

### Organic pollutants in marine environment of the Montenegro Coast South Adriatic

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Organic contaminants from several different classes were analysed in south-eastern part of the Adriatic sea - Montenegro coast. To estimate the level of pollution the contents of organic carbon, total phenols and polycyclic aromatic hydrocarbons were analysed in sea water, while in sediments and marine organisms were determined the contents of aromatic as well as chlorinated hydrocarbons.

The organic carbon concentration is a measure of content of organic matter and in the same time the measure of the productivity of system.

Phenol compounds in aquatic ecosystem could be of synthetic or naturally occurring. The pathological effect of phenols on fish referred to acute and subacute poisoning.

Chlorinated pesticides (DDT and metabolites, DDD, DDE), polychlorinated biphenyls (PCB) and polycyclic aromatic hydrocarbons (PAH) are ubiquitous pollutants which have a similar environmental fate. On the other hand they have quite different origins and can be used as a tracers for agricultural (DDT), industrial (PCB) and mixed industrial and urban contamination (PAH).

South Adriatic is relatively low investigated and there is no information about organic pollutants contents. It was chosen 7 sampling stations (Fig. 1) and the seawater, sediments, fish and shellfish samples were collected.

The concentrations of organic carbon in seawater were analysed with acid bichromate titrimetric method and total phenols were determined colorimetrically with

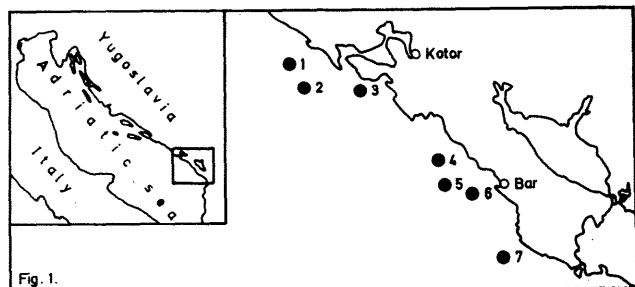


Fig. 1.

antipyrene method. PAH content in seawater, sediments, fish and shellfish were analysed with fluorescence technique (Perkin-Elmer 3000 fluorimeter) with conventional and synchronous scanning mode. Chlorinated hydrocarbons were determined by gas chromatograph (Pye Unicam 4550).

The concentrations of organic carbon in seawater ranged from 0.97 to 4.19 mg C/dm<sup>3</sup> what is in the same level determined in North Adriatic.

The mean value of total phenol concentrations was 1.6 µg/dm<sup>3</sup> determined in September 1988, while in December of the same year it was higher (4.0 µg/dm<sup>3</sup>). A very small variability in results in water column shows a good vertical mixing of the sea masses.

The total PAH contents in seawater were at all station below the detection limit of applicable method and are found to be 0.14 µg chrysene equivalents/dm<sup>3</sup>. The same values were determined in middle Adriatic and we can conclude that the seawater of the Adriatic sea is not contaminated with these compounds.

Total PAH contents in sediments varied from 0.52 to 3.41 µg/g. It was noticed the increasing trend in PAH contents toward the south, that could be explained with larger terrigenous influence of Bojana river.

The same group of aromatic compounds were also determined in marine organisms fish (*Mullus barbatus*) and shellfish (*Lithophaga lithophaga*). The total PAH contents in fish ranged from 0.66 to 3.08 µg/g while in shellfish it was not determined the large differences in PAH contents between samples and it ranges from 0.22 to 0.73 µg/g. All values of PAH content are given in chrysene equivalents and in relation to dry weight.

The synchronous mode of scanning was also applied for all samples of sediments, fish and shellfish. From the obtained spectra it is evident that fish and shellfish accumulate most aromatics with two rings while in sediments beside these compounds it was found also aromatics with five and more rings.

Chlorinated hydrocarbons in sediments were generally low and not always presented. It was found a larger amount of these pollutants in fish and shellfish especially DDT and its metabolites.

The contents of HCB in fish varied from 0.01 to 1.27, HCH from 0.01 to 0.42, lindan from 0.28 to 2.26, pp'DDE 0.01 to 4.95, pp'DDD 0.01 to 0.84, pp'DDT 4.17 to 15.14 and PCBs from 0.01 to 297.31 µg/kg. The same group of compounds was also determined in shellfish and the results are as follows: HCB - 0.01 to 0.49, HCH - 0.02 (mean value), lindan - 1.70 (mean value), pp'DDE - 8.18 to 14.42, op'DDT - 1.75, pp'DDD - 0.32 to 0.67, pp'DDT - 2.80 to 3.56, PCBs - 0.01 µg/kg.

