

Bioleaching of Arsenic-Rich Tailings Material in Sudbury, Ontario: A Biogeochemical Analysis

E.A.Principe¹, N. Mykytczuk¹, G. Spiers¹

¹Department of Earth Sciences, Laurentian University, Sudbury, ON

The As-rich tailings of the abandoned Long Lake Gold Mine located in Sudbury, Ontario provide an excellent example of an abandoned mine site in need of extensive environmental rehabilitation. Drainage waters from these tailings have contaminated the southwestern end of Long Lake, with As concentrations of 570 µg/L and 12,800 µg/g in lake water and sediment respectively. The presence of a viable microbial community and >1 ppm Au, make the Long Lake tailings a suitable candidate for testing the efficiency of bioleaching as a pretreatment for refractory Au recovery. This study analyzes the geochemical, mineralogical and biological processes pre- and post- bioleaching of tailings material to determine both leaching efficiency and bi-product production from the activity of indigenous microbial communities. The mineralogy and elemental content of the tailings material has been analyzed by scanning electron microscopy, x-ray diffraction, ICP-AES, ICP-MS and combustion with IR detection for C and S content. The reduced zone within the tailings is dominated by pyrite, arsenopyrite and quartz, with the secondary hardpan and hardpan-reduced transition zone being rich in jarosite and quartz. The microbially mediated oxidation of sulfide to sulfate is a key precursor for the formation of the jarosite. The microbial community sequencing has been completed to characterize the Fe and S oxidizing community, with *Acidithiobacillus* and *Leptospirillum* spp. being most abundant. Promoting the growth of Fe and S oxidizing bacteria will increase the rate of oxidative dissolution of the sulfide minerals present, thus removing As from the solid materials and priming the remaining quartz-rich tailings matrix for Au extraction.