

Microbial leaching of nickel from low-grade pyrrhotite ores

C. Romano¹, G. Moldoveanu², D. Ren³, A. Yakunin⁴, E. Edwards^{5*}, and V. Papangelakis^{6*}

¹⁻⁶Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, ON, Canada
^{5,6}(*correspondence: elizabeth.edwards@utoronto.ca; vladimirov.papangelakis@utoronto.ca)

Mines in the Sudbury Basin of Ontario have generated an estimated 100 million dry metric tons of pyrrhotite (Po) tailings, which are stored in shallow ponds [1]. Po has the approximate stoichiometry Fe_7S_8 , and the Sudbury tailings also contain ~1 wt% Ni that is worth an estimated \$9.35 billion USD [1]. We aim to extract this nickel and convert the remaining Po into elemental sulfur and ferric iron.

We propose a two-step leaching process. The first step is abiotic, where high temperatures and low pH are required to leach nickel from the Po [2]. The remains will be sent to a second reactor wherein thermoacidophilic iron oxidizing microbes will generate Fe^{3+} , which oxidatively degrades Po to complete the leaching [3]. Financial constraints require that minimal sulfate is produced.

Currently, several strategies are being explored in parallel to design and optimize the bioleaching step: 1) Investigate the capacity of known Fe oxidizing strains to mediate oxidative degradation of Po and minimize sulfate production under the bioreactor conditions; 2) Enrich for and characterize iron oxidizing microbes from the environment that will be suitable for Po leaching; 3) Examine known microbial sulfur metabolic pathways to determine targets for genetic engineering.

[1] Peek *et al.* (2011). *Minerals Engineering* **24**, 625-637. [2] S. Garg. (2017), Ph.D. Thesis, University of Toronto. [3] Belzile *et al.* (2004). *Journal of Geochemical Exploration* **84**, 65–76.