Carbon and Nitrogen Isotopes Biosignatures of Early Earth Continental Biosphere Modern Analogs

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While our understanding of the coupled evolution of life mediated carbon and nitrogen cycles with the chemical evolution of the early Earth has significantly advanced thanks to the systematic survey of the isotopic signature of fossils microbial mats, the terrestrial biosphere, its evolution and its relations with the others Earth's surficial reservoirs are still poorly understood.

In the last decade growing geochemical evidence suggested that microorganisms capable of oxygenic photosynthesis (e.g. cyanobacteria) colonized the Archean continent prior to the Great Oxidation and two recent studies have streghten this idea of the existence of an early Earth life on land biosphere [1, 2]. The first one shows that microbial mats inhabiting terrestrial habitats are preserved in the Moodies Group (South Africa), at 3.2 Ga, and that their organic matter carbon isotopic composition and bulk nitrogen isotopic composition are statistically different from their marine counterpart [1]. The second study carried out a meta-analysis of the biogeochemical cycling of nitrogen by modern terrestrial phototrophic microbial communities, i.e. biocrust, and suggested that this system could have exported sustantial amount of ammonium and nitrate to the Archean ocean [2].

Here we propose to fill the gap between these two reports by studying the carbon and nitrogen biosignatures of modern biocrusts as analogs to the terrestrial microbial mats observed in the Moodies Group. This study allows a direct isotopic, $\delta^{13}C$ and $\delta^{15}N$, biosignatures comparison of the Archean geochemical archives to their modern terrestrial counterpart.

[1] Homann et al. (2018) Nat. Geo., 11, 665. [2] Thomazo et al. (2018) Nat. Comm., 9, 253-256.