Advanced research on nickel toxicity in sediment: species, bioavailability and toxicity

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Introduction

Sediment toxicity is known to be affected by abiotic factors such as the concentrations of Total Organic Carbon (TOC) and Acid Volatile Sulphides (AVS) in the sediment, but also by biotic factors such as the intrinsic sensitivity and the behaviour of test species. In this study, the sensitivity to nickel toxicity was evaluated for several benthic species representing different taxonomic groups and life styles. A natural sediment with low binding capacity (i.e. low TOC and AVS) was used.

Materials & Methods

- 28-d sediment exposure with Tubifex tubifex, Chironomus riparius, Lumbriculus variegatus and 35-d sediment exposure with Sphaerium corneum
- Sediment: Acid Volatile Sulphide (AVS): 1-2 µmol/g. Simultaneously Extracted Metals (SEM): 0.5 µmol/g, organic carbon: 1.5%
- Flow-through system (8 volumes renewed/day)
- Daily feeding with TetraMin® (200 – 500 µg/organism)
- Ni spiked sediments were equilibrated for 4-6 months; indirect spiking method [1]: nominal Ni concentrations: 180 – 3,200 mg/kg
- Measurements: survival, growth, development rate and metal body burdens
- AVS; Ni in sediment, pore water, SEM (t=0, 28 and 35d) and in overlying water (t=0, 7, 14, 21, 28 and 35d)
- Micro X-ray fluorescence (XRF) measurements are used to analyse the internal distribution of Ni
- ANOVA, significance level set at p = 0.05

Results & Discussion

![Graph](image)

**XRF analysis**

Lumbriculus variegatus worms exposed to Ni under different feeding scenarios and in different sediments varying in AVS content

![Graph](image)

**Ni spiked sediment (fixed concentration)**

- Clear detection of Ni in exposed worms
- Different distribution and/or concentration of Ni depending on exposure scenario

Conclusions

The results support the basis of the SEM-AVS concept, as it reflects the absence of toxicity at SEM-AVS < 0 for all species. A clear accumulation of Ni was found once SEM-AVS >0. The internal distribution of Ni over the body tissue was dependent on the exposure scenario. In on-going and future experiments, additional species and sediments will be evaluated and tomography XRF analysis will reveal more detailed tissue distributions.

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