

Geochemistry and speciation of mercury and arsenic within wetland sediments impacted by historical tailings with and without reactive amendment and protective capping treatments (RAPC)

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Chemically reactive amendment materials which have higher sorptive capacities than traditional passive isolation caps are a promising option for remediating and restoring legacy tailing-impacted wetlands. Preliminary laboratory results have demonstrated that adding a proprietary zero-valent iron (ZVI)/zeolite reactive amendment to the sediment together with a thin protective capping reduces the available mercury and arsenic in the sediment and in the overlying water. There is potential to scale up this application for remediation of contaminated wetlands, but it is important to first investigate the geochemistry of mercury (Hg) and arsenic (As) and stability of the treatment in changing redox conditions. The purpose of this project is to assess the long-term effectiveness of the reactive amendment/protective capping (RAPC) technique in decreasing mobile and bioavailable species of As and Hg. This will be accomplished through a column leaching experiment spanning over one year; the year will consist of a wet season and a dry season both lasting about six months. Free-draining columns will simulate small portions of the wetlands with contaminated sediment and RAPC. Field-collected sediment samples will be prepared in a controlled-atmosphere anaerobic chamber glovebox in order to maintain field redox conditions as closely as possible. The sediments will be inserted into a series of replicate columns with and without RAPC and with water from the contaminated site on top to mimic saturated wetland conditions and to measure changes in As and Hg solid and aqueous speciation. Porewater, leachate, and water samples will be collected regularly. Factors influencing As and Hg speciation such as drying and wetting cycles, redox conditions, temperature changes, pH changes, and dissolved organic carbon content will also be assessed. Solid speciation analysis will be done on a sub-set of treated and untreated sediments at different time intervals and depths to characterize in-situ speciation and structures of Hg and As compounds using approaches including scanning electron microscopy and Raman spectroscopy at SMU and X-ray absorption spectroscopy (XAS) synchrotron analyses at the Canadian Light Source (Saskatoon).