The Use of Seismic Inversion Results as an Input in a High Resolution Petroleum System Modeling in the Santos Basin, Brazil

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This work shows the results of the application of a methodology for high resolution lithology definition in a petroleum system model of the Santos Basin, Brazil. After building a standard petroleum system model, the seismic data, calibrated with petrophysical and geological well information (using empirical and theoretical rock physics), was employed to assign a high resolution facies distribution for the post-salt stratigraphic units. The goal of this study was to define an accurate geologic input and provide a basis for a more reliable assessment of the hydrocarbon charge risk.
Following a Bayesian Neural Network approach, the petrophysical data set and seismic attributes were used for a lithologic facies inference at the seismic volume. First the petrophysical data were utilized to create local probability density functions (fdps) associated to each facies at seismic attribute domains. Then 3D probability models for each facies were constructed using these fdps together with the seismic attributes from seismic inversion of the seismic cube. The obtained probability models were employed as inputs for all inference work regarding the facies distribution.
The petroleum system model was initially built as usual, making use of seismic interpretation data, regional facies distribution and geochemical information. The boundary conditions were defined and the model was calibrated with the available thermal and geochemical data. After that, the model's layers were subdivided and the grid was refined to increase the vertical and horizontal resolution within the layers of interest. The seismic inversion results were upscaled to this new grid-resolution in order to re-define the facies distribution in the post-salt section at high resolution, based on the geophysical-petrophysical analysis of the seismic data. The high resolution facies distribution allows for a high resolution fluid migration during simulation of this refined model.
The presented methodology integrates well information, seismic attributes and rock physics with the petroleum system model, enabling a better understanding of the dynamics of sediments and fluids, and providing an accurate tool to evaluate the exploration risk.