### Aromatic hydrocarbons contamination and characterization of sediments from larger seaports on East Adriatic

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Aromatic hydrocarbons enter the environment via a wide range of activities: accidental and normal operation from ships, coastal drilling and production operations, refinery and other industrial effluent, natural seeps, municipal effluents and storm sewer runoff and atmospheric transport of combustion products of various fossil fuel compounds (FARRINGTON et al., 1983).

Conventional fluorescence spectroscopy is a useful technique for analysis of aromatic hydrocarbons in marine environment. However, an improvement in resolution of the spectra may be made by varying the excitation wavelength maintained 20-30 nm less than the emission wavelength (LLOYD, 1971). He has also been demonstrated that the wavelength of maximum emission is a function of number of rings in a molecule.

Surface sediments (top 5 cm) were collected with gravity corer from 6 stations at a mouth of larger seaports on east Adriatic (Zadar, Šibenik, Split, Kardeljevo, Dubrovnik and referent station Vis) during July 1988. The fluorescence intensities of hexane extracts were measured in one cm quartz cells using a Perkin-Elmer 3000 fluorimeter.

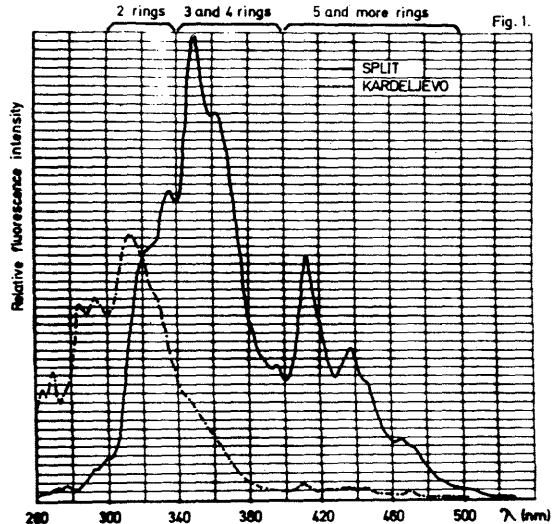
The results of various types of aromatic compounds expressed as a ratio between each aromatic group and total aromatics obtained with synchronous technique and the content of aromatic compounds analysed with fixed excitation wavelength technique are given in Table 1.

Table 1. The relative abundance of each group of aromatic hydrocarbons presented in surface sediments obtained from synchronous excitation emission spectra and total aromatic content calculated from fixed excitation technique.

Stations	2 rings aromatics	3 and 4 rings aromatics	5 and more rings aromatics	Total aromatic contents*
Zadar	0.38	0.42	0.20	4.50
Šibenik	0.25	0.41	0.34	60.10
Split	0.25	0.48	0.27	28.99
Kardeljevo	0.71	0.23	0.06	1.44
Dubrovnik	0.24	0.42	0.34	20.26
Vis	0.60	0.20	0.20	0.48

\* µg chrysene equivalents/g dry weight of sediments

Examples of the types of relative abundance of aromatics are given in Fig. 1.



According to the results obtained with this investigation it was established that the ratio of various types of aromatic compounds in sediments from a larger seaports of eastern Adriatic coast are of mixed origin of petroleum sources and pyrogenic inputs (fossil fuel combustion).

The synchronous spectra of all samples (except from seaport Kardeljevo and locality Vis) have high content of three and four rings compounds probably as consequence of larger entering the bunker oil in these highly industrialised areas.

In seaports in which are determined the elevated contents of total aromatic hydrocarbons (Šibenik, Split, Dubrovnik) sediment is polluted also with larger amount of pyrogenic fossil fuel compounds.

It seems that light fuel oil discharged to seaport area of Kardeljevo is predominant aromatic compounds.

FARRINGTON, J.W., E.D. GOLDBERG, R.W. RISEBROUGH, J.H. MARTIN and V.T. BOWEN, 1983. Environ. Sci. Technol., 17 (8): 490-496.

LLOYD, J.B.F., 1971. J. Forens. Sci. Soc., 11: 83-94.