Exploring the Geomicrobiology of the Río Tinto subsurface Mars analog by using a life detector biochip

FERNANDO PUENTE-SÁNCHEZ[1*], MERCEDES MORENO-PAZ[1], PATRICIA CRUZ-GIL[1], LUIS RIVAS[1], MARINA POSTIGO[1], MANUEL J. GÓMEZ[1], MIRIAM GARCÍA-VILLADANGOS[1] AND VICTOR PARRO[1]

[1]Centro de Astrobiología (INTA-CSIC), Madrid, Spain, puentesf@cab.inta-csic.es (*presenting author)

Introduction:

The Iberian Pyritic Belt (IPB) is one of the largest massive pyrite deposits in the world, and is considered as a Martian analog. Several studies [1][2] of the acidic, heavy metal rich-Tinto river in the IPB have revealed a surprisingly rich extreme ecosystem, yet little is known about the geomicrobiology of its subsurface. In a previous work [3] we described an antibody microarray which contains more than 200 antibodies against bacterial strains, different fractions of natural extracts, proteins, etc. and reported its usefulness for immunoprofiling of environmental samples and for the detection of biomarkers with different range of universality.

Results and conclusions:

Here we show the results obtained by using LDChip200 (Life Dectector Chip) for immunoprofiling the whole depth of a drill in the IPB at the Tinto river origin. From 0,5 to 1 g of samples from cores up to 160 m depth were processed for a quick analysis with the LDChip200. The results showed the presence of Gram-positive bacteria and peptides or proteins from the ferritin superfamily which might be involved in tolerance to the high iron concentrations present in the IPB subsurface. Biodiversity was also assessed by DNA extraction and analysis with a phylogenetic oligonucleotide microarray for prokaryotes [4], and by cloning and sequencing of the PCR-amplified bacterial 16s rRNA gene. Members of the Gram-positive Firmicutes group of bacteria were detected by the oligonucleotide microarray and sequencing. Sequencing also revealed sequences similar to those of nitrate and sulphate reducing bacteria. Those results allowed us to build a preliminary model of the ecosystem and provided an initial insight into the biology of the deep subsurface of the Iberian Pyritic Belt.

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Ar-39 dating of groundwater: How limiting is underground production?

ROLAND PURTSCHERT[1]

[1]Climate and Environmental Physics, University of Bern, Switzerland, purtschert@climate.unibe.ch

With a half-live of 269 years is ^{39}Ar an ideal tracer for groundwater dating in the age range 50-1000 years [1]. Ground water resources beyond the dating range of transient tracers such as $^{3}H/^{3}He$, Sf_6, CFC's and ^{85}Kr become increasingly important due to contamination and overexploitation of shallow and young groundwater's. A potential limitation of ^{39}Ar dating of groundwater, besides the difficult sampling protocol, is the possibility of underground production due to neutron activation of potassium [2]. Over modern ^{39}Ar concentrations have for example been observed in U- and Th- rich crystalline rocks [3]. Another important factor is the escape path and probability of ^{39}Ar from the rock matrix into the water permeable pore space. In this review paper the importance of underground production of ^{39}Ar is assessed. Data collected over the last decade in numerous porous and fractured aquifers woldwide are discussed.

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