Influence of *Leptospirillum ferrooxidans* on the breakdown of As-bearing sulphides in acid mine drainage systems

C.L. CORKHILL[1]*, P.L. WINCOTT, J.R. LLOYD AND D.J. VAUGHAN

School of Earth, Atmospheric and Environmental Sciences and the Williamson Centre for Environmental Molecular Research, University of Manchester
(*correspondence: claire.corkhill@postgrad.manchester.ac.uk)

Acid mine drainage environements contain high levels of dissolved metals, often including arsenic, which is sourced from the oxidation of minerals such as arsenopyrite (FeAsS) and enargite (Cu_3AsS_4). Acidophilic bacteria such as *Leptospirillum ferrooxidans* have been shown to enhance the dissolution of sulphide minerals in these environments, and could therefore accelerate the release of arsenic.

Arsenopyrite and enargite were characterised after acidic (pH 1.8), oxidative dissolution in both the presence and absence of *Leptospirillum ferrooxidans*. Dissolution was monitored through analysis of the coexisting aqueous solution, and chemical changes at the mineral surface obserevd using X-ray photoelectron spectroscopy and environmental scanning electron microscopy (ESEM). Biologically mediated oxidation of arsenopyrite and enargite (2.5g in 25ml) was seen to proceed to a greater extent than abiotic oxidation, although arsenopyrite oxidation was significantly greater than enargite oxidation. These dissolution reactions were associated with the release of 917.4 ppm and 179.7 ppm of arsenic into solution. The formation of Fe(III)-oxyhydroxides, sulphate and arsenate was observed for arsenopyrite, thiosulphate and arsenate for enargite. ESEM revealed an extensive coating of an extracellular polymeric substance associated with the *L. ferrooxidans* cells on the arsenopyrite surface and bacterial leach pits suggest a direct biological oxidation mechanism. Although oxidation rates of enargite were greater in the presence of *L. ferrooxidans*, cells were not in contact with the surface suggesting an indirect biological oxidation mechanism. Cells of *L. ferrooxidans* appear able to withstand up to 322.0 ppm As(III) and 353.5 ppm As(V).

[1] Jones *et al.* (2003) *GCA*. **67(5)** 955–965. [2] Schrenk *et al.* (1998) *Science*. **279,** 1519–1522.

Siderophores catalyze the oxidation of commercial Pb to nano-sized lead (hydr)oxides stable in water at pH 5 and 25 °C

H. CORNEJO-GARRIDO[1], J. GUZMAN[2], A. ALONSO-GOMEZ[3], P. FERNANDEZ-LOMELIN[1], M. TREJO[4], Z. HAO[5], G. LAPIDUS-LAVINE[3], B. GILBERT[6] AND J. CERVINI-SILVA[1]*

[1]Instituto de Geografía, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D.F.
[2]CICATA-IPN, Legaria, México, D.F.
[3]UAM-Iztapalapa, México, D.F.
[4]CIDETEQ-IPN, México, D.F.
[5]Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, CA.
[6]Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA.

Lead is a highly toxic, priority pollutant. Solubility often limits the mobility of lead in the environment. Yet, biological weathering can accelerate the corrosion of lead surfaces. Here we show that biogenic compounds produced by plants and microorganisms named siderophores induce the oxidation of Pb(0) surfaces. Lead transformation occurs within 1-2 hr of reaction time as evidenced by EDS analyses. In water, secondary phases remain associated with original Pb surfaces ($d > 100$ nm). In the presence of 200 μM DFO-B, the solution becomes turbid due to the formation of white small-sized particles. Small crystals formed after reacting commercial Pb with DFO-B were found to be $d \leq 50$ nm in size. Notably, particulated Pb was found to be stable in suspension even after three months of first exposing lead to solutions bearing DFO-B. As evidenced by XRD analyses for lead surfaces exposed to DFO-B at varying reaction times, there is a progressive surface accumulation of reaction products. Miller diffraction index values indicate the preferential formation of lead oxides. Electrochemical measurements indicate the formation of DFO-B surface complexes prior the release of Pb(II) to solution.