Generation and dynamics of thiosalts in drainages from pyrrhotitic tailings

G. SCHUDEL[1]*, B. PLANTE[1], B. BUSSIÈRE[1], J. M. MCBETH[2] AND G. DUFOUR[3]

[1]Research Institute on Mines and the Environment, l'Université du Québec en Abitibi-Témiscamingue (*correspondence: gary.schudel@uqat.ca)
[2]Dept. Geological Sciences, University of Saskatchewan
[3]Raglan Mine, Glencore plc

The water quality of mine drainage is largely controlled by the oxidation of sulfide minerals such as pyrite and pyrrhotite. During this process, sulfur is usually converted from sulfide (S^{2-}) to sulfate (SO_4^{2-}); however, this reaction does not always proceed to completion [1]. Instead, several intermediate sulfur species, such as thiosulfate ($S_2O_3^{2-}$) and other polythionates ($S_nO_6^{2-}$, $3 \leq n \leq 6$), may be formed [2]. This can have significant implications during kinetic testing, where sulfate concentrations in leachates are often used as a proxy to track the progress of sulfide oxidation and estimate rates of acid generation [e.g., 3, 4, 5]. Furthermore, although polythionates are unlikely to result in direct toxicity to aquatic organisms, their subsequent oxidation upon release into receiving waters can cause harmful decreases in pH [6].

In this study, pyrrhotite-rich tailings from Raglan Mine (QC, Canada) were submitted to laboratory-scale column kinetic tests for 550 days. Each wetting-drying cycle was *ca*35 days long, with a 7-day leaching period followed by a 28-day drying period. Half of the tests were performed at ambient temperature, while the other half were submitted to alternating freeze-thaw cycles. The effect of salinity was also tested using a solution comprised of DI water, NaCl (0.09M), and KCl (0.07M). Leachates were analyzed for various geochemical parameters, including pH, Eh, electrical conductivity, metal concentrations, and sulfur speciation ($S_2O_3^{2-}$, $S_4O_6^{2-}$, SO_4^{2-}).

All columns produced high levels of sulfur intermediates throughout the duration of the tests. The main factors influencing the production and distribution of intermediate sulfur species will be assessed. Specifically, these include temperature, redox conditions, and microbiological activity.

[1] Janzen *et al.* (2000) *GCA* **64**, 1511-1522. [2] Wasserlauf & Dutrizac (1984) *Can. Metall. Q.* **23**, 259-269. [3] Benzaazouaa *et al.* (2004) *Environ. Geol.* **46**, 1086-1101. [4] Bouzahzah *et al.* (2013) *Mine Water Environ.* **33**, 54-65. [5] Frostad *et al.* (2002) *Mine Water Environ.* **21**, 183-192. [6] Schwartz *et al.* (2006) *CANMET Report*.