

Ecological risk assessment of chromium in sediments

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Introduction: The river 'Grote Calie' in Belgium is historically polluted with high concentrations of chromium (Cr) in the sediments in its river banks. Chromium is present in the sediments in two different oxidation states: Cr(III) and Cr(VI). The naturally occurring trivalent chromium is relatively insoluble and nontoxic and therefore is less bioavailable, whereas Cr(VI) is very soluble and highly toxic. Cr(VI) is not stable in reducing environments where acid volatile sulfide (AVS) is formed. In the presence of AVS, the bioavailability of Cr is low due to reduction of the highly toxic Cr(VI) to the less toxic and less mobile Cr(III) (Berry et al., 2004). It is crucial to assess the bioavailability of chromium for predicting its toxic effects on benthic organisms and for evaluating ecosystem health. Correspondingly, tests for bioavailability, bioaccumulation and toxicity have been conducted in the laboratory and in situ to study the risk of this contaminant.

Methods: Several variables have been considered in the lab and *in situ* tests to assess the bioavailability and effects of Cr in the sediment:

- The total concentration of Cr and Cr(VI)
- The concentration of AVS
- The bioaccumulation of Cr in caged biota (*Lumbriculus variegatus* and *Gammarus*)
- The fluxes of labile Cr(III) and Cr(VI) species, obtained in situ using the DGT technique (Zhang et al., 1995, Pan et al., 2015).
- Chronic toxicity tests have been conducted on *Lumbriculus variegatus* and *Gammarus pulex* with the endpoints mortality, reproduction and growth.
- Ecological effect of metal pollution on Macroinvertebrate community composition in terms of Multimetric Macroinvertebrate Index Flanders (MMIF, Gabriels et al., 2010).

Results:

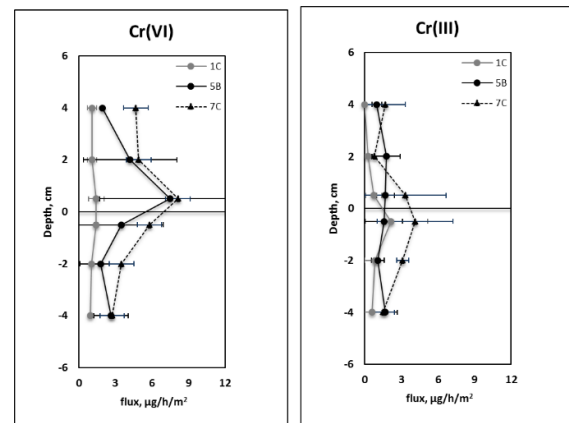


Figure 1 Vertical profiles of DGT-Cr(VI) and -Cr(III) in pore waters and overlying waters compared to reference site (1C) (values are average of 3 replicates)

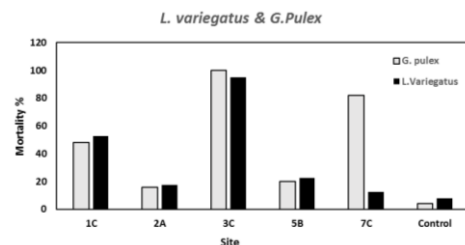


Figure 2 Mortality percentages of *G. pulex* (12 days) and *L. Variegatus* (28 days) at different sites

Discussion:

Despite the high total Cr concentrations (580 µg/gDW) in the most polluted sites, the results of bioaccumulation, passive sampling, AVS, and toxicity tests do not show very large differences from the upstream point. Cr seems not to cause very severe effects since its bioavailability has been controlled by the presence of AVS in the organic matter (Berry et al. (2004). In all the sites low ecological quality has been observed, but there are no large differences visible between Cr contaminated and upstream locations.

References: [1] Berry et al. (2004), *Env.Tox* **23**: 2981-2992 [2] Gabriels et al. (2010). *Limnologica* **40**: 199-207 [3] Pan et al. (2015) *Environ.Sci.Technol* **49**:14267-14273. [4] Zhang et al. (1995). *Anal.Chem* **67** :3391-3400