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Conundrum of the iron isotopic fractionation: banded iron formation from Urucum district, West Brazil

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The iron biogeochemical cycle is redox-sensitive and, therefore, can be linked to the major variations on the atmospheric and ocean compositions over the Earth's evolution. Regarding the two main increases in the oxygen levels during the Precambrian, the Great and the Neoproterozoic Oxidation Events, both are related to paleogeographic, paleoenvironmetal and biochemical changes, linked also to global glaciations. These paleoclimatic variations caused disturbances in the iron cycle, which reacted by depositing paleoclimatic archives as banded iron formations (BIF). Investigations on the iron cycle can shed a light on the responses of the ocean redox state and the iron reservoir through these atmospheric variations. Thus, the analyses of the iron isotopic composition in the BIFs are a fundamental tool for these studies. It is essential to considerate the associated isotopic fractionation processes and uncertainties during the interpretation of these data. To this extend, many authors address the possibility of the impact of post-depositional processes in the primary signature of iron isotopic values, such as diagenesis, metamorphism and weathering. In all these scenarios and along the depositional process, the metabolic activity of planktonic bacteria must be considered as an active mechanism of isotopic fractioning. Therefore, the biologic enrolment in Fe (II) oxidation in a poor-O_2 atmosphere environment can help the understanding of BIF genesis during the major paleoclimatic events and its connection to life evolutionary leaps. In this study, we have performed a statistic evaluation of a bulk iron isotopic compilation from BIFs of different localities through the Precambrian, highlighting the Archean, the Paleoproterozoic and the Neoproterozoic. This evaluation was applied to ensure an iron isotopic anomaly, pointing towards an intense fractionation, found in the Neoproterozoic BIF of Banda Alta Formation (Jacadigo Group), located at Urucum district, West Brazil, bordering Bolivia. This formation is mainly composed of banded iron formations, interbedded with manganese facies, granular iron formation, diamictite and pelitic siliciclastic units. Its age constrains is in current debate, often linked to the Marinoan glaciation, whereas a recent biostratigraphic study indicates connection to the Sturtian glaciation. One of the main goals of this research is the evaluation of the uncertainty of primary isotopic signature regarding the impacts of post-depositional processes. To this extent, we have performed a detailed diagenetic characterization using clay mineralogy on stratigraphic cores establishing the diagenetic-low metamorphic stage in which these BIFs where submitted to. Moreover, in order to interpret the iron isotopic anomalous values, this research aimed the recognition of biogenic contribution in the BIF genesis. For this purpose, magnetic measures, such as low temperature magnetic measurements and standard bulk rock magnetism analyses, were performed to understand the

minerology of the iron oxide phases and their genesis, in particular the attempt to identify biogenic magnetite proxies. In conclusion, a multiproxy approach was used targeting the understanding of the observed iron isotopic anomaly in the BIF of Urucum district.