Analysis of heavy metals in floodplains of the Morava and Jizera rivers

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Regional pollution by Cu, Pb and Zn during the 20th century was studied in floodplains of two rivers in Czech Republic, usually considered less contaminated - the Morava and the Jizera; the latter is one of three water sources for Prague. Sediments were obtained by hand-drilled cores (2-4 m long) and in the case of the Morava River from outcrops in erosion banks. To describe realistically the pollution of floodplain sediments, facial analysis and outline of floodplain architecture are essential for two main reasons: to distinguish anthropogenic impact from natural background and evaluate possible post-depositional migration of pollutants. Geochemical analysis by laboratory ED XRF spectrometer offers handy tools for both these subtasks, which we have learnt in the Morava River floodplain and now apply to Jizera River floodplain. Additional subtask is sediment dating, which can be achieved by careful examination of depth dependences of activities of ^{137}Cs and unsupported ^{210}Pb; the use of ^{14}C of plant debris is, unfortunately, limited. For reliable reconstruction of the past pollution, fine sediments (silty clay with small sand content) should be used, which slow down the vertical migration of both pollutants and ^{137}Cs. Cu, Pb and Zn start to migrate substantially in floodplain sediments of both studied rivers at depths larger than 1.5 m, where they follow lithofacial boundaries and redox accumulations of Fe and Mn oxides. Extensive correlations of densely and continuously sampled cores must be performed to avoid lithofacial biases and migration - and only that can allow sound interpretations. Approximate dating of sediments from the Morava River area can be based on the onset of Pb and Zn contamination at about 1900, Pb fastest enhancement at moderate Zn in the 1950's, stagnating Pb 1960's – 1980's), and stagnating Zn and declining Pb since 1990's.

Acquisition of Fe by aerobic microorganisms: Effects of Fe oxide nanoparticle size

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Most organisms require Fe as a fundamental nutrient; yet, Fe-bearing minerals tend to be highly insoluble in circum-neutral aerobic environments. Many aerobic microorganisms overcome Fe limitation by releasing low molecular weight organic ligands known as siderophores into the environment. Siderophore-Fe(III) 1:1 complex stability constants range from 10^{23}-10^{52}.

Using an obligate aerobic bacterium *Pseudomonas mendocina* ymp wild type (WT) and a siderphore (-) mutant of the species (MT; i.e. a mutant that can not produce siderophore), along with a reporter strain that signals Fe deficiency, our group investigated Fe acquisition from hematite (nano)particles of different average particle sizes. Fe associated with < 10 nm hematite was considerably more bioavailable than Fe associated with larger particles. Hematite nanoparticles < 10 nm have more transient or labile Fe, dissolve at about an order of magnitude faster rate in siderophore at circumneutral pH, and support enhanced growth (relative to growth on 72 nm hematite) by *P. mendocina* WT under Fe-limited conditions. The greater bioavailability is also related in part to mechanism (s) that depend on cell/nanomineral proximity, but not on siderophores. MT bacteria readily acquire Fe from particles < 10 nm but must be in direct physical proximity to the nanomineral. Addition of the reducing ligand ascorbate is particularly effective at supplying nano-hematite Fe to the bacteria under siderophore-free conditions. Even a small amount of cell-surface associated reducing activity, as further suggested by results of ferrozine assay, therefore would be likely to enhance cell growth considerably.