

# SPATIAL AND TEMPORAL WATER CHEMISTRY VARIATIONS IN ACID ROCK DRAINAGE FROM THE TAILINGS AT THE RUTTAN MINE, LEAF RAPIDS, MANITOBA, CANADA.<sup>1</sup>

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**Abstract:** From 1973 until 2002, the Ruttan Mine extracted Cu and Zn ore from volcanoclastic and siliciclastic sequences of the Rusty Lake Greenstone Belt. Flotation refinement of the ore produced over 30 million tons of fine-grained sulfide tailings which were submerged in retention ponds. Since mine closure, through the addition of trenches and dyke cuts, there has been a systematic dewatering of the tailings ponds to prevent possible dyke collapse. Currently, the tailings are draining into the open pit and underground mine via Ruttan Lake. The purpose of this study is to understand processes and variability within aqueous media of the tailings, using geochemical, mineralogical and hydrogeological techniques.

Groundwater water collected from monitoring wells installed within the tailings are at near neutral pH (6.0 – 8.2) with low concentrations of metals (Total Fe: <0.01 – 3.66 ppm; Al: <0.01- 0.29 ppm; Zn: <0.1 – 1.26 ppm; Cu: <0.05; and Sulfate 1522 – 3019 ppm). On-site rising head tests give an average hydraulic conductivity of the tailings of  $4.8 \times 10^{-5}$  cm/s. Geotechnical laboratory measurements gave average porosity and average grainsize diameters of approximately 42 % and 0.05 mm, respectively. Tailings surface waters collected from pools and the trench streams are characterized by low pH (2.6 – 3.3) and high dissolved metal concentrations (Total Fe: 162 – 2526 ppm; Al: 17 – 500 ppm; Zn: 15 - 420 ppm; Cu: 0.5 – 27 ppm; and Sulfate 1650 - 3190). While tailings are exposed to the atmosphere the breakdowns of sulfides by oxidation processes releases metals and sulfate and adds H<sup>+</sup> ions into solution. The precipitation of jarosite and schwertmannite (from XRD analyses) from surface water does not change concentrations of the metals in the water because of the limited sorption of cations to these minerals at low pH.

Differences between tailings surface- and ground-water chemistry suggests that groundwater is not impacted by surface process. The paucity of pH buffering minerals within the tailings implies that some other process is involved in either buffering the groundwater or acting as a barrier between the two to produce the neutral pH condition within the tailings groundwater. Sequential extraction and porewater analyses of the tailings will help pinpoint the location of heavy metals at various depths within the tailings which may help determine the processes involved in creating the difference between surface- and ground-water.

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<sup>1</sup>Poster paper presented at the 7<sup>th</sup> International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.) Published by the American Society of Mining and Reclamation (ASMR), 3134 Montavesta Road, Lexington, KY 40502

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