



Petrophysical properties of carbonate rocks: example from the cretaceous Jandaira Formation, Potiguar basin - Brazil

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Carbonate sediments are prone to rapid and pervasive diagenetic alterations that change the mineralogy and pore structure within carbonate units. In particular, cementation and dissolution processes continuously modify the pore structure to create or destroy porosity. In extreme cases these modifications can completely change the mineralogy from calcite to dolomite, in the properties of rock for soil (Caliche), or reverse the pore distribution whereby original grains are dissolved to produce pores as the original pore space is filled with cement to form the rock. These processes are common in fractured carbonate units. All these modifications alter the elastic properties of the rock and, therefore, the sonic velocity. This study presents the result of relationship among diagenesis, porosity, grain density, and sonic velocity, in limestones, dolomites and caliche samples from the Jandaíra Formation, Potiguar basin, Brasil. This stratigraphic unit have been subjected to fracturing since the late Cretaceous. The rock and soil samples were collected in outcrops, prepared as plugs, and analyzed at ambient temperature. The porosity and grain density analysis were performed under ambient pressure, while elastic properties analyses were conducted with samples under confining pressure between 5 and 40 MPa. The result is a wide range of sonic velocity in carbonates, in which compressional-wave velocity (VP) ranges from 3507 to 6119 m/s and shear-wave velocity (VS) range from 2114 to 3451 m/s. The ratio $VS1/VS2$ indicate a level of anisotropy equal to 2%, without any clear relationship with porosity. The elastic properties are affected by rock alteration process or by modification of mineral composition, due to the presence of clay minerals and organic matter, The porosity and grain density values range from 3.2 to 21.5%, and 2.7 to 2.8 (g/cm³), respectively. The grain density analysis in the carbonate rocks indicate the existence of two groups: the first group of calcareous matrix, with density of 2.7 g/cm³, and the second group of dolomitic matrix, with density of 2.8 g/cm³. The caliche present density values than the average carbonate rock. The elastic and grain density properties in carbonate rocks showed strong inverse correlation with porosity. These correlations have high coefficients of determination, valid for samples with both carbonate and dolomitic matrix. The Poisson ratio shows a soft correlation and a considerable dispersion.