

Using PLFA to constrain microbial distribution related to S-cycling in oil-sands composite tailings during reclamation

NGONADI, N.*¹, ZIOLKOWSKI, L.A.¹, PENNER, T.²,
SLATER, G.F.¹

¹McMaster University, Hamilton, Canada gslater@mcmaster.ca

²Synchrude Environmental Research, Edmonton, Canada

Understanding the extent and nature of biogeochemical cycling by microbial communities is a critical component of predicting and managing their impact within systems. This study is applying phospholipid fatty acid (PLFA) analysis to investigate the microbial communities associated with reclamation of composite tailings recently initiated at Syncrude's Mildred Lake site. PLFA concentrations and distributions were determined within the sand cap that separates the fen reclamation from the CT below, as well as in the CT itself. The goal was to determine how cell densities and microbial community parameters varied between the CT and the sand cap, and to determine the relative importance of these communities to biogeochemical cycling of sulphur, particularly H₂S generation.

Results from sand cap samples show cell densities in the 10⁷ range based on generic conversion factors, not unexpected for oligotrophic conditions. The presence of branched PLFA, particularly iso and anteiso C15:0 are indicative of the presence of sulphate reducing organisms in the sand cap. Such organisms have also been enriched from these samples. Analysis of CT samples in on-going and will be compared to these surface samples to determine whether microbial cycling rates are expected to be lower or higher within the CT which has a highly distinct geochemistry to the sand cap, including the presence of abundant sulphate, used in flocculation of tailings.

The results of these studies will yield insight into the cycling that may be carried out by these communities. They also provide the foundational understanding for on-going isotopic studies of microbial carbon sources and cycling.

Identifying the arsenic source in glacial aquifer sediments, west-central Minnesota, USA

SARAH L. NICHOLAS^{1*}, BRANDY M. TONER², MELINDA L. ERICKSON³, ALAN R. KNAEBLE⁴

¹Land and Atmospheric Sciences Graduate Program, Department of Soil, Water, and Climate, University of Minnesota, Saint Paul, MN, USA (*presenting author) nich0160@umn.edu

²Department of Soil, Water, and Climate, University of Minnesota, Saint Paul, MN, USA toner@umn.edu

³United States Geological Survey Minnesota Water Science Center, Mounds View, Minnesota USA merickso@usgs.gov

⁴Minnesota Geological Survey, Minneapolis, Minnesota USA knaeb001@umn.edu

X-ray absorption spectroscopy (XAS) and sequential extractions were used to identify and quantify different arsenic (As) species present in glacial aquifer materials from west-central Minnesota, USA. Sample locations were chosen based on proximity to domestic drinking water wells with As concentrations exceeding the 10µg/L¹ maximum contaminant level for drinking water in the United States. Glacial sediments were collected from rotary-sonic drill cores (25-100m depth).

Sequential extractions were used to quantify arsenic species concentrations. Total (all species) arsenic concentrations of the glacial aquifer sediments are not unusually high, however the concentration of labile species of arsenic are unusually high. Here the labile species are defined operationally as those liberated by anion exchange with Cl⁻ and PO₄³⁻. Labile As concentrations in many samples are near or above the crustal average of about 1-1.8mg kg⁻¹ for all forms of solid-phase arsenic.

X-ray absorption spectroscopy of the samples shows that arsenic is present in three oxidation states: As⁵⁺, As³⁺, and As^{1- to 2-}. Non-uniform distribution of oxidized arsenic may explain the spatial heterogeneity of high As wells in the area.

Arsenic-bearing sulfide minerals in the Cretaceous shale fragments found in these glacial sediments are frequently hypothesized to be the source of arsenic in drinking water in west-central Minnesota. Our data suggest that the solid-phase arsenic sources in water are likely to be the more labile, oxidized species found in unusual abundance in these samples. Most As-bearing sulfide minerals would be expected to be chemically refractory in the reduced groundwater of the area.