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Petrophysical Study of the Reservoirs in Itapu Field, Santos Basin, Brazil

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Abstract

The Santos Basin is considered the primary contributor to oil and gas production; however, the Pre-Salt reservoirs remain crucial and highly due to their lateral and vertical variability, mainly influenced by diagenetic processes and fractures. This study focuses on the Itapu Field, located within the Iara Complex, and comprises three wells (1-BRSA-1116-RJS, 3-BRSA-1215-RJS, 9-ITP-1-RJS). Through well log profile interpretation, the research aims to evaluate the permo-porous parameters of the Barra Velha Formation by integrating various methodologies for reservoir characterization, including fluid saturation analysis and Net Pay estimations. Nuclear Magnetic Resonance (NMR) profiles were used to determine reservoir parameters such as effective porosity, irreducible water saturation, and the presence of fine grains. Based on cutoff values, it was possible to obtain the effective thickness saturated with hydrocarbons. Rock physics cross plot and petrographic thin sections were utilized to enhance the analysis and define the optimal production zones. Finally, achieving the interpretations and the discussion of results, it is expected to contribute with innovative information about the oil potential, and improve the efficiency of the analytical methods used for petrophysical studies of interest geological formations in hydrocarbon exploration. For the three wells, the caliper (CAL) log, used to assess the quality of the profile responses, showed no significant variations, thus ensuring greater reliability of the data. Different zones were interpreted along the reservoir interval. Preliminary results indicate that using pressure data and their respective depths effectively derived the pressure gradient, enabling the identification of two main fluid types in the Barra Velha Formation reservoirs for well 1-BRSA-1116-RJS. In the well 9-ITP-1-RJS, the entire reservoir interval is located above the contact, whereas in well 3-BRSA-1215-RJS, identification was inconclusive, showing only a single trend in the graph. Unlike neighboring wells, an analysis of the profile behavior, for the third well, reveals that only the BV-02 zone exhibited the best permo-porosity parameters, while the others zones showed a significant decline in reservoir quality. In this interval, the T2 time (NMR) presented high values, with an average effective porosity reaching 14%. However, the remaining intervals fall within the microporosity zone, with total porosity close to 10%, but with very low effective porosity values. Similarly, permeability values indicate that fine sediments are negatively impacting the permo-porous properties of this reservoir. Additionally, lateral sample descriptions demonstrate that most intervals exhibit closed porosity due to muddy sediments or silicification, with silica further contributing to pore obstruction. The application of different methodologies offers multiple scenarios that can improve reservoir characterization, potentially leading to a more effective approach for the study area and similar fields. The NMR is a reliable method for zones above the oil/water contact. In addition to well log data, petrographic thin sections and lateral sample descriptions are critical for detailed lithological assessment, providing insights into porosity types and processes that influence reservoir conditions.

Keywords: Reservoir Characterization; Porosity; NMR; Permo-Porous Parameters.