MARS ANALOGS ON EARTH: PUTATIVE HABITATS ON MARS? LECTURES FROM EXTREMOPHILES. F. Gómez[1] , D. C. Fernández-Remolar[1], O. Prieto[1] , J.A. Rodríguez-Manfredi, N. Rodríguez[1] and R. Amils[1,2], [1]Centro de Astrobiología-INTA, Torrejón de Ardoz 28850, Spain (gomezgf@inta.es); [2]Centro de Biología Molecular, Universidad Autonoma de Madrid, Cantoblanco 28049, Spain.

Introduction: Results form Mars Orbiters and Rovers are transforming our point of view about the red planet. That dry and inhospitable planet is becoming a weedy planet with high probabilities of water existence on the past. Now days some results seem to indicate the presence of water underneath the Mars surface [1].

Mineralogy studies by NASA Opportunity Rover report iron oxides and hydroxides precipitates on Endurance Crater. Sedimentary deposits have been identify at Meridiani Planum [2]. This deposits should had generated in a dune aqueous acidic and oxidizing environment. Similarities appear when we study Rio Tinto, and acidic river under the control of iron [3]. We will focus on two principal Mars Analogs of astrobiological interest: Rio Tinto in Spain and Imuruk Lake permafrost in Alaska (See Gomez G.F. et al. same conference for more details).

Río Tinto Case. Rio Tinto is a 100 Km river with very hard red color waters. The color is due to ferric iron in solution. High metal concentration with a very low pH (mean of 2.3) defines this extreme environment with a high microbial biodiversity [4]. Jarosite precipitates and other iron rich sulphates deposits appear on the bed and shores of the river (Fig. 1). This ecosystem is a self-maintained Gaian environment [5] with a microbiology based on chemolithotrophic bacteria (Fig. 2). pH is buffered around 2.3 by iron oxides precipitation in the dry season and redisolution in the rain season. The model of the system is divided in two different environments depending on the presence or absence of oxygen. Metabolism of aerobic microorganism uses oxygen like electron acceptor. Oxygen level became to cero at very low deep. Anaerobic microorganisms used ferric iron like electron acceptor in the absence of oxygen and a different habitat are established. Ferric iron solution is a protecting agent against ultraviolet radiation [6]. Ferric iron works like a shielding shell. This element can play an important role for the habitability of an ecosystem exposed to high UV radiation.

An interesting paradox in Rio Tinto is the high level of Eukarya biodiversity. Most of the biomass of the Tinto ecosystem is located on the riverbed and the surface of the rocks forming dense biofilms (fig. 3), composed mainly by filamentous algae and fungi in which prokaryotic organisms are trapped. Heterotrophic protists have been also detected associated to these biofilms.

Figure 1: Iron oxides precipitates on a shallow part of Rio Tinto in Huelva (SW Spain). Sulphate salts are precipitating over pineapple leaves.

The astrobiological interest of the Rio Tinto determined an international collaboration between NASA Ames and CAB to develop the M.A.R.T.E. project on the source of the river for looking for subsurface isolated ecosystem [7]. This project consists on a 160 m deep drill for geological, mineralogical and microbiological analysis of the samples.

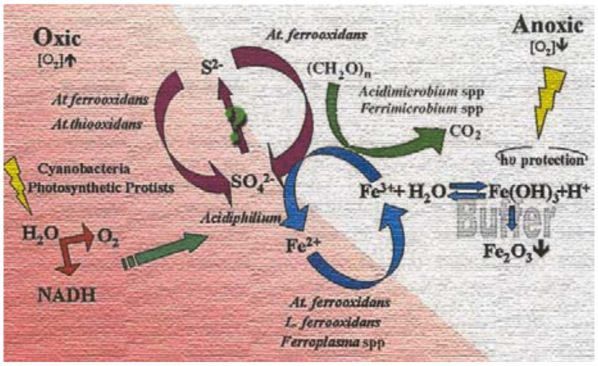

Figure 2: Rio Tinto microbiological model. Two different environments with different microbiology are defined due to the presence or absence of oxygen.

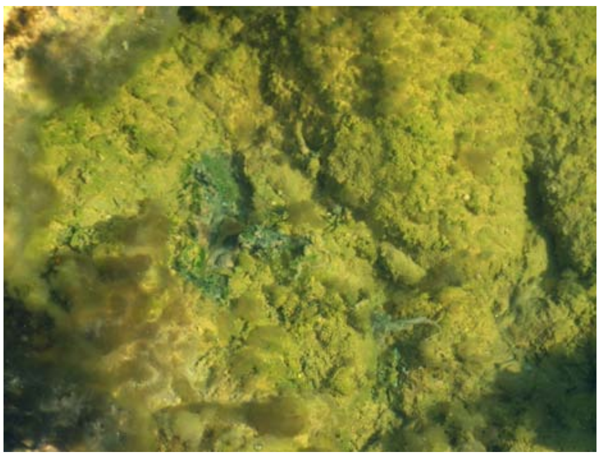

Figure 3: Photosynthetic eukaryote in a shallow puddle in Tinto River. This environment is characterized by high metal concentration.

Imuruk lake permafrost case. The possibilities of life in isolate environments are of special interests. Permafrost existence on Mars [1] could suppose a shielding niche where life could be supported.

Studies were focus on microbial biodiversity identification for modelling of the system. Several molecular techniques for microorganisms identification were used including "in situ" hybridization with DNA group and species specific probes (Fig. 4). Several microbiological media were defined for microbial groups enrichment including aerobic heterotrophic bacteria, anaerobic methanogens with several energy sources (volatile fatty acidic, amino acids, methanol, etc.).

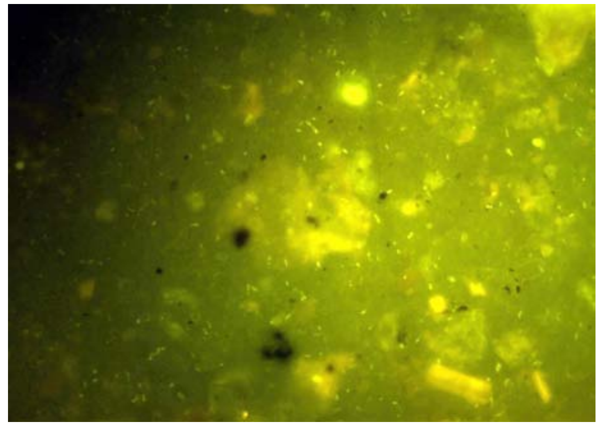

Figure 4: "in situ" hybridization of heterotrophic bacteria. DNA probe was specific for alfaproteobacteria. This sample was form a depth of 3.6 m.

Conclusion. Extreme environments on Earth can help us to understand possible habitats on Mars. Harsh conditions on Mars surface (oxidative stress by chemicals and UV irradiation) recommend focusing the look for life on the subsurface. Better understanding of subsurface ecosystem (subsurface microbiology at the source area of Tinto River and permafrost in the Imuruk Lake) could help us to identify methodologies and techniques for automated remote exploration for life detection.

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