Microbial Fe(II) oxidation and heavy metal precipitation in Rio Tinto (Spain)

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Pyrite oxidation in the Iberian Pyrite Belt mines leads to a high input of dissolved heavy metals into the Rio Tinto. Despite of these potentially harmful and toxic conditions, the Rio Tinto is inhabited by acidophilic Fe(II)-oxidizing microorganisms enriching the acidic water with dissolved Fe(III). However, the hydrochemistry of the river is dramatically changing at a transitional zone where acidic, metal-contaminated water mixes with tidal pH-neutral ocean water twice a day. The effect of these changes on the activity and identity of Fe(II)-oxidizing microorganisms, on the precipitation of minerals and metals, and on the fate of heavy metals is unknown.

In order to address this, we isolated Fe(II)-oxidizing microorganisms from the river and demonstrated that they can grow under pH-fluctuations, oxidize Fe(II) and immobilize heavy metals. We also performed diurnal sampling and filtration of water from the transitional zone of the Rio Tinto. Filtered water and particulate matter were used for quantification of metals distributed between water-soluble and particle-associated fractions. While more than 90% of Cu, Mn, Zn, Co, Fe, Cd and Pb were dissolved, 20% of As, as well 100% of Ti, Cr and Mo were found to be associated with particles. Based on our results, we suggest that Fe(II)-oxidizing microorganisms can participate in formation of particulate matter at the transitional zone of the Rio Tinto. These particles can play a key role in transportation of As, Ti, Cr and Mo into the Atlantic Ocean. Current microbial community analysis based on the 16S rRNA gene will reveal potential differences among particle-associated and free-living microbial populations, putatively involved in metal transformation reactions.