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Lipidic biosignatures in diagenetically stabilized ironstones terraces of Rio Tinto, an acidic environment with analogies to Mars

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Abstract

The characterization of extreme environments with analogies to Mars is important for understanding if/how life may have thrived in the Red Planet. Río Tinto in SW Spain is an extreme environment with constant acidic waters (mean pH of 2.3) and high concentration of heavy metals, which are direct consequence of the active metabolism of chemolithotrophic microorganisms thriving in the rich polymetallic sulfides present in the massive Iberian Pyritic Belt. Abundant minerals rich in ferric iron and sulfates, which result from the pyrite metabolism (e.g. jarosite, goethite, hematites, etc.) are of special interest for their potential for organics preservation [1]. Here, we investigate the occurrence and preservation of biological signatures in diagenetically stabilized ironstone deposits in Río Tinto, by using geolipidic markers.

1. Introduction

Río Tinto sedimentary deposits record aspects of the geochemical and biological environment of the regional ecosystem, that persist through diagenesis to provide a geobiological chronicle of Río Tinto processes through time. Diagenetically stabilized ironstones in the Río Tinto terraces preserve macroscopic and microscopic biosignatures in iron oxide precipitates [1], which may help to understand the potential for life preservation in a similar environment such as Mars iron outcrops.

1.1 Study area and Sampling

Three terraces recording different depositional episodes (from the late Pliocene to the Holocene) and a regionally developed Gossan from the end of the Miocene were sampled to analyze diverse lipidic families with diagnostic value. The molecular distribution patterns and the relative abundance of functionalized geolipids allowed to infer organic source inputs and preservation degree.

2. Results and Discussion

Unusually high contents of total organic carbon indicated the relatively good preservation of the organic fraction in the old geological deposits, what is discussed to be potentially related to organo-FeOx sorption, organo-Fe precipitates, and/or ternary associations among FeOx, organic matter, and clay minerals [2]. The distribution patterns of functionalized lipids showed mixed inputs of organic matter dominated by microbial sources (bacteria, archaea) and higher plants, with a fading trend in the diagnostic fingerprints with the increasing age of the samples. These are relevant findings for understanding life thriving and survival strategies in an acidic environment developed on a Fe- and S-based chemistry with analogies to Mars.

3. Figures

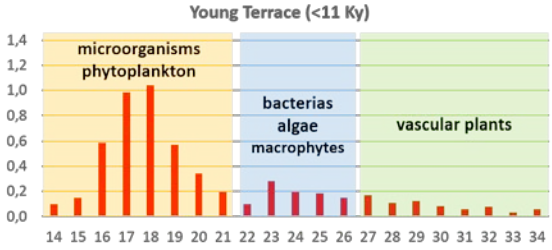

Fig. 1: *n*-Alkanes distribution patterns in one of the three Río Tinto terraces, showing the most likely source inputs associated with the carbon units and even/odd preferences.

4. Acknowledgements

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