Contaminated sediments: Methods to assess release and toxicity of organic chemical mixtures

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Abstract

Bottom sediments around the world store large amounts of legacy hydrophobic organic contaminants (HOCs), forming mixtures of unknown chemical composition. Primary emissions to the environment of many HOCs have been reduced as a consequence of regulation. However, HOCs may be released from the sediments to water and biota, and there is therefore a risk of negative effects on local ecosystems. The activity of benthic organisms can enhance the sediment-to-water flux of HOCs, a process called bioturbation. Few *in situ* assessments of the sediment-to-water flux are available in the scientific literature, and the effect of bioturbation on the sediment-to-water flux of HOCs has not been studied in the field. Thus, there is a need to improve *in situ* methods for direct determination of sediments as a source of HOCs to water, and thereby include the effect of bioturbation. In **Paper I**, a benthic flow-through chamber was developed for environmentally realistic *in situ* assessments of the sediment-to-water flux. In **Paper II,** the sediment-to-water flux of polycyclic aromatic hydrocarbons (PAHs) was assessed using the flow-through chamber at four sites on the Swedish Baltic Sea coast. The sediments at all four sites acted as sources of PAHs to water. In the same study, potential effects of bioturbation, with an increase of the sediment-to-water flux by up to one order of magnitude, were observed at sites with bioturbating organisms. In the past, assessing the toxicity of HOCs has been challenging due to difficulties in maintaining stable exposure concentrations of the test chemical. In **Paper III**, a passive dosing method, where the test chemical partitions from a polymer (silicone) to the aquatic exposure medium, was developed and tested for chronic exposure. A stable exposure concentration could be maintained, and the chronic toxicity to the sediment-dwelling harpacticoid *Nitocra spinipes* of chronic exposure to triclosan was assessed in a 6-week population development test. In **Paper IV**, a passive sampling and dosing method was developed and used to assess the toxicity of an environmental chemical mixture of bioavailable sediment-associated HOCs transferred from a contaminated sediment to the laboratory-based bioassay. The passive sampling and dosing method can be used to assess the toxicity of environmental mixtures of chemicals at environmentally realistic concentrations to which ecosystems are constantly exposed.

Keywords: *Sediment, Hydrophobic organic contaminants, Flux, Bioturbation, Passive sampling, Passive dosing, Mixture toxicity.*

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