Direct infusion lipidomics: profiling the oil sands microbiome

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Introduction

Oil sands processing recycles large quantites of water from settling ponds employed to settle out the fine particulate matter end products of bitumen extraction. Settling pond characterization has indicated vibrant microbial communities and thus there is a strong likelihood that at least some portion of this community is present in process water; where their impacts on extraction efficiency and/or settling pond water quality remain unknown. We are applying a comprehensive bacterial lipid profiling method previously developed [1,2] to characterize the bacterial community associated with process water collected prior to discharge into the settling pond in an effort to identify possible microbially linked strategies for improved management and process efficiencies.

Results

Process water samples were treated with organic solvents to extract the non-polar constituents, using a developed method [1,2] capable of detecting profiles of eight lipid classes using direct infusion electrospray mass spectroscopy in a triple quadrupole mass spectrometer. The profiles of individual lipid classes were obtained by infusion of a $CHCl_3$:MeOH solution of the process water extract in the presence of 4mM LiCl; each lipid class is detected using tandem mass spectrometry with a neutral mass loss specific to each phospholipid class. For example, phosphatidylethanolamines (PE) undergo a neutral loss of 147 mass units while phosphatidylcholines lose 189 mass units. The presence of lithium chloride not only affords more intense neutral losses but also simplifies the mass spectrum by affording a single metal ion (Li^+) adduct. By using phospholipid standards it is possible to quantify the intact lipid components in the extracts. This work is being undertaken in concert with phospholipid fatty acid (PLFA) analyses. Results indicate microbial lipids in the process water sample. Phospholipid profiles of this microbial community will be presented.

References

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^{10}Be Basin averaged erosion rates from the Cordillera Blanca, Peru: a record of interacting climate and tectonics.

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Overview

Current numerical and analog models predict discrete interactions and feedbacks between tectonic deformation and climate-driven denudation [1]. To test the applicability of these models, we utilize cosmogenic radionuclides (CRN) to quantify basin-scale erosion rates in the Cordillera Blanca Mountain Range (CB) of Northern Peru [2]. The range is an actively deforming, NNW trending massif running from ~8-10°S. The CB is closely associated with pronounced extension along the Cordillera Blanca Detachment Fault (CBDF) that delineates the western margin of the grano-tonalitic batholith. The ~200 km long, NNW trending CBDF accommodates significant crustal scale extension in the heart of the dominantly contractile Andean Orogen [3]. Previous thermochronologic and CRN based studies have outlined the potential for linkages between patterns of long-term (Ma) exhumation/uplift and short-term (ka) rates of fault slip [4,5]. Exhumation data, while sparsely dispributed, suggest elevated rates of uplift from ~4-6 Ma in the central portion of the range relative to the flanks (~0.5 km Ma^{-1} and ~0.2 km Ma^{-1}, respectively). More recent exhumation rates spanning ~2-4 Ma suggest a unform ~0.5 km Ma^{-1} along the entire range. Spatial trends in CRN-based fault slip rates are reminescent of those from 4-6 Ma exhumation rates, and decrease dramatically by an order of magnitude towards the south. Our new CRN dataset fills a crucial gap in the development history of the range, representing landscape modification on the order of 10^3 to 10^5 years in response to both tectonic and climatic variations within the batholith.

Results and Conclusion

Preliminary calculated erosion rates range from 0.0096 to 4.1 mm yr^{-1}. Highest erosion rates are located near the center of the range, correlating with the highest peak elevations and the highest degrees of glacial cover. Spatial patterns follow those of 4-6 Ma exhumation rates and CRN fault slip rates, suggesting a long-lived, tectonic control on range development. Erosion and uplift are likely encanced in basins with higher degrees of glaciation due to isostatic responses to glacial erosion.

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