Biomarkers in Archaean banded iron formations from Pilbara and Dhawar Craton

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The origin of Archeaen banded iron formations (BIF) and the role of biosphere in Fe precipitation is still highly debated. In order to elucidate these processes, detailed mineralogical and textural analyses combined with $\delta^{15}N$, $\delta^{56}Fe$ and $\delta^{13}C$ data were obtained on Fe-oxide bands from Marble Bar chert Unit (MB, 3.46 Ga, Pilbara craton, W. Australia) and a BIF from the Bababudan Group (BG, 2.7-2.9 Ga, Dhawar Craton, Southern India). Both samples are composed of alternating quartz and Fe-oxide bands with wavy micro-textures. CI-normalized REE patterns show that MB reflects hydrothermal fluid/basalt interactions, while BG precipitated from a hydrothermal fluid/seawater mixture. In MB, nano-cristalline hematite replaced magnetite, Mg-calcite and Fe-sulfides producing a matlike surface, preserving nanometric N-bearing amorphous carbon nodules. Measured C/N ratios (2.3 to 52) are typical of Precambrian organic matter. The $\delta^{56}Fe$ of -0.40±0.02‰ suggests MOR-hydrothermal fluids as a Fe-source, while a $\delta^{15}N$ of +7.4±0.4‰ is compatible with nitrification-denitrification processes. BG is composed of intergrown magnetite and hematite. Disseminated grunerite and magnetite grew during low T metamorphism. Fe-oxide spherules compose vermicular-filaments that nucleated perpendicular to quartz surfaces. Fe-oxide spherule bunches are perfectly preserved in the silica bands forming micrometric mats, which contain heterogeneously distributed N (~0.09at.%) and C (0.51 at.%, C/N=5.73). Bulk $\delta^{13}C$ of -15.35‰±0.10 points to an organic origin for C. The $\delta^{56}Fe$ in Fe and Si layers (0.75‰ to 2.16‰) is compatible with a chemical precipitation for BIF. A negative correlation between $\delta^{56}Fe$ and the Th/U ratio suggests that Fe isotopic variations are related to fluid circulation and re-precipitation of Fe-oxides. High $\delta^{15}N$, on one Fe-oxide layer, of +21.8±0.7‰, corresponds to that observed for Archeaen BIFs and may be related to nitrate-dependent microbial oxidation of Fe.