

Formation of secondary pyrite and carbonate minerals in the Lower Williams Lake tailings basin, Elliot Lake, Ontario, Canada

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ABSTRACT

The Lower Williams Lake tailings, which resulted from U-milling operations during the late 1950s and early 1960s, cover an area of 2 ha in a small bog under partial water cover. The tailings are underlain by a sand unit containing decaying organic material above the natural base consisting of sand, till, and gravel. The tailings are composed predominantly of quartz, muscovite, K-feldspar, plagioclase, and clinocllore. Residual pyrite grains, displaying angular to subangular particles measuring less than 1 to 250 μm , occur in concentrations ranging from trace to approximately 6 wt%. Framboidal pyrite has formed within the tailings basin in association with organic-rich material. The appearance of framboidal pyrite in the tailings indicates a reversal of the oxidation process and reprecipitation of Fe sulfides. In addition, the tailings include calcite, calcian siderite, Fe-oxyhydroxides, and Fe-Si-oxyhydroxides as secondary precipitates and replacement products. Groundwaters in the tailings and the underlying units are saturated with respect to gypsum and siderite. These and the other saturation indices calculated for calcite, goethite, and barite are consistent with the secondary mineralogy of the tailings. Conditions promoting the formation of pyrite can be described as neutral to weakly alkaline and reducing assisted by microbial activity. This study provides the first account of secondary carbonates and framboidal pyrite in the Elliot Lake tailings. The existing environmental conditions at the site are favorable for the desired site rehabilitation.