Controls on the mobility of mercury from gossan mine tailings

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Between 1989 and 1992, gold was recovered from a gossan overlying the Murray Brook massive sulphide deposit in northern New Brunswick by cyanide heap leaching. Following mining, previous workers found that elevated mercury concentrations in ground water below the tailings correlated well with elevated cyanide concentrations. Those data indicated that residual cyanide from the gold leaching operation contributed to increased mercury mobility from the tailings through solubility enhancement by cyanide complexation. The concentration of cyanide in the ground water has declined since 1993 with a coincident decline in mercury concentration. Residual cyanide in the tailings is expected to continue to degrade and the present study is designed to evaluate the degree of mercury mobility within the tailings pore water that could occur in the future as a result of complexation with natural ligands such as humic acid, OH^- and Cl^-. Based on X-ray diffraction, optical and scanning-electron microscopy examination of the tailings, mercury is distributed, probably through co-precipitation, within the secondary ferric oxy-hydroxide and sulphate minerals such as goethite [FeO(OH)], jarosite [$KFe_3(SO_4)_2(OH)_6$] and beudantite [$PbFe_3(AsO_4)(SO_4)(OH)_6$]. Batch leaching experiments were conducted on the tailings by varying the concentrations of humic acid, OH^- and Cl^- to determine the effect on mercury concentration in the leachate. Mercury concentrations in the leachates ranged from 11 to 54 μg/L. Humic acid concentrations had no significant effect on mercury concentrations compared to a de-ionized water control. The pH and Cl concentration have the greatest effect on the mercury concentration, probably as a result of the competing effects of OH^- and Cl^- complexation with mercury adsorption to solid surfaces. These results may have implications with respect to plans for rehabilitation of the gossan tailings.