An infrared study of modern and paleo-filamentous bacteria from Rio Tinto, Spain

Conference or Workshop Item

A nested watershed study of streamflow, suspended sediment, and contaminant sources in the urbanized Coastal Plain

K.L. PRESTEGAARD, M.E. OCCHI AND Z. BLANCHET

Dept. of Geology, University of Maryland, College Park, MD 20742 (*correspondence: kpresto@umd.edu, mocchi@umd.edu, zblanchet@gmail.com)

The fate of trace metals (Pb, Zn, Cd, Cu,) that are introduced as airborne contaminants into watershed systems depends upon the pathways that water takes from precipitation to stream channels, sediment mobilization and deposition, and changes in pH, biogeochemical processes and redox state that affect the partitioning of of metals from solutes to sediment. We exsamined these processes in an urban-suburban watershed We monitored stream flow, conductivity, pH, and turbidity in a nested watershed design (5 sampling locations, ranging from 10-150 km^2) in the urbanized Anacostia River Watershed. Electrical conductivity was used as a continuous tracer to separate hydrographs into new and old water sources. Suspended sediment was sampled during storm events along with masurements of flow velocity and shear velocity that are used to define transport conditions. Suspended sediment samples were used to convert continuous turbidity measurements into suspended sediment loads. Samples of water and sediment collected during storms were filtered in the field and analyzed for trace, minor, and major element composition by ICP-MS.

The hydrograph separation results indicate that the upper tributaries generated new water in excess of the amount of impervious surface, and trace metals are transported both as solutes and on sediment. Sediment fingerprinting analysis indicates upper tributaries receive sediment from both surface erosion and bank eroson. Suspended sediment concentrations are significantly higher in the tributaries than at the river mouth. At the mouth, total new water runoff was lower than in the tributaries although impervious cover was greater. Suspended sediment sources change from street sediment sourrces to bank erosion over the duration of a storm. Sediment contaminantion with trace metals is highest at the mouth and trace metals are transported with the sediment, not in the aqueous phase due to the high pH (7-9) of urban runoff conveyed in cement-lined channels to the lower watershed.

An infrared study of modern and paleo-filamentous bacteria from Rio Tinto, Spain

L.J. PRESTON[1,2]*, J. SHUSTER[1], D. FERNÁNDEZ-REMOLAR[3], N.R. BANERJEE[1,2], G.R. OSINSKI[1,2] AND G. SOUTHAM[1,2]

[1]Centre for Planetary Science and Exploration (CPSX),
[2]Department of Earth Sciences, University of Western Ontario, 1151 Richmond Street, London, Ontario, N6A 5B7, Canada (*correspondence: lpresto5@uwo.ca)
[3]Centro de Astrobiologíca, INTA, Ctra Ajalvir Km. 4, 28850 Torrejón de Ardoz, Spain

The Rio Tinto River Basin in southwestern Spain is a natural acidic (pH ~2.3) drainage system that supports a diversity of acid tolerant bacteria and eukaryotes with iron- and sulfur- oxidizing prokaryotes performing chemolithotrophy and supporting anaerobic respiration [1, 2]. River terrace deposits formed over the past 2 Myr have preserved remnants of this unique biosphere, particularly microbial filaments, which provide templates for iron sulfate and iron oxide precipitation [1, 2]. This process of permineralization causes organic material to become trapped within a mineral matrix and preserved over geological time.

This study analysed cultured filamentous bacteria, modern biofilms and sediments, and river terrace deposits spanning 2.1 Myr to assess the preservation of organics in this extreme environment over time, and the ability to correlate them with a contemporary culture.

Filamentous bacteria are preserved within optically translucent nanophase to crystalline jarosite and goethite within all samples. The cultures contained 1 μm diameter filaments, some partially encrusted with iron oxides with visible cell walls, and others completely free of iron oxides, that are morphologically comparable to those preserved in the Rio Tinto rock record. Organic compounds (e.g. aliphatic hydrocarbons, amides and carboxylic acids) were detected at various levels within the culture and river terraces using mid-IR spectroscopy.

Rio Tinto is a natural laboratory allowing living cells to be studied and correlated to morphological and biomolecular fossils in the geological record. These deposits will provide predictive tools for biomarker studies that may be extended to analogous environments on ancient Earth or even Mars.

[1] Fernández-Remolar *et al*. (2005) *Earth Planet Sci Lett* **240**, 149-167. [2] Fernández-Remolar & Knoll (2008) *Icarus* **194**, 72-85.