STRATIGRAPHIC AND STRUCTURAL CHARACTERISTICS OF THE SANTA MARTA IMPACT STRUCTURE, BRAZIL

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Introduction: Santa Marta (10°10'S/45°14'W) is a moderate-size (D~10 km) complex impact structure with a ~3.2 km central uplift, which is located in southeastern Piauí State, Brazil. Santa Marta was recently confirmed as the sixth meteorite impact structure in Brazil [1,2]. Shock indicators include the widespread occurrence of shatter cones, as well as shock deformation features in quartz, such as PDFs and FFs, together with abundant PFs [2]. The structure was formed in sedimentary rocks (conglomerates, sandstones, siltstones and shales) of two basins that overlap in this region - the Paleozoic Parnaíba and the Mesozoic Sanfranciscan basins [3]. Here, we provide an overview of the geology and stratigraphy of the strata identified within the structure. This study is aimed at contributing to a better understanding of the cratering process at formation of complex impact structures in sedimentary targets.

Methods: Geological data were collected during five field campaigns, at 354 GPS-referenced locations, with notes of lithology, bedding plane orientation, and structural measurements. The results were spatially integrated and analyzed using the ArcGIS 10.0 software, and a 1:30,000 geological map was produced. The area within the crater was analyzed in detail in order to distinguish between distinct lithostratigraphic units and to recognize deformation patterns, considering different morpho-structural domains of the Santa Marta structure and adding new information to that presented by [1-3].

Results and discussion: Rocks of the Paleozoic sequence of the Parnaíba Basin (Serra Grande Group, Pimenteiras and Cabeças formations) were identified in the central area of the Santa Marta structure, with Mesozoic sequences of the Sanfranciscan basin (Abaeté, Quiricó, Três Barras, and Posse formations) occurring in the areas of the annular basin and in the rim of the structure. The identification of the Paleozoic sequence in the central area of the Santa Marta structure was no trivial task, due to the highly complex deformation patterns that they exhibit and the scarce regional geological information for stratigraphic comparison purposes. The complexity and intensity of the deformation increases progressively towards the central uplift (CU). The central elevation of the structure comprises two distinct morpho-structural domains, the CU, comprising deformed Paleozoic strata, and the overlying central elevated plateau (CEP) comprising Cenozoic, post-impact detrital cover.

The large variety of lithologies of the respective units occurring inside the structure was responsible for the different responses to stress that resulted in different patterns of deformation. These different responses can be related to the occurrence of inner rings in the structure, similar to those that have been mapped in the Haughton Dome structure, Canada [4]. There it was suggested that this pattern was caused by the presence of a peak-ring impact structure. At Santa Marta we prefer to relate the spatially varied deformation not to morphology but to differential response of lithotypes to stress.

Conclusions: This study contributed the lithostratigraphic definition of Paleozoic and Mesozoic sequences that occur within the Santa Marta structure. The main structural characteristics of the distinct morpho-structural domains of Santa Marta (central uplift - CU and central elevated plateau - CEP, inner rings and outer edge) show variations in deformation that are the result of the stress to which the strata was subjected and their heterogeneous response.

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