Assessing the bioavailability of metals in natural sediments by DGT passive sampling and bioaccumulation

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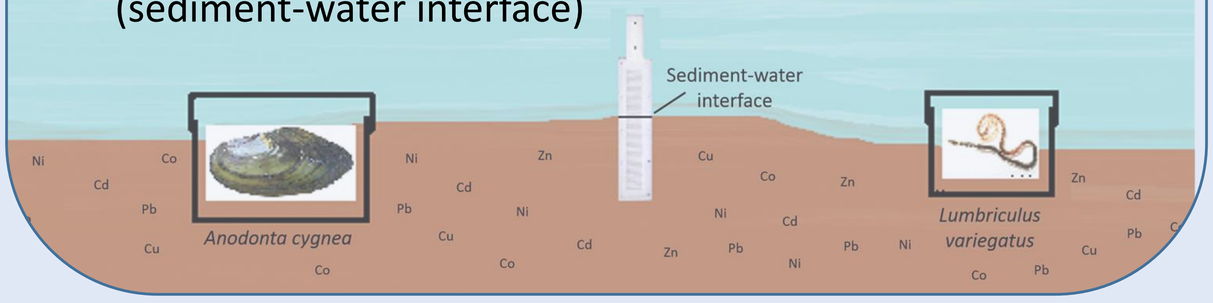
Introduction

- Sediment related metals can be present in a range of different physicochemical forms, some of which may be unavailable, non-toxic and therefore not-harmful to organisms what means that the interplay between the **chemical speciation** and **biological effects of metals** can be very site specific and hard to predict → total sediment concentrations poor predictors of the actual risk
  → measure of bioavailability should be considered in risk assessment procedures
- Recently, passive samplers have been tested to estimate the bioavailable contaminant fraction as well as the contaminant flux over the sediment-water interface over time, what provides several advantages over established monitoring techniques (such as grab- or spot sampling) in combination with being less destructive than conventional methods for which animal or plant tissue is needed.
- "Diffusive Gradient in Thin film samplers" (**DGTs**) have been indicated to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species under (semi-) controlled conditions.

Research objectives: Evaluation of the use of DGT passive samplers as indicators for the bioavailability of metals for (benthic) macroinvertebrates as well as of the robustness of the results from laboratory studies under field conditions.

Materials and Methods

- **6** Flemish field locations with known metal contamination background and physicochemical characteristics
  -> 3 x fresh, 3x brackish
- Caged organisms will be exposed for 28d
- Passive samplers will e installed for 24h at 3 time points
- Bioaccumulation within the organisms after 28d will be compared to the metal concentrations measured by DGTs
- These measurements will be performed in the **field** (sediment-water interface & water) as well as in the **lab** (sediment-water interface)

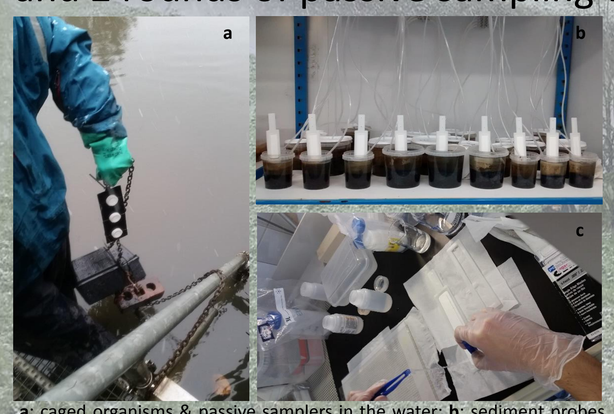


Pilot study

- A pilot study has been performed for one location in November/ December 2017
- 4 different species (2 fresh - & 2 brackish water species) were deployed in the field and in the laboratory for 28d

Hediste diversicolor *Scrobicularia plana* *Anodonta cygnea* *Corbicula fluminea*

and 2 rounds of passive sampling were performed



a: caged organisms & passive samplers in the water; **b**: sediment probes & organisms in the laboratory and **c**: processing the sediment probes after a 24h deployment

Aim

Evaluation of the choice of test organisms as well as the general set up and procedures

Preliminary results pilot study

- 100% mortality of *H. diversicolor* and *S. plana* -> brackish species will only be used for brackish locations
- Concentrations of several metals measured by the passive samplers below the limit of quantification

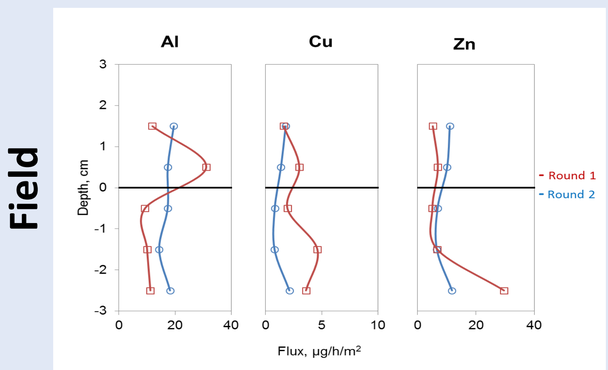


Figure 1: Flux of Al, Cu and Zn in µg/h/m² after 24h in the field.

