# Analysing the microbial-mineral interface within sulfidic mine wastes

EMILIA PRINCIPE*, NADIA CS MYKYTCZUK, GRAEME SPIERS, MICHAEL SCHINDLER

Laurentian University, Sudbury, ON, P3E 2C6, Canada (*correspondence: eprincipe@laurentian.ca)

Sulfidic mine tailings harbour microorganisms that catalyze the oxidation and reduction of metal-bearing sulfides and reduction of ferric ions and sulfate. Microbially-mediated mineral oxidation and reduction ultimately result in the formation of secondary minerals and subsequently affect the transformation and attenuation of metals. We used a combined geochemistry, mineralogy, and genomics approach to better understand the biogeochemical processes occurring within a gradient of tailing dam materials both at surface and along a depth profile. A total of 54 environmental samples were collected aseptically from five constructed tailing dam structures, in Sudbury, Ontario. These samples include biogenic mineral precipitates, unconsolidated silt-sand sized tailings materials, slag, and waste rock, together with pore and groundwater. The mineralogical and chemical compositions of the materials were identified using optical microscopy, XRD, SEM and ICP-MS. Isolation and extraction of genomic DNA of the native microbial community within all collected samples has been performed, where bacterial diversity and abundance is based on 16S rRNA gene Illumina sequencing. The mineralogical composition of the oxidized, transition and unoxidized alteration zones exhibit unexpected results, as sulfides (including pyrite, pyrrhotite, and chalcopyrite), iron-hydroxides (goethite) and iron-hydroxy sulfate minerals (jarosite, schwertmannite) occur across a wide range of environmental gradients. Selected samples collected from shallower depths (0-20ft), and greater depths (20-50ft) indicate similar mineralogical and geochemical composition, however, microbial community complexes and mineral textures differ greatly. Iron and sulfur oxidizing bacteria, including *Acidimicrobiales*, *Acidithiobacillales*, *Hydrogenophilales*, *Ignavibacterales* and *Nitrospirales* occur variably at depths ranging from 0-45ft, suggesting profound extent of potential oxidation of both sulfides and secondary Fe-phases along the dam gradients. Additional analyses includes probing the microbial-mineral interface of selected samples at the nanometer scale by TEM, in order to observe potential micro-environments. Ultimately, the environmental fate of tailings-derived metals is fundamentally controlled by redox and microbial processes; understanding microbial-mineral interactions at surface and at depth is critical to ameliorating environmental impacts from tailings.