Correlative microscopy for analysing dissolution of minerals and electron transfer processes as a key step for development of bio-mining concepts

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Metal-biomining processes based on the bioleaching activity of microbes deals with the extraction of metals from mineral resources not accessible to conventional mining. Microbes such as bacteria may convert metal compounds into their water-soluble forms. Since, first metal extractions in the presence of iron-oxidizing microorganisms, many studies have focused on these organisms and their role in bioleaching. However, a great variety of microbes were recently identified in leaching environments by molecular methods such as 16S rRNA sequencing, fluorescence in situ hybridization, immunological techniques and isolation. At present there is very little known about the in situ abundance, metabolic activity, the role of such communities in bioleaching and their potential use in biomining. In the present talk we will tackle the following questions: i) Who are the in situ key players of microbial communities in terrestrial habitats such as mine tailings and waste dumps (Davidschacht and Theissenschlamm sites)? ii) What are their in situ function and metabolic rates with respect to C and N uptake? iii) What is the main mechanism of bioleaching in these environments (cell attachment to minerals vs electron carriers e.g. ferrous iron)? iv) How are microorganisms attaching to the minerals? v) What are the main factors influencing bioleaching and metal recovery (e.g. pH, temperature, microbial community structure, particle size, nutrient availability)? Using a combination of high resolution correlative microscopy and chemical imaging e.g. fluorescence microscopy, nano-scale secondary ion mass spectrometry (nanoSIMS), confocal RAMAN spectroscopy, scanning electron and helium ion microscopy (SEM/HIM) we aim at solving nano-scale intercellular metabolic interactions and those between cells and minerals. In addition to environmental communities, we used *Shewanella* as model organism to understand biofilm formation and colonization of metals as well as electron transfer processes.