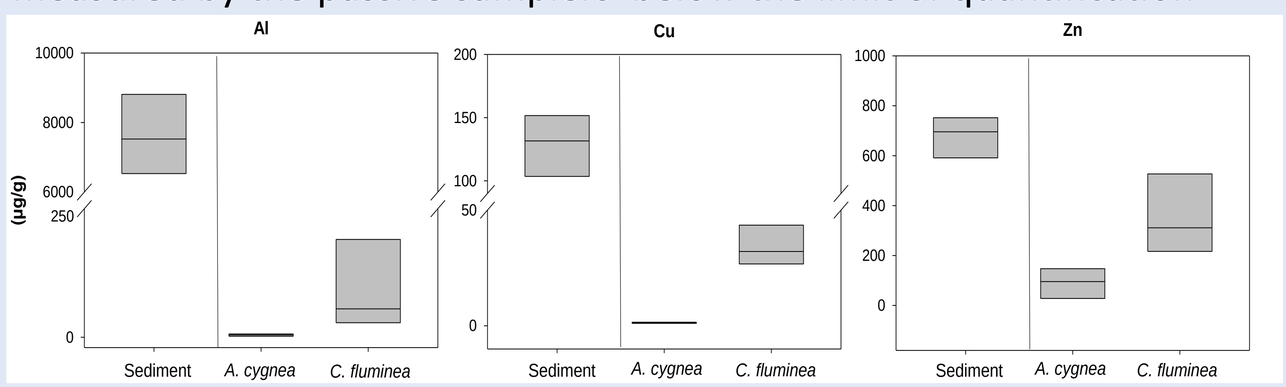


Figure 2: Background concentrations of Al, Cu and Zn in the sediment & metal concentrations measured in *A. cygnea* and *C. fluminea after a 28d field exposure.*

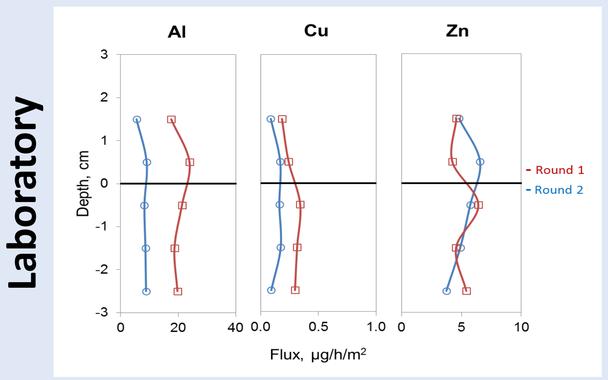


Figure 3: Flux of Al, Cu and Zn in µg/h/m² after 24h in the laboratory.

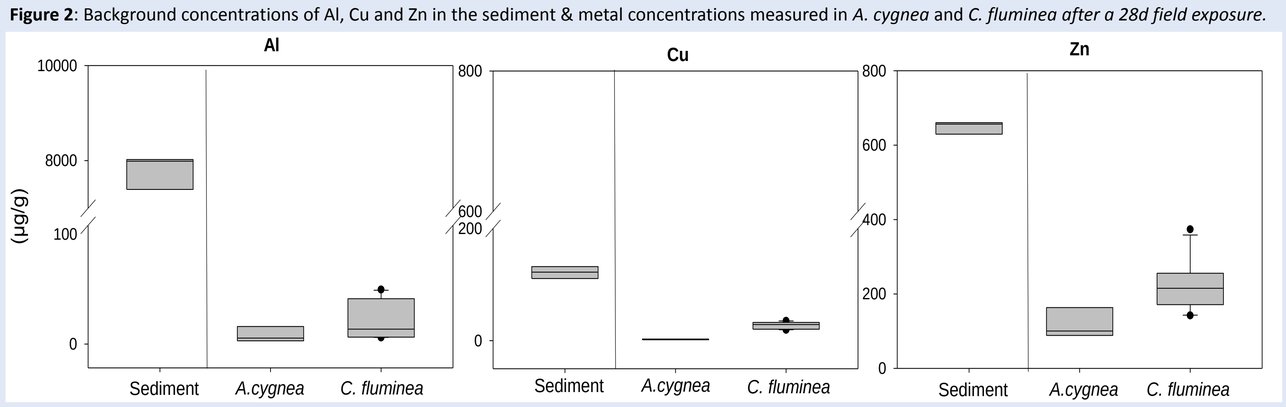


Figure 4: Background concentrations of Al, Cu and Zn in the sediment & metal concentrations measured in *A. cygnea* and *C. fluminea after a 28d lab exposure.*

- Bioaccumulation in *C. fluminea* higher than in *A. cygnea* under field and laboratory conditions
- Metal flux and bio-accumulation in the field tend to be (slightly) higher than in the lab
- Lower DGT metal concentrations in the 2cond measurement within the lab sediment *-> depletion ?*

→ *possible underestimation of the actual biological risk if measurements are only performed under laboratory conditions ?*

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