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Passive Attenuation of Nitrogen Species at Northern Mine Sites

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Abstract : Elevated concentrations of inorganic nitrogen (N) compounds (nitrate, nitrite, and ammonia) are a ubiquitous feature to mine-influenced drainages due to the leaching of blasting residues and use of cyanide in the milling of gold ores. For many mines, the management of N is a focus for environmental protection, therefore understanding the factors controlling the speciation and behavior of N is central to effective decision making. In this paper, the passive attenuation of ammonia and nitrite is described for three northern water bodies (two lakes and a tailings pond) influenced by mining activities. In two of the water bodies, inorganic N compounds originate from explosives residues in mine water and waste rock. The third water body is a decommissioned tailings impoundment, with N compounds largely originating from the breakdown of cyanide compounds used in the processing of gold ores. Empirical observations from water quality monitoring indicate nitrification (the oxidation of ammonia to nitrate) occurs in all three waterbodies, where enrichment of nitrate occurs commensurately with ammonia depletion. The N species conversions in these systems occurred more rapidly than chemical oxidation kinetics permit, indicating that microbial mediated conversion was occurring, despite the cool water temperatures. While nitrification of ammonia and nitrite to nitrate was the primary process, in all three waterbodies nitrite was consistently present at approximately 0.5 to 2.0 % of total N, even following ammonia depletion. The persistence of trace amounts of nitrite under these conditions suggests the co-occurrence denitrification processes in the water column and/or underlying substrates. The implications for N management in mine waters are discussed.

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