Is arsenic available as energy source for microbial growth in acidic and hypersaline lakes?

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Hypersaline and acidic Andean lakes are considered a Mars analogue environment and studied as a model system for understanding the available energy sources for life development. Geological mapping, geochemical analysis of sediments, salts, bedrock and brines samples as well as the analysis of the associated microbiota were performed in the Gorbea Andean salt-flat in Northern Chile (25°24´S/ 68°40´W). Ponds with acidic brines of the Cl-SO4-Na (-Mg) type reaching up to pH 1, surrounded by yellow efflorescences, were found in the distal part of an alluvial fan. Other ponds towards the basin center progressively increase in concentration due to evaporation. Brines are rich in aluminium (2–6000 mg L^{-1}) and boron (5–21000 mg L^{-1}) with considerable levels of manganese, lithium and iron. An advanced hydrothermal argillic alteration affecting the country rocks, native sulfur associated to active solfataras, alunite and jarosite occurrences in sediments and chloride and sulfate efflorescent salts were evidenced. The combination of geochemical, mineralogical and stable S and O isotopic composition results, allowed us to develop a preliminary scheme of the system. Low soluble arsenic concentration (0.004 and 24 mg L^{-1}) results from the increased tendency for the removal of As from solution under acidic pH [1]. The microbial community in brines and sediments was dominated by Proteobacteria and Cyanobacteria and by Firmicutes, Proteobacteria and Actinobacteria, respectively. Sulfur, iron and arsenic oxidizing microbial activity were detected. Microbial growth via respiratory As(V) and S(VI) reduction, like the described in neutral Andean salt-flats[2], have only been noted in sediments over pH 4 using either organic or inorganic substrates. As conclusion, a highly restricted arsenic biogeochemical redox cycle has been evidenced in this acidic hypersaline environment.

[1] Eary (1999) *Appl Geochem* **14**: 963-987. [2] Demergasso *et al* (2007) *Geomicrobiol J* **24**(2): 111-123.