LIFE ON MARS?
Río Tinto as a terrestrial analogue of the Red Planet
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Introduction
Search for life beyond Earth has been a major scientific and philosophical issue for decades, and our neighbor planet Mars is considered one of the main candidates to host some kind of extraterrestrial life. One of the most relevant terrestrial analogs of the Red Planet is a very peculiar river, located in a small region in the south of the Iberian Peninsula, the province of Huelva (Spain). This river, “Río Tinto”, has been studied for years because its unique ecosystem, where true extreme conditions (acidity, toxic heavy metals) are present; and at the same time it hosts an unexpectedly high microbial diversity, both Eukaryotic and Prokaryotic.

Relevant findings on Mars

Liquid water evidence
Evidence of liquid water flowing on Mars is indispensable to consider any biological form of life in the Red Planet. In 2016, NASA’s Mars Reconnaissance Orbiter (MRO), using an imaging spectrometer, provided the strongest evidence of water flowing on Mars surface yet.

Methane on Mars
In summer 2003, Mumma et al. performed a study where the main objective was the detection of methane gas on the Red Planet. High methane levels were detected, and the authors suggested that an active source of methane must exist in Mars nowadays.

Eukaryotic and prokaryotic diversity

Eukaryotes
In an extreme environment like Río Tinto, where acidic conditions and high metal concentrations are present, it is thought that eukaryotic growth and diversity would be very limited. However, Eukaryotic algae present 60% of the river biomass, with chlorophytes Chlorella, Dunaliella and Chlamydomonas being the most abundant genera.

Fungal species have a strong presence all along the river: phylum Ascomycota is the most abundant, and one species related to the genus was found forming characteristich melanin cap structures.

Protists are also well represented, with photoautotrophic flagellates (Euglena, Bodo and Ochromonas), ciliates (order Hypotrichida), pennated diatoms (mostly Penninariiigenus), amoebas (Vahlkampfia spp. and amoebas (Actinophryus genus), all being reported in the river.

Prokaryotes
Eighty percent of the prokaryotic diversity was identified as bacteria belonging to only three genera: Leptospirillum, Acidiphilum and Acidithiobacillus, all described members of the iron. Acidithiobacillus ferrooxidans is the most remarkable species, as it is involved in several biogeochemical processes (showed at Fig.7).

Conclusions
Several studies have been performed in recent years in this peculiar river, achieving different goals: the hypothesis of microbial activity as the origin of extreme acidic conditions has been tested and proved, with obtained results being consistent with previous work. Microorganisms responsible for these conditions have been isolated and identified, and a great eukaryotic and prokaryotic diversity has been found. Iron and sulfur cycles sustain the ecosystem, and A. Ferrooxidans is the most relevant species among these cycles. Also, it has been proven that methane production can live in extremely unfriendly conditions, thanks to the creation of suitable microhabitats.

Despite the obvious differences (oxygen, temperature, water abundance), Río Tinto is useful as a terrestrial analog of Mars, as it study allows researchers to extrapolate different possible biogeochemical processes on the Red Planet surface or subsoil.

References:

1. [Image credit: NASA/JPL/University of Arizona].
2. [Image credit: Trent Schindler/NASA].
3. [Image credit: NASA/JPL/Cornell/USGS].