

A Method for Time Trend Analysis of PAHs and PCBs in the Baltic Sea - The Historical Record of Laminated Recent Sediments.

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Introduction

Sediments which are laminated can be described as horizontally striped, undisturbed sediments where the different laminae represent material deposited during different periods of time¹⁻⁴. The theories of their formation are that in deep accumulation bottom environments where the redox-potential varies greatly anoxic and oxic situations occur alternately causing differently coloured laminae, and/or the deposition of allochthonous matter on these kinds of sediments or on totally anoxic sediments generates laminated sediments. During anoxic periods no benthic organisms can live in the sediment and since the succession of oxic and anoxic environments can be relatively frequent the time for new organisms to settle during oxic periods is too short. The absence of organisms implies that there is no bioturbation in the sediment which is one prerequisite for obtaining laminated sediments, another being the absence of heavy resuspension.

By establishing the activities of different radionuclides (e.g. ²¹⁰Pb, ¹³⁷Cs, ²³⁹⁺²⁴⁰Pu) in the laminae it is possible to date the sediment and to determine processes like mixing and compaction⁵⁻⁷. After analyses of the contents of different pollutants of the dated laminae it is also possible to relate the linear growth rate (mm/year) of the sediment with the amount of pollutants to establish their chronology of deposition. In the present study laminated sediments from the Baltic Sea were analysed for polychlorinated biphenyls (PCB) and polycyclic aromatic hydrocarbons (PAH) and the contents of these pollutants were related to the different time zones of the sediment as established with radionuclides.

Materials and Methods

Laminated sediments were collected with a gravity core sampler at a location in the Baltic Sea (N 58°26'99", E 18°19'16") at a depth of 160m. The thicknesses of the slices cut out from collected cores were decided by the thickness of the differently coloured laminas. The slices were Soxhlet extracted with toluene (Dean-Stark) and the extracts were fractionated on HPLC for obtaining PAHs and PCBs in separate fractions⁸. After further clean-up of the HPLC fractions the samples were analyzed for their contents of PAHs and PCBs on GC/MS^{8,9}. The activity of radionuclides was determined on sub-samples of each slice for dating of the sediments.

Results and Discussion

Earlier results on the concentration in a large number of bottom surface sediments (0-1 cm) from the Baltic (from the Bothnian Bay to the southern Baltic proper) show that the spatial variation of both PAHs and PCBs is very low¹⁰. When expressed on a carbon weight basis the concentrations of PAHs (15 compounds) vary only with a factor of approximately 8, from 10 µg/gC to 80 µg/gC and for the sum of PCBs (nine compounds) the picture is almost the same, all samples vary with a factor of approximately 6 when expressed on a carbon weight basis (approx. 100-600 ng/gC). The results of the present study indicate decreasing levels of PAHs and PCBs with increasing depth of the core. The first preliminary results show a 5 fold decrease in total PAH content 15 cm down in the sediment compared with the content in the surface layer.

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