Geophysical Logging Applied to Rock Correlation on Fundão Island (RJ): Integration of Petrophysical Data from Borehole UFRJ-01-RJ.

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Introduction

In mineral exploration and ore deposits, drill core samples are of great importance when recovery is high. However, in cases of poor recovery, geophysical methods prove to be efficient for indirectly obtaining rock property data. Geophysical logging employs tools that measure the petrophysical properties of rocks, generating integrated profiles in an upward direction along the borehole.

Method and/or Theory

In the present study, well logging data were processed and interpreted using acoustic (ATV) and optical (OTV) imaging tools, along with bulk density data acquired through the gamma-gamma method using the High Density Gamma Sonde (HDGS) tool and determinate porosity with Nuclear Magnetic Resonance (NMR). Logging was conducted in borehole UFRJ-01-RJ, which is 42 meters deep and located in the external area of the Department of Geology at the Federal University of Rio de Janeiro (UFRJ). This study aims to correlate the petrophysical data with density measurement values from small core plug samples. It also seeks to correlate the lithotypes identified in the borehole with the outcropping rocks found in Fundão island (RJ), particularly on Catalão and Bom Jesus islands, as well as outcrops adjacent to the studied borehole.

Results and Conclusions

The rocks described exhibit primarily textural variation and were classified into five distinct gneiss facies, in addition to later intrusions of granite and pegmatite. Petrographic analysis showed that the rock compositions range from quartz monzonite to granodiorite, with an average density of 2.62 g/cm³. In contrast, laboratory measurements using core plugs yielded an average density of 2.73 g/cm³. The natural gamma log exhibited higher values in more felsic sections due to the greater concentration of potassium feldspar in these areas compared to the more mafic lithotypes. The optical and acoustic imaging tools enabled the generation of an integrated borehole profile and supported the textural characterization of the core samples. The NMR indicates that the porosity of the rock tends toward 0%, except in fractured zones and in the upper borehole casing, exhibiting a porosity of approximately 50%, corresponding to the region filled with sand landfill material. The outcropping rocks on Fundão island showed excellent textural correlation with those described in the borehole, with only one facies not represented in the core samples. Thus, the combined evaluation of geophysical data and geological characterization allowed the differentiation of several lithological intervals, revealing strong correlations in composition, texture, and color index between borehole samples and the outcropping rocks of Fundão island.