

Pore water and accesible concentrations of hydrophobic contaminants in Danube river sediments estimated by multi-ratio equilibrium passive sampling

MICHAELA BELHÁČOVÁ¹, BRANISLAV VRANA¹, TATSIANA RUSINA¹, FOPPE SMEDES¹

1Masaryk University, Research Centre for Toxic Compounds in the Environment, Kamenice 753/5, 625 00 Brno, Czech Republic

belhacova@recetox.muni.cz, vrana@recetox.muni.cz,
rusina@recetox.muni.cz, smedes@recetox.muni.cz

The information about total concentration of persistent organic pollutants (POPs) in sediment is not adequate to assess the risks linked with sediment contamination. A fraction of POPs may be adsorbed to sediment very firmly (amorphous organic carbon - different types of black carbon) or cannot be released (1) while it is the concentration released to the aqueous phase, actually the POP's concentration, that pose the risk to the surrounding environment. (2) Freely dissolved concentrations in pore water are directly proportional to chemical activity, i. e. also driving force of POPs accumulation in organisms and diffusive transport. As a result of the presence of a strongly bound POPs fraction in sediment, the contaminants concentration in pore water may be significantly lower than estimated using equilibrium partitioning models from total concentration and generic partition coefficients.

Freely dissolved concentrations in pore water (C_w) as well as the accessible/releasable (CAS) concentrations in the sediment can be determined by equilibration of a partitioning passive sampler (silicone rubber polymer with a high sorption capacity for non-polar compounds) with sediment using various sampler-sediment ratios. (3) This method allows construct a sorption isotherm yielding the concentration in the pore water at low sampler/sediment ratio (minor depletion of the sediment phase) or at high sampler/sediment ratio (maximum depletion of the sediment phase) - the accesible concentration in the sediment (3).

We demonstrated the application of the multi-ratio equilibrium passive sampling method (five different sampler-sediment phase ratios rating from 0.0005 to 0.2) to measure freely dissolved concentrations and accesible concentrations of polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), musks and alkylphosphates and their total concentrations in the sediments that were collected at 9 locations of the Danube river. The comparison of obtained freely dissolved concentrations in porewater and the water column in the river allow to assess the potential of riverbed sediments to spontaneously release or accumulate contaminants to/from the water column. The accesible concentrations provide the information of contaminant pool in sediment available for a spontaneous exchange with the surrounding environment.

(1) Cornelissen G., Gustafsson Ö. □, Bucheli T. D., Jonker M. T. O., Koelmans A. a., and Van Noort P. C. M., Extensive sorption of organic compounds to black carbon, coal, and kerogen in sediments and soils: Mechanisms and consequences for distribution, bioaccumulation, and biodegradation, *Environ. Sci. Technol.*, 2005, 39, 6881–6895.

(2) Reichenberg F. and Mayer* P., Two Complementary Sides of Bioavailability: Accessibility and Chemical Activity of Organic Contaminants in Sediments and Soils, *Environ. Toxicol. Chem.*, 2006, 25, 1239.

(3) Smedes F., van Vliet L. A., and Booij K., Multi-ratio equilibrium passive sampling method to estimate accesible and pore water concentrations of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in sediment., *Environ. Sci. Technol.*, Jan. 2013, 47, 510–7.