

EFFECT-DIRECTED-ANALYSIS OF UNRESOLVED COMPLEX MIXTURES OF HYDROCARBONS (UCM). IDENTIFICATION OF PERSISTENT, BIOACCUMULATIVE AND TOXIC COMPONENTS

Scarlett[#], A., Rowland[#], S.J., Galloway^{*}, T.S.

#Petroleum and Environmental Geochemistry Group
 *Ecotoxicology & Stress Biology Group
 University of Plymouth, PL4 8AA
 Tel. +44 1752 232930
 ascarlett@plymouth.ac.uk

www.research.plymouth.ac.uk/pegg/

Introduction

Unresolved complex mixtures of hydrocarbons (UCMs) contain many thousands of individual compounds. A small number of studies (e.g. Booth *et al*, 2007) have shown that components of aromatic UCMs (fig. 1) can reduce the clearance rate (a measure of sublethal toxicity) of mussels *Mytilus edulis* but there remains a huge gap in our understanding of which compounds are involved, the mechanism of their toxicity and their bioavailability when adsorbed to sediments.

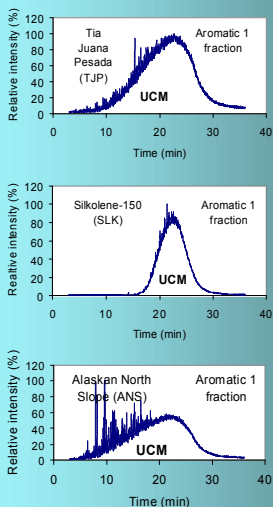


Fig. 1 Aromatic fractions of three oils showing dominance of UCM. Analysis by Gas Chromatography – Mass Spectrometry (GC-MS)

Following baseline toxicity tests using whole oils which showed population-level effects on the sediment-dwelling amphipod *Corophium volutator*, aliphatic and 2 aromatic fractions were tested using *C. volutator* and the blue mussel *M. edulis*.

Useful references:

- Booth *et al*, 2007. Environ. Sci. Technol., 41: 457-464.
- Scarlett *et al*, 2007. Mar. Environ. Res., 63: 457-470.
- Donkin *et al*, 2003. Environ. Sci. Technol., 37: 4825-4830.

Results & Discussion

Sediment tests with *C. volutator*

- All fractions contributed to overall toxic effect
- Growth rate reduced (e.g. Fig. 2a)
- Reproduction reduced (e.g. Fig. 2b)

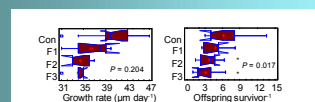


Fig. 2 Effect of chronic exposure to fractions of TJP crude oil on growth (a) and reproductive success (b) of *C. volutator*. * = significant reduction.

Aqueous tests with *M. edulis*

- Aromatic fractions reduced clearance rate
- Only F2 fraction significant reduction (Fig. 3)
- Mussels recovered after 5 days depuration

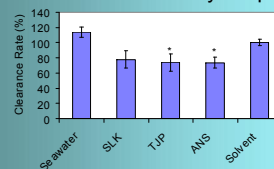


Fig. 3 Effect of aromatic F2 fractions on mussel clearance rates (normalised to solvent control) * = significant reduction ($P \leq 0.05$).

- Distinct UCM accumulated in mussel tissues (Fig. 4) – mostly lost upon depuration and corresponding recovery of mussels.

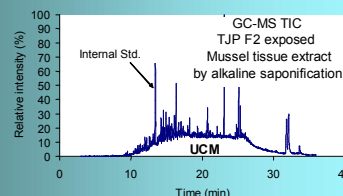
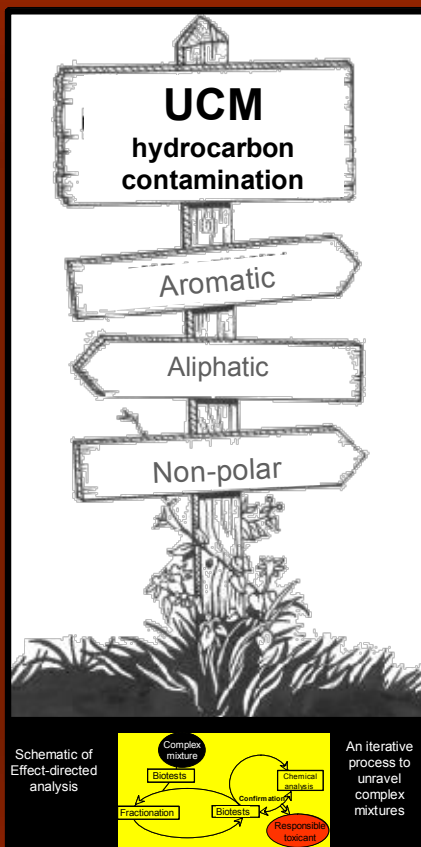


Fig. 4 Total ion chromatogram (TIC) of tissue extract from mussels exposed to aromatic fraction of TJP

Identification of compound groups by GC×GC-tof-MS accumulated in mussels is presented in our sister poster:

TH PC2-1

Poster corner



Methodology

Sediment tests with *C. volutator*

Table 1. Concentrations of fractions in sediment $\mu\text{g g}^{-1}$ (Sed. dry wt.) and seawater (S.W. mg L^{-1}) i.e. whole oil equivalents as used in baseline tests.

	F1		F2		F3	
	Sed.	S.W.	Sed.	S.W.	Sed.	S.W.
SLK	417	26	77	5	Not performed	
TJP	133	7	141	9	100	7
ANS	234	10	145	4	60	3

Sediments were spiked with aliphatic (F1) and 2 aromatic fractions (F2 & F3) of 3 oils to give nominal concentrations of $500 \mu\text{g g}^{-1}$ (dry wt.) of whole oil equivalents (Table 1) based on gravimetric analysis. Juvenile amphipods ($n = 20$ per treatment) were exposed for 60 days and their growth rates and reproductive success measured and compared with control organisms.

Aqueous tests with *M. edulis*

Mussels ($n = 9$ per treatment) were exposed for 48 h then the clearance rates measured by particle counting using a Coulter counter. Fractions that caused significant reduction (ANOVA, $P \leq 0.05$) were retested and subject to depuration (5 days) in clean seawater.

