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Multi-Scale Gamma-Ray Spectrometry Analysis for the Morro de São João Alkaline Massif, Casimiro de Abreu, Rio de Janeiro, Brazil.

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Introduction.

The Morro de São João Alkaline Massif (MSJ) is a circular alkaline plutonic intrusion situated within the Poços de Caldas-Cabo Frio alignment. Petrologically, three distinct facies predominate in the MSJ: melanocratic (mostly classified as hornblende gabbro), mesocratic (hornblende syenite), and leucocratic (syenite and nepheline syenite). The latter is the most abundant. Another notable feature of the massif is the absence of outcrops; the presence of blocks of various sizes enables the observation of the alkaline lithotypes of the MSJ. These blocks are formed through differential erosion, which is typically concentrated in areas with relatively low topography due to gravitational displacement, for example at the borders of massifs or along drainage systems.

Method and/or Theory.

This work compares the results of the radiometric characterization of the main lithotypes present in the MSJ at different scales. These results were obtained through gamma spectrometry data from aerial surveys (regional), fieldwork collections (local), and samples (in situ - laboratory). This characterization enables the processes of movement distribution of the main natural radionuclides in the environment to be described, as well as their enrichment or depletion. It also reveals important information about the hydrothermal processes undergone by these alkaline rocks.

Aerial data was obtained from the Aerogeophysical Project 1117 (CPRM), at a spacing of 500m and an acquisition height of 100m. The data resolution was in the order of 1024 channels. Field data was obtained using an RS-125 portable gamma spectrometer at 242 logistical points that cut through the massif and sought to involve its main lithological types. The 35 samples collected in the field were sent to the Radioprotection and Dosimetry Institute to determine their concentrations of potassium (K), uranium (U) and thorium (Th) using the hyperpure germanium gamma spectrometry Canberra Be5030.

Results and Conclusions

The K-U-Th distribution maps generated from regional and local data show discrepancies, which may be a result from the higher resolution of the field equipment used and the locations at which the measurements were taken.

Generally, both analyses identify higher concentrations of uranium (U) and thorium (Th) at the edges of the massif, as well as in areas of relatively low topography within it, such as drainages. The mineralogy composition of MSJ rocks, which are rich in potassium feldspars and feldspathoids, results in relatively high potassium throughout the massif. The concentrations obtained for the samples show that the felsic rocks have higher average K-U-Th contents than the mafic rocks, reflecting the crystallization conditions of the parent magma. The mafic rocks crystallize first, with little enrichment in incompatible elements, while felsic rocks generated in the final stages of crystallization are strongly enriched in them.

It can therefore be concluded that the radioelement contents obtained for the samples are related to the fractional crystallization processes that generated the massif. The morphology of the massif strongly influences its distribution, favouring the deposition of rock blocks in areas of relatively low topography, such as the massif border and drainages.

Keywords: alkalines, radiogenic elements, gamma spectrometry, São João Massif.