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Reservoir Geophysics allied with Artificial Intelligence to Unlock Remaining Potential in the Peregrino Field

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Introduction

The Peregrino field, located in the shallow waters of Campos Basin in Brazil, is a prolific heavy oil field that has produced roughly 280 MMbbl of oil during its 14 years of life. The reservoir is characterized as multi-darcy sandstones with high porosity from the Carapebus Formation, which were deposited as open-marine turbidites, overlaying the Albian carbonates from Macaé Group. The field is divided into two segments: A mature brown one, on stream since 2011; and a green one, producing since 2022.

After more than 70 wells drilled, the key challenges of Peregrino field are the limited number of slots; horizontal well placement in thin reservoir sandstones below seismic resolution; high compartmentalization; and identification of remaining targets in the more mature area of the field.

Geophysical workflows allied to artificial intelligence are needed to derisk, identify and define uncertainties that enable target delineation, maturation and well planning processes. Artificial Intelligence for Maturation (AIM), designed by Equinor and White Space Solutions, is an end-to-end collaborative tool designed to integrate the process and disciplines.

Method and/or Theory

Target Heatmap is a feature within AIM which translates data driven rules (or products from them) for target identification, which serve as the basis for user driven well placement in reservoir are in turn converted to drillable well paths connecting to available slots.

The data products used in Peregrino for Target Heatmap generation include mapped bounding box of Top and Base Reservoir where oil-water contact surface determines the target existence limits. Polygons and geophysical attribute maps determine reservoir geometry and extent. A rule-layer is established on the data products to identify the targets. Drilled wells and reservoir drilling parameters (max reservoir section, max inclination, max dogleg severity, separation factor, etc.) are then used as drilling rules to shape reservoir trajectories for drilling feasibility if the target can be reached (which AIM assesses by exploring millions of options using overburden drilling rules) from available slots and kick off depths.

Results and Conclusions

Peregrino has effectively used AIM over the past four years, demonstrating significant value by unlocking targets, previously considered as inaccessible.

More recently, with the Target Heatmap it is possible to explore the automated target definition using geophysical data for reservoir landing options to end of reservoir section for available slots for viable well designs. This workflow integration allows for portfolio optimization, strategy for target maturation, optimizing reservoir drainage at a speed which is a fraction of the conventional manual process.