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TEXTURAL CLASSIFICATION OF CARBONATIC ROCKS FROM THE BARRA VELHA FORMATION BASED ON X-RAY COMPUTED TOMOGRAPHY IMAGES AND CORRELATION WITH THEIR PERMOPOROUS SYSTEM AND DIAGENETIC PROCESSES

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Introduction

The lacustrine carbonates of the Barra Velha Formation, part of the pre-salt in the Santos Basin, are heterogeneous rocks of high complexity, presenting a significant challenge for reservoir characterization, as porosity and permeability parameters are directly linked to the rock's genesis. Variations in sedimentary facies therefore reflect distinct reservoir quality, highlighting both favorable and unfavorable properties. This work aims to define the main textures derived from X-ray Computed Tomography (CT) images from the interpretation of lithofacies and analyze the relationship of these textures with porosity and permeability data through scatter plots, identifying a pattern between texture and effective porosity in reservoirs quality assessment, as well as to correlate the influence of diagenetic processes with the textures observed in CT images. This approach seeks to infer the intensity of diagenetic alteration based on the identified textural variations.

Method and/or Theory

Data were obtained from a well in the Sururu Field, located in the pre-salt section of the Santos Basin. The well contains three cores, totaling 78.8 meters, with available X-ray computed tomography images acquired at intervals. Core 1, which is the focus of this study, is 21 meters long. Cores 2 and 3 are 30 and 30.8 meters long, respectively, totaling 78.8 meters. CT images were used to identify four main textures associated with distinct sedimentary facies: Laminated, Shrubby, Fragmented Clastic, and Recrystallized. A macroscopic description of Core 1 enabled the construction of a lithological profile at a 1:10 scale. Additionally, we conducted microscopic analysis of 20 thin sections with emphasis on diagenetic features. Finally, pore system graphs were generated using RCAL data obtained from core plugs analyzed in the laboratory.

Results and Conclusions

Four main textures were identified through the interpretation of X-ray CT images: laminated, shrubby, clastic fragmented, and recrystallized, each with specific characteristics and a direct relationship with the intensity of diagenetic processes. The Laminated texture exhibits well-preserved lamination, indicating textural attributes of primary origin. The shrubby texture shows parallel bedding related to the upward growth of shrubs and also indicates a primary origin attributes. The Clastic Fragmented texture displays moderate stratification with dark gray spots related to silicification, and may contain fractures, discontinuities, and deformities linked to moderate diagenetic processes. In contrast, the Recrystallized texture lacks clear stratification or retains only weak remnants, showing a homogeneous appearance that reflects intense diagenesis, including substitution, recrystallization, and dolomitization. The permoporous system was evaluated using porosity and permeability data. The Clastic Fragmented and Recrystallized textures showed lower values, with average porosity and permeability of 11.29% and 7.95 mD for the Clastic Fragmented texture, and 15.13% and 7.03 mD for the Recrystallized texture, respectively. In contrast, the Laminated and Shrubby textures yielded better results, with 13.46% porosity and 19.67 mD permeability for the Laminated texture, and 14.69% porosity and 75.81 mD permeability for the Shrubby texture. These

results demonstrate that the methodology of textural classification using X-ray Computed Tomography images in lacustrine carbonate rocks of the Barra Velha Formation (pre-salt) is effective. It enables the identification of reservoir intervals with improved effective porosity, and reveals a correlation between Clastic Fragmented and Recrystallized textures with advanced diagenetic processes, while Laminated and Shrubby textures are associated with depositional, pre-diagenetic sedimentary structures.