Microbial Sulfur Metabolism in Mining WasteWaters

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Mining environments are a significant and increasing component of the global sulfur biogeochemical cycle. It is estimated that 7125 Mt/year of total tailings are produced worldwide [1]. Here, the objectives were to establish the sulfur geochemistry and microbial community and metabolic networks of a Ni/Cu mine wastewater system in northern Ontario, Canada. Far less studied than AMD, mining wastewater systems receive a greater diversity of waste-derived sulfur constituents than AMD and are commonly not acidic. Samples were collected from the oxidation reservoir and its diverse wastewater inputs at two seasonal timepoints (September and November 2014) for joint, genome-resolved metagenomic analyses and geochemical characterization.

Results identified wide ranging geochemical conditions across waste rock, tailings deposit, and adjacent mine wastewater inputs and the oxidation reservoir itself (pH: <3 - >11; $\%O_2$: 13 - >100; °C: 4 - 25). In the oxidation reservoir, while total sulfur concentrations were very similar, (~10 mM), seasonal differences in the relative abundances of different sulfur intermediate species associated with lowered temperature, and increased $\%O_2$ and $[NO_3^-]$ occurred.

Genome-resolved metagenomics analyses identified distinct communities with many novel organisms across the different sampling points. In all communities, extensive oxidative sulfur as well as nitrogen reduction (nitrate, nitrite) metabolism capabilities were present. These results implicate nitrogen, not typically considered in management strategies, as an important factor involved in sulfur cycling and associated water quality outcomes in these waters.

[1] Mudd & Boger (2013), *Journal of the Australian Institute of Mining & Metallurgy*, 56-59.