

DISTRIBUTION AND ORIGIN OF HYDROCARBONS IN SURFICIAL SEDIMENTS FROM IZMIR BAY (TURKEY)

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Abstract

Hydrocarbons were studied in sediments collected from the bay. Total hydrocarbon concentrations ranged from 762-8502 while total aliphatic and aromatic hydrocarbons varied between 448-4427 and 223-6461 ng g⁻¹, respectively. High levels of aliphatics were observed in the inner bay due to domestic and industrial activities. Molecular indices were used to indicate the most probable source of contamination. Pri/Phy ratios of all stations were found >1 indicating the biogenic sources. All samples are characterized by Phenanthrene/Anthracene ratio values <10 and most of samples are grouped by Fluoranthene/Pyrene ratios >1, which is characteristic of strong pyrolytic input.

Key words: sediment, aliphatic hydrocarbon, aromatic hydrocarbon, Izmir Bay

Introduction

Izmir Bay is one of the great natural bays of the Mediterranean. Industrial activities cover a large range of industries including food processing, tanneries, paint, chemicals, textile and petroleum refining. A large number of studies have been carried out on the physical, chemical and biological oceanography of Izmir Bay, but no published data are available on petroleum hydrocarbon concentrations. Aksuet *et al.* (1) have only investigated congeners of polycyclic aromatic hydrocarbon (PAH) in surface sediments from the inner bay. This is the first time that the complete set of such data has been collected and evaluated in the bay.

Materials and methods

Surface sediments were collected at 16 locations in November 2000. Samples were collected using with a Van-Veen grab sampler and extracted in a Soxhlet apparatus, using n-hexane and dichloromethane, according to UNEP (2). Extracts were separated into two fractions, using a column chromatography on silica and alumina. The first group has saturated aliphatic, the second group has unsaturated and aromatic hydrocarbons. High-resolution gas chromatography was conducted on a CHROMPACK gas chromatograph, equipped with a split/splitless capillary injection system, flame ionization detector. The detection limits range between 0.15-2.9 (ng g⁻¹).

Results and discussion

Aromatic Petroleum Hydrocarbons

The relatively high concentrations observed for the inner bay and the port is linked to the greater industrialisation and urbanisation at this part compared to the other sites (Table 1). In contrast, PAH concentrations in most of the sediments in the outer bay are low, and are typical of locations distant from extensive anthropogenic activities. Anthracene and indeno[1,2,3-c,d]pyrene are measured at all stations while naphthalene and benzo[g,h,i]perylene are only found in the middle bay. Total PAH ranges from 223-646 ng g⁻¹ dry wt. and concentrations in the bay are comparable to relatively unpolluted locations in the Mediterranean and are lower than levels reported for polluted NW Mediterranean (3). The fingerprints of PAHs from pyrolytic or petrogenic origin may be used to differentiate these two origins by using molecular indices based on ratios of selected PAHs. Equivalent values for the phenanthrene/anthracene (Phe/Ant), fluoranthene/pyrene (Flt/Pyr) are presented in Table 1. All samples are characterized by Phe/Ant ratio values <10 and most of samples are grouped by Flt/Pyr ratios >1, which is characteristic of strong pyrolytic input. Low values indicate petrogenic origin of the compounds. It is mainly linked to the shipping activity. The various possible PAH sources were estimated by calculating correlation coefficients between total and individual PAHs. All coefficients were generally found to be high (R² = 0.70-0.90). These high correlation levels for most PAHs indicate that sediment contamination was produced by the same sources and the fate of these contaminants was similar.

Aliphatic Petroleum Hydrocarbons

n-C14, n-C17 ranged between 0.12-829, 33-414 ng g⁻¹ in the study area, respectively. C14-C18 was found throughout study area in which C18 (196-1068 ng g⁻¹) was the most abundant. High levels of aliphatics were observed in the inner bay due to anthropogenic sources. It is suggested that the presents of aliphatics due not only to anthropogenic activity but also result of marine phytoplankton and terrestrial vegetation (4). This is indicated by the presence of phytane and pristane at all stations. Pristane and phytane are often considered as good indicators of petroleum contamination. Pri/Phy ratios were >1 indicating the biogenic source in the bay. Increased ratios are also

found at the estuary of Gediz River. The Pri/Phy ratio was low in the inner bay, indicating low contribution from biogenic hydrocarbons. Total aliphatic hydrocarbons ranged from 448-4427 ng g⁻¹. Total aliphatic hydrocarbon concentrations were higher than Eastern Mediterranean by Gogou *et al.* (5), similar in coastline-Black Sea by Readman *et al.* (6). Total extractable organic matter (EOM) ranged between 1-6.9 mg g⁻¹ in the outer bay, 1.7-11 mg g⁻¹ in the middle-inner bays, 84 mg g⁻¹ in the harbor. The linear regressions between total PAHs, aliphatic hydrocarbon and the % of organic matter show significant correlation coefficients.

Table 1. The concentration of total aliphatic (T.Ali), total aromatic (T.Aro), total hydrocarbons (T.Hc), organic matter, extractable organic matter (EOM) and selected ratios

Sta No	T.Ali (ng/g)	T.Aro (ng/g)	T.Hc (ng/g)	Phe/Ant	Flt/Pyr	Flt/Phy	nC ₁₇ /nC ₁₄	EOM (mg/g)	Org. mat. (%)
1	455	307	762	0.08	1.4	2.7	2.0	6.9	2.8
2	440	1009	1457	0.02	0.70	5.5	1.7	0.99	2.8
3	553	223	1176	0.01	1.9	3.0	1.2	2.2	1.9
4	551	1604	2165	0.13	1.9	1.9	0.90	1.8	3.4
5	578	1208	1787	0.05	4.0	7.1	1.1	3.4	3.4
6	421	498	1149	0.02	2.14	3.0	1.3	7.1	1.7
7	702	1141	1843	0.44	100	2.1	1.0	2.4	3.5
8	858	788	1422	0.08	1.0	1.0	1.9	2.4	3.6
9	868	858	1526	0.12	2.3	2.0	1.5	1.9	3.8
10	725	227	953	0.05	1.5	2.8	0.89	1.0	5.5
11	857	2369	3546	0.02	1.2	3.1	1.2	5.1	3.6
12	424	230	1019	0.03	1.5	3.0	0.70	2.2	4.0
13	623	810	1641	0.07	0.89	4.1	0.77	1.1	4.6
14	1961	1840	3801	0.13	0.81	1.0	1.2	2.4	6.7
15	2041	6461	8502	0.13	0.99	1.2	0.74	1.7	8.0
16	4127	711	5138	0.15	0.38	1.1	0.07	81	15

Conclusions

Two main source of PAHs in Izmir Bay sediments studied here have been found; pyrolytic and petrogenic, but the pyrolytic one is predominant. An important change in the sediments characterization can be observed according to the industrial activities along the Gediz River estuary. Relative to other urbanized coastal areas worldwide, the measured total hydrocarbons content of the bay can be considered low to moderately contaminate.

References

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