

GEOCHEMICAL FEATURES OF SURFACE SEDIMENTS ALONG THE IONIAN COASTS

Fanny Voutsinou-Taliadouri

National Centre for Marine Research, Aghios Kosmas, Hellenikon, Athens 166 04, Greece

Abstract

Surface sediment samples collected from five coastal areas of the Ionian Sea were analysed for grain composition, organic carbon and Fe, Cr, Ni, Mn, Zn, Co, Cu, Pb concentrations. Analysis of the data reveals that generally the Ionian surface sediments have not been affected by anthropogenic influences and contain naturally higher amounts of heavy metals when compared with Aegean Sea sediments.

Key-words : metals, sediments, Ionian Sea

Introduction

Marginal marine environments including estuaries, lagoons, bays, gulfs, etc., are especially sensitive to long- and short-term external factors. In particular, coastal areas are subject to diverse anthropogenic influences including industrial development, domestic wastes, maritime transport and agricultural activities. In addition, the effects of the weathering of nearby soils also have to be considered. For all these reasons sediment analyses of coastal areas play a very important role in the quality assessment of the marine environment as far as metal pollution is concerned. Coastal sediments are important hosts for pollutant heavy metals and as such should be included in routine environmental monitoring programmes, although they do not furnish quantitative data on the absolute degree of pollution. This is due to the fact that marine sediments naturally contain different quantities of metals, so "background values" cannot be as readily established as for other parameters. Therefore, the knowledge of heavy metal baseline concentrations is required. The most reliable way for the selection of baseline material is to consider those sediments within the area under investigation for which the distribution pattern of the metals becomes far less distinct or disappears altogether. The aim of the present work is to assess the environmental state of the region under study, as far as the heavy metal pollution is concerned, in comparison with other Greek coastal areas.

The study area comprises the following regions of the Ionian Sea: The Kerkyra Strait, Amvrakikos Gulf, Messolonghi Lagoon, Patraikos

Gulf and Navarino Bay (Fig. 1). The Kerkyra Passage is situated in the uppermost northeastern part of the Ionian Sea between Kerkyra Island and mainland Greece. It communicates with the Ionian Sea through two straits: 1 n.m. wide in the North, 6 n.m. in the South; max. width of the area 16 n.m. The depth contours generally follow the coastal lines, and maxima of around 70 m are attained in the central part of the region. The study area receives agricultural and industrial wastes brought by the Kalamas River (mean annual discharge: $1,619 \cdot 10^6 \text{ m}^3$) and domestic and industrial wastes by a small torrent north of the city of Kerkyra (pop. approximately 40,000 and more than 80,000 tourists). The second study area comprises the Amvrakikos Gulf, a semi-enclosed embayment and a lagoonal complex consisting of three systems. The Gulf is connected with the Ionian Sea through Preveza Channel (sill depth 4 m; width 60 m; length 5 km). Water depths in the Amvrakikos Gulf are less than 60m, while in the adjacent lagoons they do not exceed 3 m. The Arachthos and Louros rivers (mean annual discharge of $2,202 \cdot 10^6 \text{ m}^3$ and $609 \cdot 10^6 \text{ m}^3$ respectively) discharge into the bay. These rivers receive the main load of the domestic (pop. around 100,000), agricultural and industrial wastes of the surrounding area. The third study area, Messolonghi Lagoon, consists of four lagoons, which do not communicate with one another and have depths from 0.2 m to 2.00 m (except in the Aitolikon lagoon, where the depth is around 25 m). The town of Messolonghi (pop. around 10,000) discharges its wastes in the Kleisova lagoon. The Patraikos Gulf, with depths not exceeding 110 m in the central part, receives mainly domestic and industrial effluents of the city of Patras (pop. around 100,000). Navarino Bay, a semi-enclosed embayment in the southwestern part of Peloponnesus with depths less than 50 m, receives some agricultural effluents from the nearby land.

