

Introduction

Although PCBs were banned over two decades ago in the UK, their persistence and toxicity means that they can still remain a potential hazard in the marine environment. In this study, the magnitude, spatial distribution and environmental variability of PCBs in marine sediments and dredged material have been established at various sites around England and Wales. The aim is to quantify PCB concentrations within coastal and estuarine sediments. A case study is presented to illustrate changes in homologue patterns over space and time.

Sampling Strategy

Since 1990, monitoring of estuarine and marine sediments in England and Wales has been conducted under the UK National Marine Monitoring Programme (NMMP) (Fig.1). Surficial sediments ($n=439$) were taken using a modified 0.1 m² Day grab and were analysed for 25 congeners ($\Sigma_{25}CBs$), which include the ICES 7 CBs under OSPAR, using Soxhlet extraction and GC-ECD methodologies (Allchin *et al.*, 1989). Dredged material was sampled under the Food and Environmental Protection Act (1985) using specific sampling protocols as specified by the Oslo Commission (CEFAS, 1997). Dredged material, for which sea disposal may be an option, was typically sampled from docks, harbours and marinas (Fig. 2) using a Van Veen grab and surface sediments ($n=922$) have been analysed for $\Sigma_{25}CBs$.



Figure 2 A typical site in an industrialised estuary in the UK.

PCBs in Marine Sediments around England and Wales

The range of $\Sigma_{25}CB$ concentrations in marine sediments was 0.2-800 $\mu g kg^{-1}$. Of all samples analysed, 86% contained PCBs < 20 $\mu g kg^{-1}$. Only 3% contained PCBs >100 $\mu g kg^{-1}$ and these sediments were sampled close to an old PCB manufacturing plant and at an offshore disposal ground. Offshore sediments exhibited very low concentrations (<10 $\mu g kg^{-1}$) as would be expected being located far from industrial inputs. Mean and median PCB concentrations in offshore sediments were 2 \pm 6 $\mu g kg^{-1}$ and 0.3 $\mu g kg^{-1}$ respectively.

In estuaries, PCB concentrations were higher than marine sediments and mean concentrations were 54 \pm 126 $\mu g kg^{-1}$. High variability in estuarine sediments was due to a small number of sites exhibiting elevated concentrations. The median PCB concentration was 12 $\mu g kg^{-1}$. Sources of PCBs to the marine environment include: riverine, atmospheric, industrial and regulated disposal of dredged material to sea.

Acknowledgements

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References

- Allchin, C.R., Kelly, C.A. & Portmann, J.E. (1989) Methods of analysis for chlorinated hydrocarbons in marine and other samples. Aquatic Environment Protection: Analytical Methods, No 6.
- CEFAS (1997) Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1994. Science Series. Aquatic Environment Monitoring Report, No. 47.

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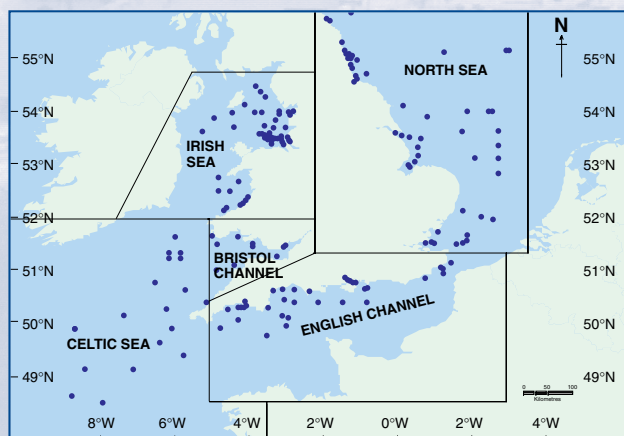


Figure 1 Marine sediment sampling sites sampled between 1990-1999.

PCBs in Dredged Material from England and Wales

Dredged material exhibited $\Sigma_{25}CB$ concentrations in the range 0.2-3,500 $\mu g kg^{-1}$. The mean concentration was 85 \pm 237 $\mu g kg^{-1}$ (Fig.3). Elevated concentrations (>100 $\mu g kg^{-1}$) were detected in docks in N.E. England (e.g. Blyth, Tyne and Tees) and South Wales (e.g. Swansea, Newport and Cardiff). Concentrations have not reduced significantly over time and in some cases have increased. Elevated levels today are attributed to historical inputs although shipbreaking practices have caused localised contamination.

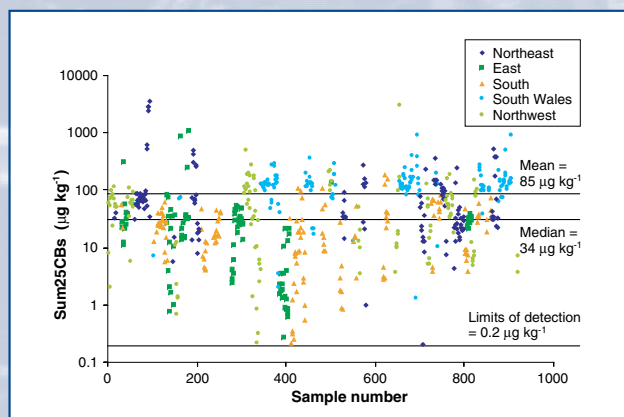


Figure 3 $\Sigma_{25}CBs$ in dredged material sampled in docks, harbours and marinas between 1990 and 1999 ($n=922$).



Figure 4 King's Dock, Swansea, South Wales.

Case Study: South Wales

Dredged material sampled in docks in Swansea (Fig.4), Cardiff and Newport consistently exhibited PCB concentrations >100 $\mu g kg^{-1}$. Some sediments in the Bristol Channel also exhibited similar concentrations. PCB homologue groups in dredged material at these sites showed comparable patterns (Fig. 5) suggesting either similar sources of PCBs or similar environmental processes operating locally.

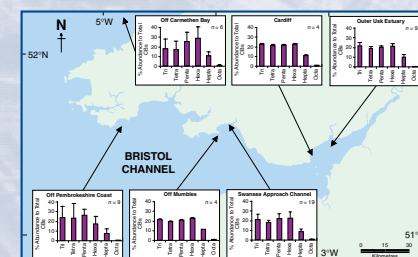


Figure 5 Spatial trends of mean PCB homologue groups (as % of $\Sigma_{25}CBs$) in dredged material in South Wales (1994-1998). (Error bars represent one standard deviation).

Homologue Patterns in Dredged Material

PCB homologue groups in dredged material sampled at two sites in Swansea Docks are shown in Figure 6. There appears to be very little difference between 1994 and 1998 data especially when considering the variations involved. This may indicate the persistent nature of these chemicals.

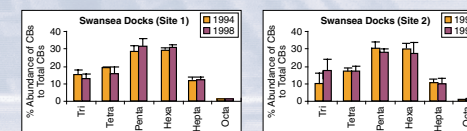


Figure 6 Mean PCB homologue groups patterns (as % abundance to $\Sigma_{25}CBs$) in dredged material at two sites in Swansea Docks, South Wales. (Error bars represent one standard deviation).

Conclusions

- This study demonstrates that PCBs in offshore sediments are low (<2 $\mu g kg^{-1}$) except at some dredged disposal grounds e.g. Tyne.
- Some sites exhibited a decrease in concentrations in estuarine sediments but there were a number of cases where concentrations have increased e.g. Blyth, Tyne and Tees.
- Elevated (>100 $\mu g kg^{-1}$) PCB concentrations were detected in dredged material prior to disposal.
- PCB concentrations in dredged material are often very variable at local scales causing difficulties for dredge license assessments.