ELEMENT GEOCHEMISTRY AND FE ISOTOPE COMPOSITION FROM IRON FORMATIONS AND BLACK SHALES: NEW INSIGHTS INTO PALEOREDOX CONDITIONS DURING THE PALEOPROTEROZOIC IN THE CARAJÁS MINERAL PROVINCE

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RESUMO: Major and trace element geochemistry combined with iron (Fe) isotopes were applied in banded iron formations (BIFs) and organic rich black shales from the Carajás Mineral Province (CMP), Pará, Brazil. The Fe isotope compositions of Archean and Proterozoic marine sedimentary rocks have been a topic of major debate in the past decades, which is mainly due to distinct lines of interpretation of the isotopic record. One of the most remarkable temporal trend in the sedimentary iron isotope record is the shift from variable and highly negative δ^{56}Fe values (~2.9 to 2.7 Ga) to near-crustal values. Clearly the iron cycle went through significant change during this time, however, the processes which caused such negative δ^{56}Fe values, are still extensively debated. One model links the isotope variability to a shift in the marine redox condition, in which partial oxidation created isotopically heavy ferric Fe(III) and left an isotopically depleted dissolved ferrous Fe(II) to be captured and transferred to the sedimentary record. In this case, the decline in iron isotope variability observed at ~2.4 Ga is linked to the oxygenation of the upper ocean as a consequence of the Great Oxidation Event (GOE). A second model, instead, suggests this iron isotope trend to reflect changes in the extent of microbial dissimilatory iron reduction (DIR), which facilitates the release of isotopically light ferrous iron. Consequently, the rise of DIR by the respiration of bacteria would have caused the Fe isotopic shift. Furthermore, of specific interest will be to look for the possibility for mass-independently fractionated Fe isotopes as this signature was shown recently to be indicative of the activity of magnetotatic bacteria (MTB). This signal was only observed from microbial cultures in the laboratory and has never been reported in natural samples yet. However, there are strong possibilities that MTB have emerged very early in Earth's history and be major actor of Precambrian life, as deduced for instance from genomic and phylogenetic analyses. Even though they have never been proposed as a possible alternative for magnetite precipitation in BIFs, putative occurrences of MTB fossils have been suggested in Precambrian carbonate platform sediments, mostly stromatolitic limestones and cherts, dated up to 2.7 Ga ago. We aim to further constrain the origin of a negative/positive δ^{56}Fe signatures in BIFs and black shales from CMP and compare them with other studied sites. Additionally, we will search for a MTB signal in BIFs from the CMP. This study will improve our understanding of iron isotope systematics and advance our understanding of Earth's biogeochemical evolution, especially through times where iron cycling was unique and still enigmatic.

PALAVRAS CHAVE: banded iron formations, Carajás, dissimilatory iron reduction, magnetotatic bacteria