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METAL(LOID)S IN SUBAQUATIC SEDIMENTS

Concentration and chemical bonding conditions of metal(loid)s in mining contaminated subaquatic sediments of the Hüttenteich near Berthelsdorf, Saxony, Germany

Clemens Hartmann[1] I Traugott Scheytt[1]

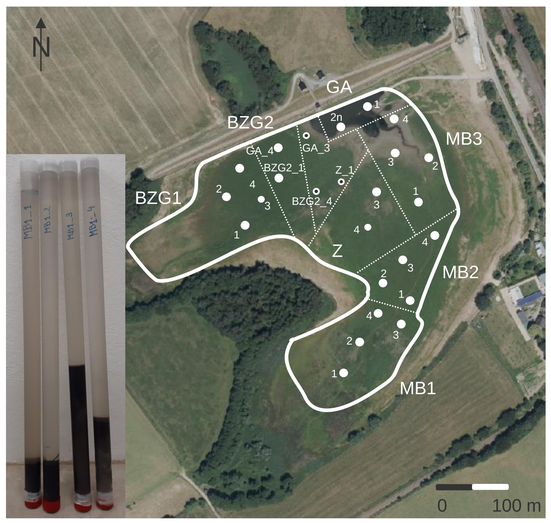
[1] Institute of Geology, Department for Hydrogeology and Hydrochemistry, TU Bergakademie Freiberg, Gustav-Zeuner-Straße 12, 09599 Freiberg, Germany

BACKGROUND

High background concentrations and past mining activities in the Ore Mountains, Saxony, Germany lead to high solid concentrations of (metal)loids in local lacustrine sediments. Large amounts of these sediments deposit in lakes and dams, so also in the Hüttenteich. Decontaminating is required for removing and recycling these sediments. Aim of the study was to determine the spatial and fractional distribution of the solid concentrations and bonding conditions of metal(loid)s in these subaquatic sediments.

METHODS

1) Subaquatic sampling of silty-clayey material (up to 2 m thick) by scientific divers: 27 locations laterally and vertically investigated (Fig. 1)
2) Sample preparation under anoxic conditions
3) Batch experiments with lake water + ultrapure water for determining eluate concentrations
4) Aqua regia digestions + sequential extractions (Fig. 2)
5) Analysis of metal(loid) concentrations by ICP-MS



Investigation areas:
- BZG: Bauerzuggraben (inflow)
- MB: Münzbach (inflow)
- Z: Centre
- GA: Basic drain

Sampling points:
- White labelled: surface samples combined in on mixing sample for each investigation area
- Black and white labelled: depth-dependent single samples

Fig. 1 Investigation areas with sampling points, sediment samples (left).

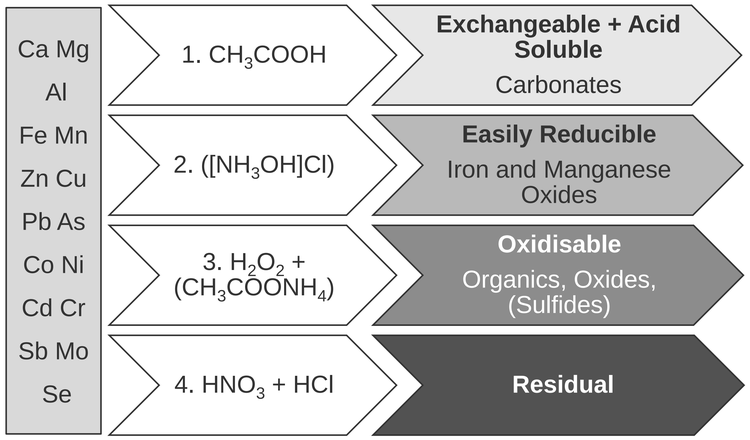


Fig. 2 BCR-scheme for sequential extraction, modified according to [1]. Metal(loid)s investigated (left), chemical agents (middle), phases thus dissolved (right).

RESULTS

- No significant difference in:
  - eluate concentrations between lake water and ultrapure water
  - solid concentrations between fraction ≤ 0.063 mm and ≤ 2 mm
- Dominating solid concentrations of Al, Fe, Mg, Ca, (Pb, Zn)
- Decreasing solid concentrations with depth with exception of the area near basic drain (GA)
- Dominant metal(loid)-specific bonding conditions (Fig. 3):
  - Al, Mg, Cr, Sb, Mo: almost completely residual
  - Fe, Mn, Ni, Co: residual up to 50 % sorptive
  - Pb, Zn, Ca, Cu, As, Cd, Se: sorptive

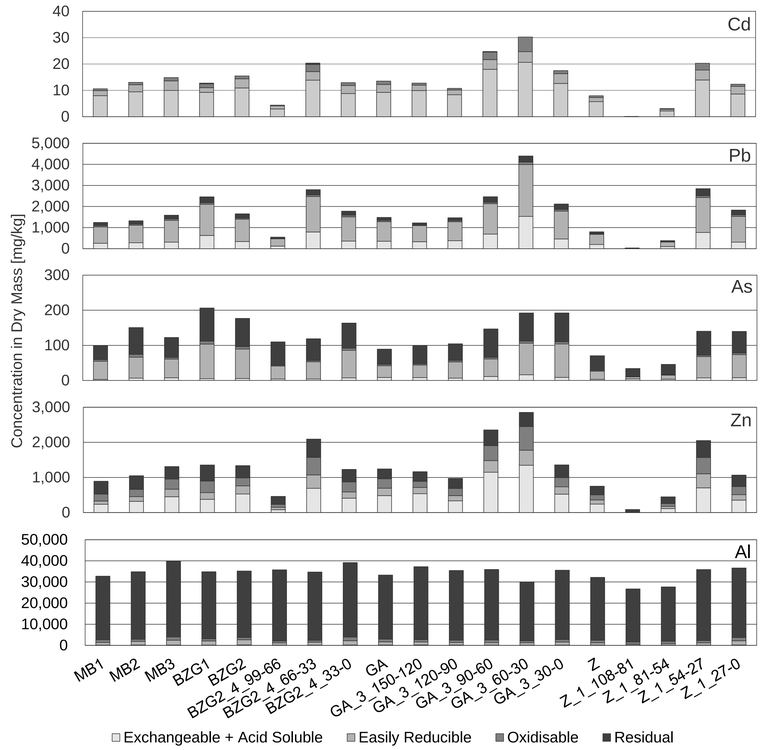


Fig. 3 Phase-dependent distribution of the metal(loid) solid concentrations of the fraction ≤ 0.063 mm determined by sequential extraction.

CONCLUSION

- rock-forming metals Al, Mg and Fe mainly bound to residual (and sulfides)
- critical metal(loid)s (Pb, Zn, Cu, As, Cd) sorptively bound
- similar dissolution efficiency of lake water as that of ultrapure water

→ mobilisation by natural leaching agents = promising treatment technology for decreasing the metal(loid) solid concentrations

LITERATURE

[1] FILGUEIRAS, A. V., LAVILLA, I. & BENDICHO, C. (2002): Chemical sequential extraction for metal portioning in environmental solid samples. The Royal Society of Chemistry, J. Environ. Monit., 2002, 4 824 – 825.

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M. Sc. Clemens Hartmann

TU Bergakademie Freiberg | Institute of Geology | Department for Hydrogeology and Hydrochemistry I Address: Gustav-Zeuner-Straße 12 | 09599 Freiberg | Phone: +493731 / 39-3810 | Clemens.Hartmann@geo.tu-freiberg.de | EGU23 Vienna | 28.04.2023