Base metal pollution in urban sediments: A study in Nomi River, Tokyo, Japan

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A study was conducted to investigate the base metal contamination of sediment of Nomi River, Tokyo, Japan. Seven sediment samples from different locations of Nomi River were collected and analysed by Atomic Absorption Spectrophotometer (AAS). In most cases, Zn concentration in sediment samples was very high and exceeded the standard environmental limit of 0.03 μg $m1^{-1}$ for Zn which has relatively high toxicity to aquatic organisms. The concentration of Zn ranged from 2933.7 μg g^{-1} to 10732.4 μg g^{-1}. The highest concentration of other metals like Cu, Cr, Cd, Pb, Co, Ni, Mn and Fe were 654.98, 286.8, 3.6, 172.4, 16.6, 157.6, 608.2 and 23218.1 μg g^{-1}, respectively. The major elements and mineralogy of the sediments were also determined by XRF and XRD, respectively. The XRD data on sediment sample showed similarities in terms of major minerals. Quartz has the strongest peak in all samples, with a relative intensity of 100. The second strongest peak was for feldspar, with relative intensity between 2.9 to 73.9. Chlorite, kaolinite, chamosite, calcite, montmorillonoids, and biotite were also found in many samples. The sediment of Nomi River was considerd to be polluted on the basis of unpolluted sediment and geochemical background, with respect to Zn. A final assessment of other base metals of Nomi River sediment will be made from the study result.

Systematic investigation of the product of microbial U(VI) reduction by different bacteria

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Bioremediation of U contaminated groundwater is based on the microbial *in situ* reduction of soluble, and hence mobile, oxidized uranium, U(VI), to a comparatively insoluble reduced species, U(IV). A number of microorganisms have been identified as capable of reducing U(VI), including metal-reducing bacteria (MRB) and sulfate-reducing bacteria (SRB). While the product of microbial U(VI) reduction is often reported as the mineral uraninite, UO_2, there is increasing evidence that other compounds may be produced. In this study, we evaluated the product of U(VI) reduction by six microorganisms under near-identical chemical conditions to determine the variability in the speciation of the reduced U product.

The microorganisms considered included SRB and MRB, Gram negative and Gram positive bacteria: *Shewanella oneidensis* MR-1, *Desulfovibrio vulgaris*, *S. putrefaciens* CN32, *Geobacter sulfurreducens, G. metallireducens* and *Desulfotomaculum reducens* MI-1. The products were characterized by XAS (X-ray Absorption Spectroscopy). The majority of the bacteria produced a reduced mineral structurally homologous to stoichiometric UO_2. However, in three cases, the product was a reduced U species lacking the U second-shell that is typical of UO_2. Those products were determined to be molecular U(IV) complexes adsorbed on iron precipitates (*Geobacter spp.*) or spores (*D. reducens*). Thus, we conclude that the chemical reduction of U(VI) by a reduced Fe phase or biological reduction by spores leads to the formation of sorbed U(IV) whereas direct enzymatic reduction of U(VI) produces UO_2.

In order to confirm the above conclusion for field remediation efforts, U(VI) reduction was carried out in columns packed with sediment from a U contaminated site and seeded with *S. oneidensis* MR-1. The reduction of added U(VI) and endogenous Fe(III) was observed and the uranium product characterized using XAS.