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

Hanne Hetjens[1], Kristine de Schamphelaere[1], Tayebeh Bashnin[1], Johnny Teuchies[1], Lieven Bervoets[1]

[1]University of Antwerp, SPHERE, Groenenborgerlaan 171, 2020 Antwerp, Belgium

Phone: +32-(0)- 653532
E-mail: Hanne.Hetjens@uantwerpen.be

Introduction: Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem in aquatic ecosystems and are of major concern for water system managers due to their impact on the surrounding water quality and resident biota. 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 so that the interplay between chemical speciation and biological effects can be very site specific and hard to predict [1]. Total sediment concentrations are therefore often found to be poor predictors of the actual risk and a measure of bio-availability should be considered in risk assessment procedures [2]. In this regard however, the established techniques of measuring the level of bioaccumulation in exposed organisms has been experienced to be highly disruptive, time consuming and limited in comparability as its results are strongly dependent on the analysed organisms themselves. Therefore, an increasing need for less disruptive, more reliable and standardized methods exists. Recently, passive samplers have been tested to estimate the bioavailable contaminant fraction as well as the contaminant flux over sediment-water interface over time. 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, by allowing weakly bound metals to selectively accumulate onto a Chelex- embedded hydrogel layer [3]. In this study, the use of DGT passive sampler as indicators for the bioavailability of metals for (benthic) macroinvertebrates should be evaluated and the robustness of the results from laboratory studies under field conditions be tested. The results are expected to increase the insights in the applicability of passive sampler for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

Methods: In an extensive field and laboratory study, which was performed in July and August 2018, the impact of three different natural freshwater sediments, with known physicochemical characteristics and metal gradients, on the performance of two macro-invertebrate species with different uptake routes, the bivalve *A. cygnea* and the oligochaete *L. variegatus*, was tested. This was done by assessing the bioavailable metal fractions by the use of DGTs (2x 24h deployment) and by measuring the metal body burden of the two species after an exposure time of 4 weeks (field and laboratory). Furthermore, para-meters such as AVS, SEM and AEM concentrations were be taken into account and will be compared with the DGT metal concentrations and bioaccumulation.

Results: At the current stage, no results can be presented yet. We are currently performing the last analyzes before we can start with the processing of the whole data set. Nevertheless, results from a pilot study that has been performed in November 2017 (same set up, one sediment and different organisms; e.g. *C. fluminea*) already indicated that, even though differences in the bioaccumulations were found, the fluxes of most metals, measured by DGTs, were comparable in the laboratory and in the field.

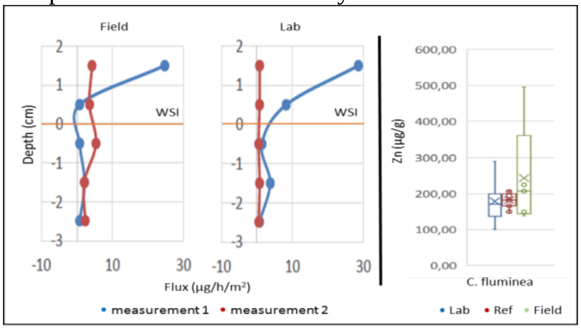

Fig. 1: Flux of Zn with DGTs (left) in comparison to the measured body burden in *C. fluminea* after 4 weeks of exposure in the field and in the lab.

Discussion: Based on the results of the pilot study a correlation between the DGT and the bioaccumulated metal concentrations seemed rather difficult. We are curious whether comparable results will be found in back in the new data set.

References: [1] Strom, et al. (2011) Environ. Toxicol. Chem., 30, 1599−610; [2] Simpson et al. (2007) Integr. Environ. Assess. Manage., 3, 18−31; [3] Amato et al. (2015) Environ. Sci. Technol., 49, 14204−14212