

# Chemical availability of hydrophobic organic contaminants in sediments from European catchments: comparison of solid-phase and Tenax® extraction

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## Introduction

In the past decades, research has shown that total concentration of hydrophobic organic contaminants (HOC) is not representative for actual exposure. This has been explained by the sorption of these compounds to two different types of organic matter: amorphous organic carbon (AOC), showing linear absorption and rapid desorption, and Black Carbon (BC), showing nonlinear adsorption and slow desorption. The rapidly desorbing fraction, which is thought to be bound by AOC has been related to the bioavailability of HOCs.

## Objective

- determine the relation between desorption behaviour of sediment bound HOCs and organic carbon characteristics.

## Method

- sediment sampled in four European catchments: Meuse, Ebro, Elbe and Danube.
- total PAH concentration determined by Soxhlet extraction (hexane/acetone).
- PAH desorption curves measured by Tenax® extraction.
- Desorption curves were fitted to a three compartment model:

$$\frac{S_t}{S_0} = F_{rap} e^{-k_{rap}t} + F_{slow} e^{-k_{slow}t} + F_{vslow} e^{-k_{vslow}t}$$

$S_t$  and  $S_0$  are the sediment-sorbed amounts at time,  $t$  and at the start of the experiment, respectively.  $F_{rap}$ ,  $F_{slow}$  and  $F_{vslow}$  represent the rapidly, slowly and very slowly desorbing fraction respectively. The  $k_{rap}$ ,  $k_{slow}$  and  $k_{vslow}$  values are the rate constants for the corresponding fractions.

- BC content measured by chemo-thermal oxidation (CTO375).
- Rock-Eval 6 analysis for determination of total organic carbon (TOC), residual carbon (RC) and  $T_{50\%}$ . RC is also a measure for BC content, but detects a larger part of the BC combustion continuum (Poot et al., in press) (see Poster WP191).  $T_{50\%}$  is the temperature at which 50% of the organic carbon is oxidized in a Rock-Eval oxidation only analysis.

## Results

- $\Sigma$ PAH varied within and between catchments and ranged from 0 to 10 mg/Kg. On average the highest concentrations were for Fluoranthene (Flu), Pyrene (Py) and Phenanthrene (Phen).
- TOC ranged from 0 to 11%, of which 1 to 48% consisted of BC.
- Desorption rate constants were within the values reported in literature (Fig. 1).
- $F_{rap}$ ,  $F_{slow}$  and  $F_{vslow}$  were on average 7, 9 and 85% respectively, which is also in accordance with literature.
- Correlations between desorption parameters and different measures for BC are shown in Table 1.
- Flu and Py show the most significant correlations, which is presented in Fig. 2.

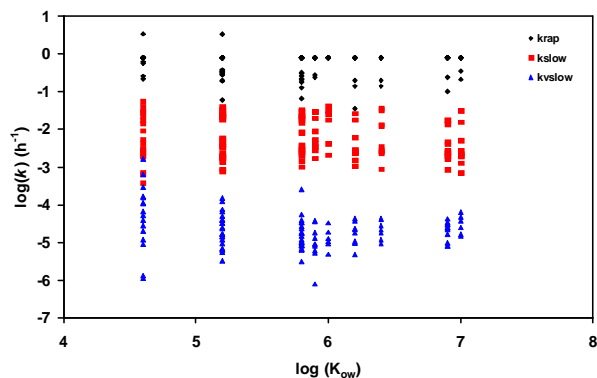


Figure 1. Desorption rate constants versus octanol-water partition coefficient ( $K_{ow}$ ).

Table 1. Correlation between desorption parameters and different BC quantification measures.

	BC%	BC/TOC	RC%	RC/TOC	$T_{50\%}$
$F_{rap}$					
Phen					
Flu	-	-	-	-	-
Py	-	-	-	-	-
Chr	-				
BbF					
BkF					
dBahA					
$F_{slow}$					
Ant					
Flu					
Py					
BkF					
BghiPe					
$F_{vslow}$					
Ant					
Flu					
Py					
Chr					
BkF					
dBahA					
$k_{rap}$					
Phen					
$k_{slow}$					
Ant					
$k_{vslow}$					
Phen					
Flu					
BbF					
BkF					
BaP					
InP					

Legend  
■ p<0.01  
■ p<0.05  
■ p<0.1  
 - negative correlation

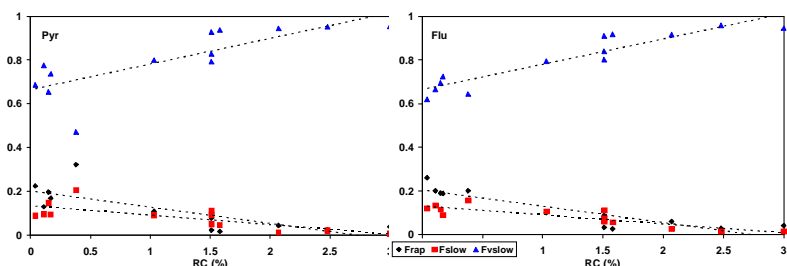


Figure 2. Correlation between desorbing fractions for Flu and Py and RC%.

## Conclusions

- Different quantification techniques for BC correlate significantly with desorption parameters for PAHs.
- Overall RC% appears to be the best variable to estimate desorption parameters for PAHs.
- For Flu and Py (both four ring PAH;  $\log K_{ow} = 5.2$ ) RC% correlates significantly with all three desorbing fractions. As RC% increases, a larger part of these compounds will reside in the very slow desorbing fraction.

## References

Poot, A., Quik, J.T.K., Veld, H. and A.A. Koelmans (in press). Journal of Chromatography A.

