The immobilization of Au(III) chloride by halophilic, sulfate reducing bacteria

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Gold (III) chloride is considered to be the mobile gold compound in saline to hypersaline environments [1]. A consortium of halophilic, dissimilatory sulfate reducing bacteria were enriched from Basque Lake #2, located near Ashcroft, British Columbia, Canada to evaluate their potential role in the immobilization of gold. Growth of this consortium occurred as a biofilm, where the cells became encased in exopolymer, on the inside surfaces of culture tubes. Reaction of the consortium with a series of gold (III) chloride solutions under freshwater to hypersaline, i.e. three times seawater salt, conditions and over a series of time points established that gold immobilization occurred rapidly, i.e. within minutes in all of the reactions systems, and that salinity did not affect gold immobilisation. The use of scanning electron microscopy and energy dispersive spectroscopy demonstrated that the gold was immobilised as fine-grained, nano-phase colloidal gold, primarily at the fluid-biofilm interface. The precipitation of gold at this interface protected cells within the biofilm from the toxic effect of ionic gold, i.e. stripping electrons from cell organics causing cell damage. Analysis of biological, i.e. washed cells grown without iron, and abiotic, i.e. culture supernatants and abiotic FeS, constituents using XANES demonstrated that gold (III) was immobilized and reduced to elemental gold 'immediately' (within 5 minutes) in all of the reaction systems. The immobilisation of gold by halophilic sulfate reducing bacteria highlights a possible role for the biosphere in 'intercepting' mobile gold from hypersaline solutions. Under these conditions, significant concentrations of gold could accumulate over geological time periods in natural systems where gold concentration are dilute and therefore even less toxic to the biosphere.

[1] Krauskopf (1951) *Economic Geology* **46**, 858–870.

Photochemical reaction of oxidized Mercury species with selected thiols in natural waters

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Mercury is a global pollutant with severe potential toxicity. It has been shown for a long time that many Hg (II) compounds can be decomposed by sunlight, both in the gaseous and in the aqueous phase. Nanomolar to millimolar levels of thiols has been reported in both seawater and freshwater systems. Studies have suggested that strong natural ligands in low concentrations and with high conditional stability constants, possibly sulfides and thiols, could be primarily responsible for dissolved mercury complexation in estuarine waters. However, no experimental study has been performed on the photolytical behavior of Hg (II) with mercaptocarboxylic acids detected in natural waters. We hereby present the first kinetic and product study on the photochemistry of oxidized mercury species with thioglycolic acid and with 3-mercaptoproponic acid at near environmental conditions. The kinetics was investigated by cold vapor atomic fluorescence spectroscopy (CVAFS) and ultraviolet-visible (UV-VIS); the reaction products were analyzed by chemical ionization-impact mass spectrometry (CI-MS) and solid phase microextraction- gas chromatography/mass spectrometry (SPME-GC/MS). Our preliminary studies indicate that the aqueous mercaptocarboxylic acids (MCAs) may react with Hg (II) to form 1:1 and 2:1 coordination complexes. The Hg $(MCA)_2^{2-}$ complex is photo-stable, yet, the Hg (MCA) complex can be photo-decomposed to form metacinnabar (β-HgS). Our future work and its potential environmental implication will be discussed.