Characterization of biominerals associated with the Rio Tinto River, Spain

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Acidophilic, aerobic iron and sulfur oxidizing bacteria thrive in the waters of the Rio Tinto River in Spain, a Martian terrestrial analogue due to the presence of jarosite and other sulphate minerals [1]. The objective of this study is to document the influence of these acidophilic microbial communities on the iron oxides from this analogue environment in conjuction to characterizing the advantages and limitations of analytical techniques currently used in astrobiological research.

Iron hydroxy sulfate (jarosite) containing sediments were collected from the Rio Tinto River, near Nerva, Spain. Acidophilic Fe and S oxidizing bacteria were cultured in a ferrous sulfate medium resulting in the formation of jarosite (XRD). Bacteria were difficult to observe within the iron oxides using phase contrast light microscopy. However, when stained with SYTO 9 dye and propidium iodide, cells were easily distinguished amongst the oxide matrix. Light micrographs of synthetic jarosite [2] were comparable to those of the biogenic system. However, the synthetic and biogenic oxides were easily distinguished from one another when examined using scanning electron microscopy. In addition to the presence of bacterial cells, which were clearly visible at high resolution, the synthetic and biogenic jarosite minerals possessed distinctly different morphologies. The precipitation of jarosite in Rio Tinto appears to be directly influenced by biology, beyond simply promoting the oxidation of reduced iron and sulfur compounds associated with the formation of these acid ecosystems.

[1] Fernández-Remolar *et al.* (2005) *Earth & Planet. Sci. Lett.* **240**, 149–167. [2] Basciano & Peterson (2007) *Mineral. Mag.* **71**, 427–441.

Assessing landscape response to land-use change using sediment-chemical chronologies and backcast modeling

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Understanding the impact of land-use change (e.g. urbanization, deforestation) on the flows of mass and energy in watersheds has been complicated by the lack of metrics to learn from the past. Recently, an innovative Backcast Model, which is a modification of an artificial neural network and GIS-based forward casting Land Transformation Model has been developed. In this paper we compare temporal chemical trends from lake sediments in Michigan, U.S.A. to past changes in land use based on the results of the Backcast Model. The hypothesis is that when land-use change is stabilized, the flow of mass and energy across a watershed will come into balance (equilibrium/steady state) with watershed physical, chemical, and biological processes.

Sediment cores were sectioned immediately after collection. Pore water was collected by whole core squeezing. Chemicals were analyzed via ICP-MS. Historic land-use change was modelled in a 500 meter buffer around each lake. Chemicals examined included proxies for pollution (e.g. Pb), in-lake processes (e.g. Ca), and watershed export (e.g. Al).

The following questions were addressed 1) do temporal changes in chemical proxies correlate with land use change, 2) can periods of balance be recognized from the temporal patterns of the chemical proxies, 3) do periods of balance correlate with periods of minimal use change and 4) can regime shifts be identified, 5) is there a lag time between land-use change and proxy response? System stability was recognized by symmetrical temporal patterns among and within proxy groups. The results are positive for questions 1 through 4. There were not enough data to answer question 5, however. These results are interpreted to support the hypothesis, but more work is needed to better understand the feedbacks between land-use change and the flows of mass and energy in watersheds.