

Bioaccumulative Modeling of Mercury Methylation in Sulphate-Enriched Pit Lakes; Implications of Projected Watershed Contamination in Northwestern Ontario

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Caland Pit Lake was formed after the Steep Rock Iron Mine, located five kilometers north of Atikokan, Ontario, was closed in the early 1970's. The basin of the lake continues to increase in depth (currently 200 m) and area. It will eventually join with Hogarth Pit Lake and spill into the Seine River within the next few decades. Caland Pit Lake contains elevated levels of sulphate, known to affect the methylation of mercury by sulphate-reducing bacteria at specific concentration ranges. The bioaccumulation and biomagnification of mercury compounds within the Seine River watershed resulting from the sulphate-laden waters of the Steep Rock pit lakes is of the utmost concern to regulators and various stakeholders. This study used a bioassay to quantify the relationship of sulphate concentration to mercury methylation within Caland Pit Lake. Unimpacted soil from the Steeprock mine site was treated with a range of concentrations of Caland Pit Lake water in a 28 day bioaccumulation experiment with *Lumbriculus variegatus*, based on EPA guidelines for the determination of methylmercury accumulation in aquatic organisms. Sediment and water samples taken over the duration of the experiment, as well as worms collected after the 28 day exposure, were analyzed via cold-vapor atomic fluorescence spectrometry (CVAFS) for total mercury and methylmercury. Results demonstrated mercury methylation increased with increasing concentration of sulphate until approximately 135 mg/L sulphate was reached. After this point methylation decreased with increasing sulphate concentrations, yielding an approximately normal distribution curve. The data suggested continued flooding of the basin with elevated sulphate water will increase mercury methylation and will be an important environmental issue once the spillover from the pit lakes into the Seine River watershed occurs allowing for the biomagnification of this toxicant through the local food web.