PETROGRAPHY AND CHEMOSTRATIGRAPHY OF THE CARAJÁS BANDED IRON FORMATION FROM N4 DEPOSIT, GRÃO-PARÁ GROUP, CARAJÁS PROVINCE

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ABSTRACT: The Carajás Mineral Province is renowned for hosting several world-class mineral deposits, including several Cu-Au and Ni deposits, as well as the jaspilite-hosted giant iron deposits. The iron deposits are associated with banded iron formations (jaspilites) inserted in the volcano-sedimentary sequence of the Grão-Pará Group. Here we present detailed petrology and chemostratigraphy through three entire core sections of the Carajás BIFs across the N4 deposit. The jaspilites have centimeter-thick intercalations of chert/jasper and iron oxides (mainly hematite). The chert ranges in color from white to grayish and to a more red variety (jasper) as a result of interstitial hematite grains. Major parts of the iron oxides bands are black and opaque while minor parts of the bands are black gray due to interlayered chert microbands. Iron-rich bands are characterized by hematite and lesser amounts of magnetite. Hematite is found both as primary fine irregular grains in Fe-layers and as <0.1 mm secondary crystals (martite), which are locally found replacing magnetite. The magnetite ranges from fine-grained to coarse grained with a well-crystallized habit and it is more common in the bottom section of the Carajás BIF. Pseudomorphic replacement of magnetite by hematite (martitization) is locally observed particularly in samples where quartz veins are observed to crosscut BIF banding. The silica and iron bands are generally continuous showing little folding. Slump structures, pinch and sweel and colorless microspherules ca.10–30 mm in diameter with hematitic nuclei are the main structures founded. Breccias with jasper fragments encompassed by a hematite-rich matrix also occur, commonly with veinlets of quartz and/or carbonate. SHRIMP U–Pb dating on zircons separated from the intercalated volcanic mafic rocks constrains the depositional age ≤ 2.75 Ga. The Carajás BIF has markedly high contents of SiO_2 + $F_2O_3^T$ (average at 97.63 wt.%), and very low Al_2O_3 content (<0.5 wt. %). In contrast, CaO and MgO are more elevated, reflecting the appearance of well-developed carbonates throughout the core. A constant low input of Al, Ti, Sr, V and high field strength elements such as Zr and Nb is consistent with the lack of a significant contribution from continental crust for these chemical sediments. The BIF has a low ∑REE (rare earth element) content (average at 8.71 ppm) and a flattened Post Archean Average Shale-normalized REE + Y pattern. Most of samples display a strongly superchondritic Y/Ho, with an average value of 72, that is considered typical of seawater precipitation. The REE + Y patterns also show a weakly developed positive La anomaly, no Ce anomaly and a pronounced positive Eu anomaly. The strongest positive Eu anomaly is usually observed in Archaean BIFs and regarded as witnessing a hydrothermal influence. Moreover, the absence of negative Ce anomaly, pointing to the less oxidized state of their Archaean seawater source. In conclusion, the deposition of the studied Carajás BIF was mainly controlled by the mixing of seawater with hydrothermal fluids. Therefore, the major components of iron and silica in the Carajás BIF should be derived from either seawater or hydrothermal fluids or both.

KEYWORDS: CARAJÁS BANDED IRON FORMATION; GRÃO-PARÁ GROUP; CHEMOSTRATIGRAPHY