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How EDTA extracts Metal(loid)s from Mining Contaminated Subaquatic Sediments – Experimental Insights from the Berthelsdorfer Hüttenteich, Erzgebirge, Germany

CLEMENS HARTMANN[1], ALEXANDER THOMPSON[2] AND TRAUGOTT SCHEYTT[1]

[1]TU Bergakademie Freiberg
[2]University of Michigan

Sedimentation in lakes and dams leads to material accumulation and chemical enrichment. In mining affected areas these subaquatic sediments are characterized by high solid contents of critical metal(loid)s, nutrients, organic matter, and clay and silt. Thus, they are not only potential secondary resources for minerals, but also additives in bricks, fertilizers, or construction materials. At the Berthelsdorfer Hüttenteich the siliceous and sulphidic subaquatic sediments are enriched with Al (41,400 mg/kg dry mass), Fe (31,200 mg/kg), Zn (1,300 mg/kg), Pb (1,300 mg/kg), Mn (410 mg/kg), As (160 mg/kg), Cu (100 mg/kg), Cr (47 mg/kg), Ni (30 mg/kg), Cd (18 mg/kg), and Co (12 mg/kg). Zn, Pb, As, Cu, Cr, Ni, Cd, and Co are significantly associated with non-residual bonding phases. Thus, extraction of these critical metal(loid)s is a remediation for the solid as well as recovery method. For this, the sediment was washed with a solution of Disodium Dihydrate EDTA in a laboratory batch process (10 rpm). According to a best-fit-analysis, the EDTA concentration (0.01 / 0.05 / 0.1 / 0.5 mol/L), the solid-liquid-ratio (1:5 / 1:10 / 1:15 / 1:20) and the pH (4.5 / 5.5 / 6.5 / 7.5 / 8.5 / 9.5) have been changed to record time series (up to 96 h) of the dissolved metal(loid) concentrations. The desorption is initialized by a fast reaction, whereas the further reaction progress strongly depends on the metal(loid). After 24 h, most metal(loid)s except for Fe, Al, Cu, and As have almost reached dissolution equilibrium. The maximum recovery rates in the eluates are Pb (88 %) > Cd (68 %) >> Mn (36 %) > As (34 %) > Zn (33 %) > Co (25 %) > Cu (25 %) > Ni (24 %) > Fe (16 %) >> Al (2 %) > Cr (0 %). Except for Cu, the lower the pH the more efficient the desorption. Contrary to the solid-liquid-ratio (the more solid the more efficient), the EDTA concentration has a minor impact on the released metal(loid)s. EDTA can play a significant role in extracting selected metal(loid)s from subaquatic sediments to recover critical minerals from these unexploited resources.