DOES PETROLEUM HYDROCARBON MONITORING OF THE MARINE ENVIRONMENT REQUIRE AN UPGRADE?

Scarlett*#, A., Galloway*, T.S., Rowland#, S.J.

#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/

Intro

The extraction and transportation of crude oil has led to contamination of parts of the marine environment by petrogenic hydrocarbons. To minimise risk to marine biota, statutory monitoring programmes exist which require determination of the concentrations of priority PAHs.

However, the majority of petrogenic hydrocarbons in oil-contaminated sediments and biota tissues are present as unresolved complex mixtures (UCM), concentrations of which are rarely reported. A small number of studies have shown that components of some aromatic hydrocarbon UCMs are toxic (e.g. to the mussel *Mytilus edulis*).

We have extended these studies to investigate the sublethal effects of UCMs following acute aqueous exposure to mussels and population-level effects on the amphipod *Corophium volutator* when chronically exposed to UCM-contaminated sediment.

Materials & Methods

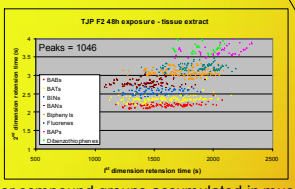
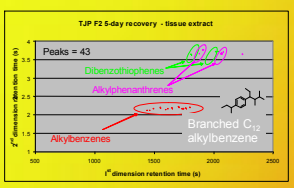


Fig. 6 Major compound groups accumulated in mussel tissue



- Most compounds depurated
- Some groups more persistent e.g. branched alkylbenzenes (BABs).
- BABs found to accumulate in wild N. Sea mussels (Booth *et al*, 2007. Environ. Sci. Technol., 41: 457-464

Fig. 7 Compounds remaining after depuration

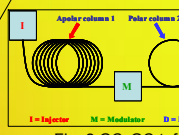
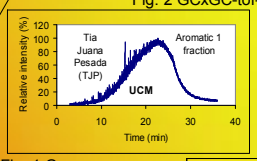


Fig. 2 GCxGC-tof-MS schematic



Oils:
- Silkolene-150 (SLK)
- Tia Juana Pesada (TJP)
- Alaskan North Slope (ANS) evaporative weathered 36%

Fig. 1 Gas chromatogram of aromatic F2 fraction of TJP biodegraded crude oil

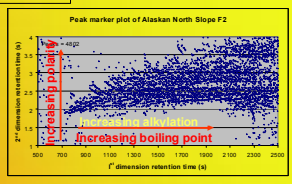


Fig. 3 GCxGC-tof-MS peak marker plot of aromatic of ANS weathered crude oil

Results & Conclusions

Aqueous
- **All major compounds from oils bioaccumulated in mussel tissues (Fig. 4 & 6)**
- **Aromatic(F2) fractions toxic (Fig. 5)**
- **Most compounds depurated (Fig. 7)**
- **Mussels recover with loss of tissue burden (Fig. 5)**
- **UCM-dominated oils (TJP & SLK) show similar toxicity to weathered oil (ANS)**

Chronic sediment exposure
- **Growth rate & reproduction reduced**
- **Population-level effects**
- **All fractions contribute to toxicity**
- **In terms of sediment concentration – aromatic UCM fraction of most concern**

Further chronic exposure results given in our sister poster spotlight: TU 097

Acute 48 h aqueous exposures to oil fractions had shown that the clearance rates of mussels *M. edulis* were reduced when exposed to aromatic fractions of UCM-dominated oils. Exposures were repeated and the mussels were subject to a 5-day depuration period. Clearance rates were measured (mean of 9 mussels) following exposure and depuration and tissues extracted by alkaline saponification then analysed by GC-MS (Fig. 1) and comprehensive tandem gas chromatography and time-of-flight mass spectrometry (GCxGC-tof-MS, Fig. 2 & 3).

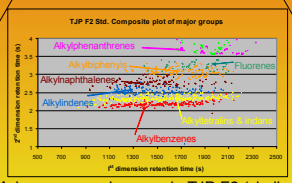


Fig. 4 Major compound groups in TJP F2 (similar in ANS)

Baseline studies had shown reductions in growth rate and reproductive success of the amphipod *C. volutator* following exposure to UCM-dominated oils.

Tests were repeated using aliphatic and two aromatic fractions of the oils. Details of chronic sediment exposure partial life-cycle tests are provided in our sister poster TU 097

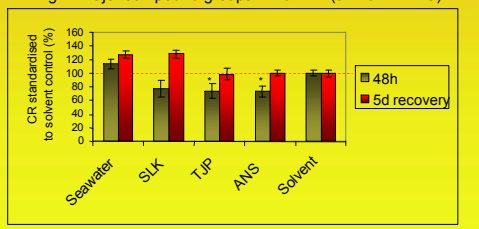


Fig. 5 Mussel clearance rates (CR) after 48 h exposure to aromatic F2 fractions are 5 day depuration