Combined FISH, µ-XRF and SEM analysis to examine microbe-metal interactions on root surfaces

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Metalliferous mine tailings in arid regions pose a significant health risk to proximal populations because they are prone to wind-borne dispersion and water erosion. The problems are extensive and persistent as impacted sites lack normal soil stabilization processes. Phytostabilization is the revegetation of mine tailings to ameliorate these issues with the goal of root zone metal accumulation to avoid metals from entering the food chain through above-ground biomass. The role of plant roots and microbes in promoting mineral dissolution-precipitation reactions and associated metal sequestration is an active area of research, but little is known about reaction trajectories and changes in particle-scale metal speciation of plant-tailings systems, owing largely to their geochemical heterogeneity and microbial complexity. Since the form or speciation of a metal controls its bioavailability and toxicity, research that probes coupling between metal speciation and microbial dynamics in response to phytostabilization is needed. The goal of this research is to develop methodology to combine the use of fluorescent *in situ* hybridization (FISH), microfocused-x-ray fluorescence (u-XRF), and scanning electron microscopy (SEM) to assess the spatial heterogeneity and relationship between bacterial colonization (FISH) and metal distribution (u-XRF) on root surfaces of plants grown in metalliferous tailings. Initial data will be presented that show FISH, u-XRF, and SEM can be technically combined to examine the same root sample. These initial results visually co-localize bacteria with metal precipitates on root surfaces.

The Bluebush Zinc Prospect, NW Queensland: Multiple base metal mineralising events and a record of fluctuating redox conditions in late Palaeoproterozoic seas

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The Bluebush Zinc Prospect is a huge accumulation of weakly Zn mineralized bedded pyrite in sedimentary rocks of late Palaeoproterozoic age. It is obscured by Mesozoic sedimentary cover some 55 – 350 m thick, but geophysical surveys indicate that pyrite-rich stratigraphy occupies an area at least 25 x 10 km. Anomalous Zn grades (0.5 – 1wt%) are present over intervals up to a few tens of metre thick in both reduced and oxidised rocks.

The sequence is conformable, laterally continuous, and composed of organic-rich silt, shale, and chemical sediments, significantly modified by diagenetic and hydrothermal alteration. Zinc mineralization occurs over 600 m of stratigraphy comprising a lower (reduced) facies that is highly pyritic and and contains distinctive ‘fluidal’ pyrite and carbonate textures. This unit is overlain by thick-bedded (barren) mass flow deposits, which are in turn overlain by a distinctive green-pink laminated and nodular (oxidised) facies containing magnetite (minor hematite) and chlorite. The oxidised facies is Zn mineralized and passes gradationally upwards into barren siltstones and pyritic, carbonaceous shales.

Sulfide textures and pyrite trace element chemistry support a multi-stage (diagenetic) origin for the Zn mineralisation [1].

The redox changes manifested in the sedimentary facies variations can be accounted for in terms of relative sea level changes over time [2]. However, we will present new S isotope data from pyrite that suggest high productivity (perhaps associated with a brine pool) had role in producing the lower pyritc facies, whereas, the upper pyritic unit formed in a more ‘normal’ Proterozoic deep marine setting.

[1] Maier, R.C.(2006) CODES Ores in Sediments Symposium *Unpublished Extended Abstracts.* [2] Maier, R.C. (2009) PhD University of Tasmania *In prep.*