The geochemistry of the deep Iberian Pyrite Belt (IBP) subsurface supports multiple microbial metabolisms

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Terrestrial subsurface geomicrobiology is a matter of growing interest not only to understand the life in the absence of light but also as a model for searching for life in other planetary bodies where the superficial conditions preclude any form of life. The Río Tinto fluvial basin is an acidic system in continuous geological evolution dating back from more than 2 million of years. It emerges in the Rio Tinto Anticline region, southwestern Spain, which is a complex geological structure taking part of the Iberian Pyrite Belt (IBP). Its formation is associated to the building up of a Carboniferous volcano-sedimentary complex exposed to a late intensive event of hydrothermal activity that mineralized the volcanic systems. During million of years, surface and underground microbial communities sustained on sulfur and iron chemolithotrophy have been using the ancient hydrothermal materials as energy sources to grow. Here we will present the first results of the IPBSL project (Iberian Pyrite Subsurface Life) funded by an European Research Council (ERC) Advanced Grant. The main scientific objective is the understanding of the bio-geochemical processes for sustaining the iron and sulfur driven life in this special subsurface habitat. The geochemical analysis of more than 200 core samples from two drilling, one to a depth of 340 m and another one to 612 m deep, revealed the presence of all the nutrients required for different anaerobic metabolisms. We detected small organic acid like propionate, acetate or formate that can be used by microbes as electron donors, and compounds like sulfate, nitrate, nitrite, and ferric iron as electron acceptor for anaerobic respiration. We used immunological techniques, a 450 antibody-containing microarray for the detection of microbial biomarkers in near real time (Rivas et al., 2008; Parro et al., 2011). We identified different microbial biomarkers at different depths revealing the presence of certain groups of prokaryotes. Environmental DNA is being extracted for metagenomic and molecular phylogenetic studies in some of the samples. Altogether the data will allow us to decipher the operating metabolisms in the deep Iberian Pyrite Belt Subsurface.

References

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