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1D DENSITY MODELING AND ITS 3D EXTRAPOLATION GUIDED BY SEISMIC ATTRIBUTES IN THE POST-SALT OF BÚZIOS FIELD: A FOCUS ON GEOHAZARDS

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Búzios Field, an ultra-deep-water reservoir located in the Santos Basin, is currently recognized as one of the largest producers of the Brazilian Pre-Salt, being responsible for approximately 25% of the country's hydrocarbon production. Nowadays, almost 100 wells have already been drilled to reach the reservoir, considering the exploration, development and production. Despite the number of wells already drilled, almost 50% of the Búzios Field Post-Salt interval does not have density logs in the available wells. Rock density is one of the most used petrophysical properties when performing activities in the oil and gas industry. However, for economic and operational reasons, coring and density logs are rarely obtained in shallow intervals. One practical and economical way to obtain density value estimates in poorly or unsampled intervals is by using empirical rock physics properties relationships. Therefore, aiming to reduce uncertainties and risks in drilling projects for future locations, the present work proposes alternative ways of modeling density logs using distinct calibration approaches of empirical relations already established in the literature. In summary, for the calculation, calibration and completion of density logs, the research had four main stages: i) preconditioning of well data; ii) density modeling from the Gardner equation (for wells with DTC); iii) density modeling from the burial equation (for wells without DTC); iv) calibration of the equations by lithology and formation. To increase density sampling and circumvent the absence of information in the interest area, it was necessary to add data from a neighboring region with the same Post-Salt characteristics. The density values prediction and distribution beyond the wells were carried out using the seismic attributes derived from amplitude as a conditioning factor, thus respecting the existing geology. The first derivative calculation of seismic data associated with a phase rotation step was essential to correlate the amplitude attribute values with the density curve, resampled at seismic resolution, and to approximate the data to a layer property volume, in the same way as expected with the seismic trace integration, but not degrading the high frequencies. Based on the obtained results and using the calibrated and combined equations, it was possible to generate density logs for all wells from the interested interval, defining the best fitting techniques for the lithologies present in the interval of interest. It also allows the understanding of the intrinsic limitations of the empirical relationship for rocks with low burial depth (< 1200 m) and low density (< 2 g/cm³), including the proposition of a minimization mismatches equation. The results presented in this work also indicate that the usage of data from a nearby field with a geological context analog to Búzios Post-Salt is a wise strategy since it allowed the density modeling of lithologies that had been poorly and/or unsampled in the study area, increasing sampling and correlation coefficients. Due to the robust hypothesis adopted in this research, the proposed methodology for predicting and extrapolating the density curves can be applied to the characterization of any other basins or fields, regardless of the geological context.