal from old, reprocessed data, new evidence in order to determine where to drill horizontal wells in the oil bearing sandstones.

Further analysis of well-seismic calibrated data and several trials on different set of attributes and spectral decomposition started to reveal some subtle geological features and amplitude responses that led to forecast gas and heavy oil intervals. Seismic attributes and spectral decomposition interpretation were the key drivers to determine GOC and OWC, as well as the oil section to set new drilling locations.

Theory Background

The quest for the oil bearing interval in the reservoir was mainly based on recent investigation of seismic responses in presence of gas in heavy oils at high GOR (Han & Liu, 2008) where seismic velocity decreases. There is well data in Uracoa field that measured GOR > 24000 scf/bbl, which is very high at the local reservoir conditions.

In addition, gas-prone sands, drilled in previous campaigns, showed that there are a few areas in the field where free gas is located at the top of reservoirs. Such fact allow to consider seismic may detect the contrast between gas and oil.

A second investigation on heavy oil seismic responses was found (Wolf, Vanorio, et al, 2008) which suggests that if the sonic log shows elastic contrast, confirmed by S converted waves from near-to-far offset data, there is a chance to differentiate velocity and/or density changes on the seismic data. Log data available in Uracoa field confirmed acoustic/elastic changes that led the team to consider the possibility of mapping gas-oil contrast.

Workflow

The workflow was derived from the many trials on the datasets. It became a two steps flow:

1) First step of the analysis was to run spectral decomposition on the seismic horizons related to the top reservoirs. Gas-prone sandstones had been drilled in the area but the three phase fluids distribution had not been mapped either clearly understood in the reservoir..