Subsurface geomicrobiology of the Iberian Pyrite Belt

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The recent geomicrobiological characterization of Río Tinto, Iberian Pyrite Belt (IPB), has proven the importance of the iron cycle, not only in generating the extreme conditions of the habitat (low pH, high concentration of toxic heavy metals) but also in maintaining the high level of microbial diversity, both prokaryotic and eukaryotic, detected in the water column and the sediments. The extreme conditions of the Tinto basin are not the product of industrial contamination but the consequence of the presence of an underground bioreactor that obtains its energy from the massive sulfide minerals of the IPB. To test this hypothesis, a drilling project was carried out to intersect ground waters that interact with the mineral ore in order to provide evidence of subsurface microbial activities and the potential resources to support them. The Iberian Pyrite Belt Subsurface Life (IPBSL) is a drilling project specifically designed to characterize the subsurface ecosystems operating in the IPB. A dedicated geophysical characterization of the area selected two drilling sites due to the possible existence of water with high ionic content. Two wells have been drilled in the selected area (Peña de Hierro), BH11 and BH10, with depths of 340 and 630 meters respectively, with recovery of cores and generation of samples in anaerobic and sterile conditions. Preliminary results showed an important alteration of mineral structures associated with the presence of water, with production of expected products from the bacterial oxidation of pyrite (sulfates and soluble iron). Ion chromatography of water soluble compounds from uncontaminated samples showed the existence of putative electron donors (ferrous iron, nitrite, hydrogen and methane, in addition of the metal sulfides), electron acceptors (sulfate, nitrate, ferric iron) as well as variable concentration of metabolic organic acids (mainly acetate, formate, propionate and oxalate), which are strong signals of the presence of an active subsurface ecosystem associated to the high sulfidic mineral content of the IPB. The system is driven by oxidants that appear to be provided by the rock matrix, only groundwater is needed to launch microbial metabolism. The geological, geomicrobiological and molecular biology analysis which are under way,

should allow the characterization of this ecosystem of astrobiological interest which is not dependent on radiation.