



SBGf Conference

18-20 NOV | Rio'25

Sustainable Geophysics at the Service of Society

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Submission code: VJ4GW4X504

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Paleodepositional interpretation of the Tremembé Formation, Taubaté Basin-SP, based on gamma spectrometry survey of the Aligra-1 core.

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Introduction

The study of cores is essential to understanding the composition, structures, and paleodepositional and paleoclimatic characteristics of specific intervals. In this context, gamma spectrometry emerges as a robust tool capable of differentiating sediment provenance and offering consistent interpretations, even in laboratory settings. A core recovery drilling was carried out by the mining company Aligra - Indústria e Comércio de Argila Ltda in the Tremembé Formation. The Taubaté Basin is located in the northeastern portion of the state of São Paulo, in the Paraíba Valley region, and is part of the set of Cenozoic basins belonging to the central segment of the Southeast Brazil Continental Rift (RCSB). Although it holds no exploratory interest for the oil industry, understanding its geology may assist studies in adjacent marginal basins, serving as an analogue, particularly regarding the Cenozoic sedimentation of the Campos and Santos basins, which share a similar age.

Method and/or Theory

In a controlled environment, the recovered core was analyzed by gamma spectrometry, considering the lithofacies previously described visually. We correlated peaks from the open-hole gamma ray (GR) log with similar peaks from the core gamma spectrometry curve. The measurements, initially in nSv/h, were converted to API units using a formula available in the literature. This conversion enabled us to align core depths with those from wireline logging. Gamma spectrometry investigates natural gamma radiation emitted by a mass of material. The detector differentiates the radioactive elements present in the rock by measuring electromagnetic energy pulses from the radioactive decay of potassium (K-40), thorium (Th-232), and uranium (U-238). These elements are widely found in rock compositions and have distinct energy spectra, enabling their identification. Gamma spectrometry also provides valuable data for paleoenvironmental, paleoclimatic, and stratigraphic/sedimentological interpretations, especially through the use of their ratios as proxies. For laboratory measurements, a portable RS-230 gamma spectrometer was used, with an acquisition time of 180 seconds and a spacing of 10 cm along the core, resulting in 1,795 measurements over the 0–220 meters interval. The results were plotted using the AnaSeTe software (Análise Sequencial de Testemunhos).

Results and Conclusions

The gamma ray profiles revealed a laminated section, from which K-40, Th-232, and U-238 curves were generated. These curves showed shifts in trends, possibly indicating stratigraphic and/or erosional surfaces formed during the deposition of the Tremembé Formation in the studied area. Anomalies in the three elemental curves and their ratios were observed and interpreted in terms of paleoclimate and paleodepositional characteristics. Cycles in the potassium curve were identified and may be related to variations in clay composition. There is a recurring trend of increasing K-40 towards the top of each cycle, suggesting a higher amount of illite. This increase may reflect greater climatic aridity at the end of each cycle, potentially related to lake level shallowing. Further mineralogical studies will be conducted to confirm this hypothesis. The goal is to associate the type of clay minerals with the gamma spectrometry curves and organic content, to better understand the response of these materials to open-hole geophysical logging.