Methodology

Surface sediment samples taken from 193 stations located along the Ionian coasts during the period 1980-1991 were analysed for grain size, organic carbon and the trace metals Fe, Cr, Ni, Mn, Zn, Co, Cu and Pb. The samples were collected using a 0.1 m^2 van Veen grab. The grain size measurement was performed by a technique (1) modified from that of Buchanan (2). Organic carbon was obtained according to Gaudette *et al.* (3). For the trace element determination the leaching of sediment samples with cold dilute HCl, which affects only the non-residual part of the metals and gives the "anthropogenic fingerprints" for the bottom deposits, provides more data on the extend of heavy metal pollution compared to the total sediment analysis.

The trace metal analysis was carried out with the sediment fraction $< 1 \text{ mm}$ which was crushed in a mortar to $< 0.063 \text{ mm}$ to reduce the influence of grain size on the analytical results. About 5 g of each representative sample were shaken for 16 h at room temperature with 75 ml of 2N HCl. The determination of the metal content of the leachates was performed on an AAS (4). The accuracy was checked by analysis of standard samples from the International Laboratory of Marine Radioactivity (IAEA) during international exercises (5). The values ($\mu\text{g/g}$) found and the certified ones were the following: Mn $0.85 \pm 0.07 / 0.88 \pm 0.06$; Cu $4.30 \pm 0.30 / 4.50 \pm 0.30$; Zn $35.20 \pm 0.30 / 37.00 \pm 3.00$; Fe $66.20 \pm 1.20 / 57.00 \pm 3.00$. The analyses, in triplicate, indicated the following average standard deviations and coefficient of variation: O.C. 0.032%, 0.9; Fe 0.85%, 4.4; Mn 38 mg/kg, 5.0; Zn 4.19 mg/kg, 6.0; Cr 1mg/kg, 2; Ni 1 mg/kg, 1; Co 0.2 mg/kg, 2; Cu 0.1 mg/kg, 1; Pb 0.5 mg/kg, 2.5.

Results and Discussion

Table 1 depicts the granulometry, organic carbon content and heavy metal concentrations in the sediments. The granulometric analyses of the sediments showed that the greater part of the open sea regions of the areas studied is covered by fine sediment (silt or clay)

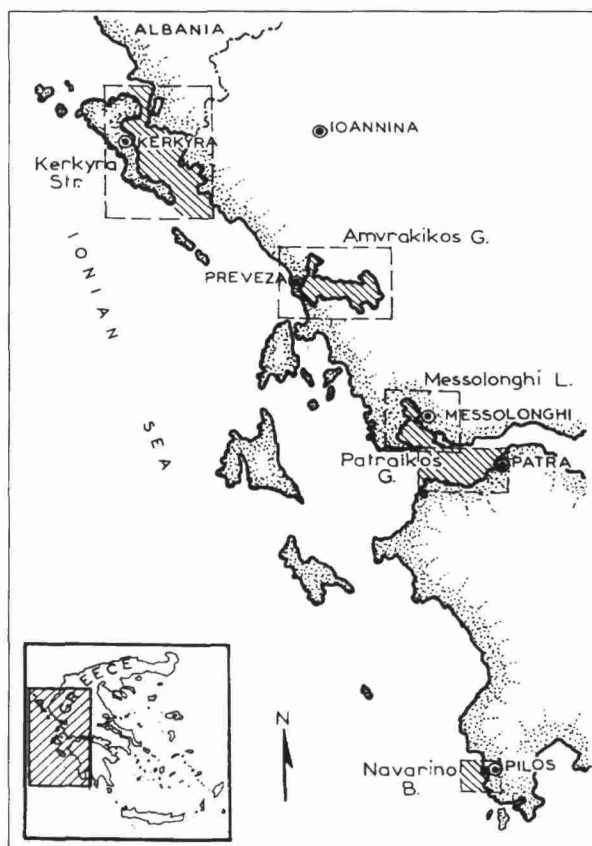


Fig.1. Sampling locations.