Goldschmidt2020 Abstract

Microbial activity recorded in Neoarchean iron formations from Carajás (Brazil)

Siciliano, E.[1,6]; Busigny, V.[2]; Lalonde, S.V.[3]; Rossignol, C.[4]; Narduzzi, F.[4,6]; Teixeira, L.[4]; Zapparoli A.[5]; Babinski, M.[1]; Philippot, P.[6,2]

[1] IGc, Universidade de São Paulo, Brazil (ersiciliano@usp.br, babinski@usp.br)
[2] IPGP, CNRS, Université de Paris, France (busigny@ipgp.fr)
[3] IUEM, CNRS, Brest, France (stefan.lalonde@univ-brest.fr)
[4] IAG, Universidade de São Paulo, Brazil (camille.rossignol@usp.br, france.nardo@iag.usp.br)
[5] VALE S.A., CTF, Nova Lima, Brazil (adriana.zapparoli@vale.com)
[6] Géosciences Montpellier, CNRS, France (pascal.philippot@umontpellier.fr)

The role of microbial activity in the precipitation of ancient chemical sediments, such as Precambrian iron formations (IF) and carbonates, remains a topic of ongoing debate. Here we combine Fe and C stable isotopes with trace element geochemistry and rare earth and yttrium (REY) systematics to constrain redox conditions and microbial activity associated with the deposition of the 2.7 Ga old IFs and carbonates from the Grão Pará Group, Carajás, Brazil. The IFs studied present two main types of lithology: finely laminated IFs consisting of alternate mm-scale layers of Fe-oxides, chert and Fe-carbonate (Type 1); relatively massive carbonate composed primarily of calcite and quartz with minor Fe-carbonate, mm-scale Fe-oxide layers, and μm-scale wrinkly laminates of organic matter with framboidal pyrite (Type 2). Bulk rock chemistry shows only minor detrital components (e.g., Al_2O_3<1wt%) and argues for an anoxic environment of deposition (positive Eu anomaly, absence of Ce anomalies, low U/Th ratio). Bulk δ^{56}Fe values vary between -0.8 and +1.59 ‰, with Type 1 and Type 2 showing a positive (+0.6 to +1.59 ‰) and a negative (-0.2 ‰ to -0.8 ‰) range of values, respectively. The $\delta^{13}C_{carb}$ in Type 1 and Type 2 range from negative (-4 ‰ to -12 ‰) towards near-zero (-2 to + 0.5 ‰) values, respectively. Correlation between δ^{56}Fe and $\delta^{13}C_{carb}$ suggests dissimilatory iron reduction in deeper, finely laminated IFs facies. By contrast, shallower carbonates precipitated from a seawater carbon source, and intriguingly, their pyrite S isotope systematics indicate important microbial sulfate reduction. Together, these results testify to a surprisingly complex redox and metabolic landscape during deposition of the Grão Pará Group.