

The Solid-Phase Sulfur Speciation of Metal Sulfides in a Permeable Reactive Barrier, Nickel Rim Mine, Sudbury, Ontario.

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Abstract

A Permeable Reactive Barrier (PRB) for the treatment of metal contaminated mine drainage was installed in August 1995 at the Nickel Rim tailings impoundment near Sudbury, Ontario. The PRB is composed of a reactive mixture of organic material and gravel, designed to precipitate dissolved metals and sulfate through bacterially mediated sulfate reduction and sulfide precipitation. Chemical and mineralogical analyses of barrier material were completed in 1997 and subsequently in 2001. Comparative studies of the two data sets were made to determine if the masses, distribution, phases, and accumulation rates of the metal sulfides had changed with time. Between 1997 and 2001 there was a 0-250% increase in the masses of acid soluble (AVS) and total reduced (TRS) sulfides in the mid- and down-gradient portions of the barrier and a 0-65% increase in the up-gradient portion. Sulfur accumulation is primarily in the AVS fraction although there are significant levels of sulfur in the pyrite/elemental sulfur fraction (up to 25 % of TRS). Mineralogical analyses indicate that there has been a shift in the form of the sulfide precipitates from mackinawite to griegite and framboidal pyrite. The average accumulation rate of TRS from 1997 to 2001 decreased by 36% in the up-gradient portion of the barrier, 24% in the mid-gradient portion of the barrier, and 26% in the down-gradient portion of the barrier. The decrease in accumulation rate is likely due to a decrease in the rate of sulfate reduction caused by a decline in the amount of carbon available for use by sulfate reducing bacteria.

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