ARSENIC IN MINE-IMPACTED SEDIMENTS: CHARACTERIZATION, BIOAVAILABILITY, AND MOBILITY

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Fifty years of gold mining in Yellowknife on the Great Slave Lake, Canada, has resulted in a huge unresolved arsenic contamination problem in the area. Microorganisms surviving in that environment could play a significant role in redox transformations of arsenic species leading to their mobilization from sediments. The focus of our study was the quantification of two target genes in sediment samples: arsC and aroA, which are, respectively, responsible for arsenate reduction and arsenite oxidation. Quantitative real-time PCR was used to monitoring the capacity for arsenic mobilization by microbes. The amplifiable DNA for analysis of both genes was purified directly from samples by a process developed to prevent heavy metal, cyanide and chloride inhibition of enzymes in qPCR analyses. Surface sediment samples obtained from Baker Creek, which receives water form the Giant Mine tailings ponds contain from 500 to 158x104 aroA gene copies per 1 ng total DNA, but very low numbers for the arsC gene, indicating that the mobility of arsenic in this environment should be low. A 2006 report revealed that arsenic, iron, and manganese concentrations in Long Lake on the Quinsam Coal Mine property were considerably elevated over provincial guidelines. There was some evidence for effects on the local benthic community. The citizens of Campbell River BC, concerned about the future of the local fishery, requested the Canadian Water Network to investigate further. We now report that the arsenic concentrations in Long Lake sediments can reach 650 mg/kg, well above background levels in the area. Statistical analysis of the analytical data from surrounding sediments, soils, and coal residues shows that the sediments in Long Lake have a unique composition. The arsenic is bound to iron oxides (XANES and X-ray studies) and is bioavailable to the indicator species *Corophium volutator* (mud shrimp). A seep into Long Lake from the mine's residue storage area was identified as one source of the contamination. Short term caged mussel studies showed that the arsenic concentration increased in mussels collected from a reference site when placed in Long Lake. Long term monitoring of the arsenic concentration in mussels in the Quinsam River indicates that an abrupt increase occurred around the year 2000 from 3 mg/L to around 8 mg/L.

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