Co-precipitation of cadmium during abiotic and biogenic iron (II) oxidation

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Motivated by the ubiquity of iron minerals, the presence of toxic metal ions in the environment, and by the lack of detailed understanding of the redox reactions and co-precipitation mechanisms amongst these compounds, we investigate microbially catalyzed and abiotic formation of iron(III) minerals and the consequences of these processes for the fate of the toxic metal cadmium (Cd). The overall goals of the proposed research are (1) to quantify Cd removal by iron(III) minerals formed during the process of abiotic and microbiologically mediated iron(II) oxidation, (2) to identify the mechanisms of Cd co-precipitation with and sorption to iron(III) minerals and (3) to compare the surface mediated reactions of biogenic and abiotic iron minerals with respect to the co-precipitation mechanisms of Cd in the presence/absence of i) inorganic phosphate and ii) organic substances (humics and isolated LPS). In this project we focus on iron(III) minerals produced by microbial oxidation of Fe(II) by the anaerobic nitrate-reducing Fe(II)-oxidizing strain BoFeN1. The behaviour of Cd in the presence of biogenic iron oxides is compared to that in presence of chemically synthesized iron(III) (hydr)oxides like ferrihydrite, goethite, and hematite. Cadmium co-precipitation and its association with the iron(III) oxide internal structure will be followed by X-ray diffraction, synchrotron techniques and Moessbauer spectroscopy.

Study of phytotoxicity in soils from mining areas by a bioassay with *Lactuca sativa L*

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This work seeks to determine the phytotoxicity of soluble elements in soils from mining areas, with anomalous concentrations of As, Pb, Zn and Cu. For this study, we used a bioassay with lettuce seeds (*Lactuca sativa L.*), which is a simple, reliable and low-cost way of determining the toxic effects of polluting elements. The solutions were obtained from soil:water extracts and we performed serial dilutions for the different treatments in each sample. These solutions were placed in contact with lettuce seeds (*Lactuca sativa L.*) for 120 hours at 25°C. The variables evaluated were: Seed Germination (SG), Root Elongation (RE), and Root Necrosis (RN) and the results were expressed as a percentage in relation to a control carried out with distilled water.

The results obtained indicated that the samples from Rodalquilar presented a low degree of toxicity; only 4 samples had high toxicity for SG and the rest were moderate to low; more toxicity groups were differentiated by RE, although most of the samples (52%) did not show significant differences with respect to the control, 28% presented moderate and 20% high toxicity. By contrast, the samples from Mazarrón presented a high degree of toxicity, reflected in the high RN values (over 50%, in a third of the samples), and the low RE values (less than 15% in most of the samples). This test therefore indicates that the phytotoxicity caused by these polluting elements is considerably higher in sediments and waste piles (from Mazarrón) than in soils (samples from Rodalquilar). This indicates the buffer capacity of soils to reduce the environmental risk associated with potentially toxic elements.