POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE SEDIMENTS OF THE AEGEAN SEA (EASTERN MEDITERRANEAN): COMPOSITION, SPATIAL VARIABILITY AND SOURCES

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Abstract

In this study the distribution, composition and sources of polycyclic aromatic hydrocarbon (PAH) mixtures were studied in the sediments of the Aegean Sea (Eastern Mediterranean). PAH concentrations were generally low. The highest values were recorded in the northern part of this marine area, which apparently receives more anthropogenic inputs, from both continental runoff and atmospheric deposition. The study of the compositional patterns of the PAH mixtures indicates that various pyrolysis and combustion processes are the major sources of PAHs, although the presence of some petroleum related residues in all sites was also evident.

Keywords : Aegean Sea, Pah, Sediments, Eastern Mediterranean.

Polycyclic aromatic hydrocarbons, mostly deriving from anthropogenic activities, have been recognized as hazardous environmental chemicals and are included in priority pollutant lists. They are easily associated with fast sinking particles and this is considered as the major mechanism of their transport from the surface to the deep-water column and subsequent accumulation in sediments. Although numerous studies on hydrocarbon geochemistry have been performed in Western Mediterranean sediments [1], much less attention has been given to the Eastern basin [2]. In this work the distribution, composition and sources of PAH mixtures were investigated in sediments of the Aegean Sea, by using a molecular marker approach and several diagnostic criteria and indices. The Aegean Sea is a dynamically active area with unique physiographic and hydrodynamical characteristics and is generally characterized by well-oxygenated waters and low primary productivity. The North part of this area is directly influenced by the brackish and low temperature Black Sea water entering the Aegean Sea through the Dardanelles Straits, whereas it is also the recipient of various riverine discharges. The South Aegean Sea does not receive freshwater inputs, whereas the water exchange with the North part is limited only above 400 m because of the peculiar bathymetry of the region. Surface sediments were collected from 31 stations during 1998-2004 and PAH were determined using GC/MS technique. Total PAH concentrations varied between 10.3 and 231 ng/g in the north Aegean and between 9.6 and 150.3 ng/g in the south Aegean Sea sediments. These values are generally considered as low and are comparable with those found in relatively unpolluted open sea locations in other marine areas [1,3]. The highest values were recorded in stations located close to the North Aegean coasts and this is probably due to the anthropogenic inputs coming into the sea through the three major rivers outflowing in this area. On the contrary, in South Aegean Sea lower PAH concentrations were measured and this is attributed a) to the lower supply of land-derived material either fluvial or atmospheric and b) to the highly oligotrophic character of this area, which does not favour the efficient transport and accumulation of significant quantities of organic matter in the sediment. The study of the compositional patterns of PAH mixtures can provide useful information regarding their sources and transport pathways. Three types of PAHs are commonly found in marine sediments: pyrolytic PAHs derived during the combustion of all the organic materials, petrogenic PAHs which are contained in petroleum and its products and biogenic PAHs from natural terrestrial or marine sources. In the sediments examined in this study a mixed origin for PAHs both pyrolytic and petrogenic was demonstrated. In most cases the pyrolytic PAH (compounds with four or more aromatic rings) were dominant, especially in the deep stations, and accounted for 51-89 % of the total PAHs. Phenanthrenes, indicative of petrogenic inputs were less abundant, accounting for 11-42 % of the total PAHs. Similar patterns have been reported in many sediment studies worldwide [2,3] and are attributed to the higher resistance of pyrolytic PAHs towards biodegradation and photo-oxidation, leading to a preferential accumulation of pyrolytic compounds in marine sediments. The use of several molecular indices based on ratios of selected PAH concentrations also confirms the mixed origin. Relatively high concentrations of biogenic PAHs (retene and perylene) were found close to the northern coastal zone, indicating the transportation of terrigenous material through the rivers.

References

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