



Evaluation of petrographic and petrophysical attributes through image analysis of Brazilian Pre-Salt carbonates.

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Abstract

The discovery of the oil and gas reserves in the carbonate rocks of the Brazilian pre-salt represents a significant geological and economical milestone. The large volume of hydrocarbons and the heterogeneity of textural and compositional features are elements that make the petroleum system complex and devoid of analogues worldwide. In this context, the characterization of petrographic and petrophysical attributes becomes necessary to guide exploratory campaigns. The present study focuses on the petrographic description in thin sections, aiming to classify and group the samples into five microfacies: spherulitic, shrubs, grainstone-rudstones, packstones and dolomudstones. In the sample set, 26 thin sections were grouped into shrub facies, 22 into packstones, 18 into grainstone-rudstones, 15 into spherulitic facies, and nine into dolomudstones. Statistical analysis on thin sections of shrub and spherulitic facies shows an average length of 3.05 ± 1.44 mm for shrubs and an average diameter of 1.48 ± 0.72 mm for spherulites. Petrographic description identified two main types of cement: carbonate and siliceous. Carbonate cement is evidenced by rhombohedral calcite and dolomite grains, while siliceous cement is defined by cementation stages in the grain-pore direction, respectively, microcrystalline silica (chert), fibrous silica (chalcedony), quartz crystals, and amorphous silica (opal). Petrophysical data includes quantification of porosity, permeability, and tortuosity obtained from plug samples and scanner images of thin sections. Through the analysis of these variables, the porosity of the plugs samples presents a directly proportional linear correlation with permeability and tortuosity. However, tortuosity as a function of permeability presents an opposite correlation, marked by a discreet inversely proportional trend. The facies considered as the best reservoirs, evidenced by the porosity-permeability relationship, are grainstone-rudstones and shrubs. The analysis of porosity data using the two adopted methodologies reveals a variation in the values obtained through plugs, which tend to be higher than those resulting from image analysis. This differentiation is due to the heterogeneity of the system, therefore underscoring the non-representativeness of a 2D analysis (image analysis) for Pre-Salt carbonate rocks.