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DISTRIBUTION OF SOME TRACE METALS IN THE MEDITERRANEAN WATERS OFF THE NILE DELTA.

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ABSTRACT

37 water samples were collected from the Mediterranean waters off the Egyptian coast and analysed for dissolved (less than 0.450 µm) and particulate trace metals, As, Cd, Co, Fe and Mn. On the whole, the total concentrations of these metals in the study area were of comparable magnitude with their levels in other Mediterranean regions.

INTRODUCTION

The Mediterranean coastal waters off the Nile Delta (Salinity 37.6%-38.9%) receive anualy about 13 x 10^9 m^3 of brackish water from different sources of land drainage including agricultural drain water, industrial and sewage effluents. The role of these sources in enriching the coastal waters with nutrient salts and trace metals has become more important since the constrcution of the Aswan High Dam and the subsequent curtailment of flow of Nile water into the south-eastern Mediterranean.

The present paper entails results on the levels and distribution patterns of dissolved and particulate As, Cd, Co, Fe and Mn in the Egyptian Mediterranean waters.

MATERIALS AND METHODS

A total of 37 stations covering both the neritic and offshore water between El-Agami (Long. 29° 45' E) and El-Arish (long 33° 40 E) were sampled during April and August 1982. At each station 10-20 l of sea water were collected at 3-5 m below the surface, using 10 l Nisken bottles previously washed with 0.2 N nitric acid. Samples were filtered on board through pre-weighed 0.45 µm Nucleopore filters to separate dissolved and particulate metals. After determination of the total particulate matter (TPM), filters with particulated materials were digested in teflon vessels and heated over a thermostaically controlled hot plate at 70°C (Tessler et al., 1979). The filterate collected in acid washed PVC stoppered bottles was allowed to pass through chelating resin column (Chelex 100), eluted by 2N nitric acid and further concentrated by evaporation (Abdullah and

Royle, 1971). The concentrations of dissolved and particulated As, Cd, Co, Fe and Mn were measured using Model 34000 Inductively Coupled Plasma Emission Spectrometer.

The precision and accuracy of the analytical techniques were checked and found satisfactory (percent of recovery ranged between 92-98%). Blanks were below detection limit of the instrument.

RESULTS AND DISCUSSION

The mean values of TPM was about 4 times higher in the inshore region than at offshore stations (Table 1). The inputs from the different sources of land drainage are responsible for enrichment of the coastal area particularly the eastern region with TPM and trace metals (Figs. 1-4). As shown in table 1, the total concentrations of nearly all metals studied were significantly much higher in the inshore water than in the offshore waters.

The mean concentration of total As varied between 0.04 µg/l in the offshore water and 0.073 µg/l in the inshore region. Its concentration was higher in spring than in summer. About 67.5%-74.0% of the total concentration of As occurred in the dissolved form. A direct correlation

TABLE 1

Mean TPM (Mg/l), total metal concentration (ug/l) and percent of dissolved metals (in parenthesis) in the Mediterranean waters off the Nile Delta.

	In shore waters		off shore waters
	Eastern region	Western region	
April			
TPM	0.44 ± 0.39	0.24 ± 0.13	0.096 ± 0.064
As	0.067 ± 0.03 (71.6)	0.073 ± 0.005 (74.0)	0.044 ± 0.015 (72.7)
Cd	0.020 ± 0.019 (80.0)	0.018 ± 0.011 (77.8)	0.021 ± 0.022 (85.7)
Co	0.026 ± 0.019 (46.2)	0.019 ± 0.008 (73.7)	0.011 ± 0.004 (72.7)
Fe	17.91 ±26.03 (8.7)	4.26 ± 1.169 (35.9)	3.99 ± 3.87 (35.0)
Mn	1.021 ± 1.60	0.203 ± 0.044 (36.4)	0.165 ± 0.079 (47.3)
August			
TSM	0.317 ± 0.16	0.292 ± 0.19	0.087 ± 0.04
As	0.050 ± 0.11 (72.0)	-----	0.040 (67.5)
Cd	0.014 ± 0.005 (78.6)	-----	0.010 (70.0)
Co	0.018 ± 0.01 (50.0)	-----	0.010 (70.0)
Fe	14.015 ±14.25 (5.7)	-----	-----
Mn	0.335 ± 0.195 (17.0)	-----	0.321 (21.8)

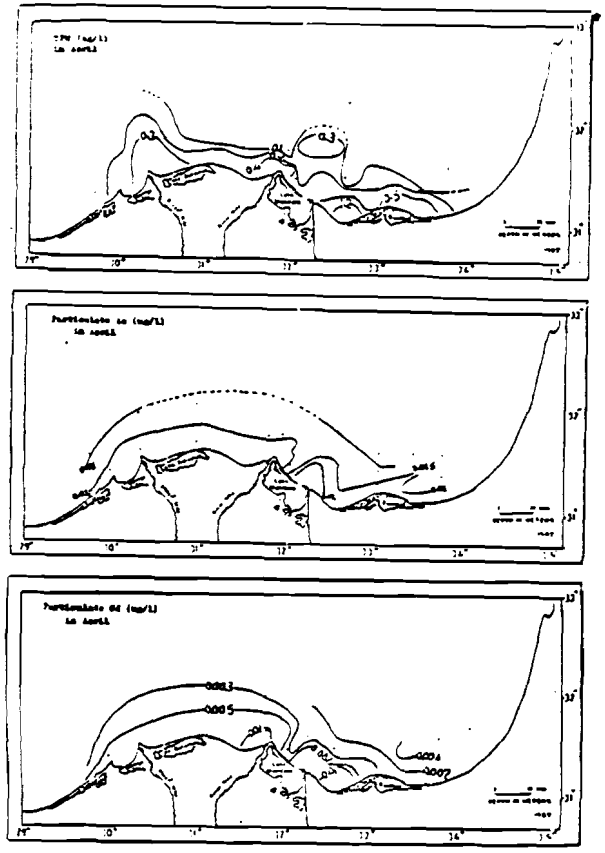

Fig. (1)
Spatial distribution of TPM, As and Cd in the study area during April, 1982.

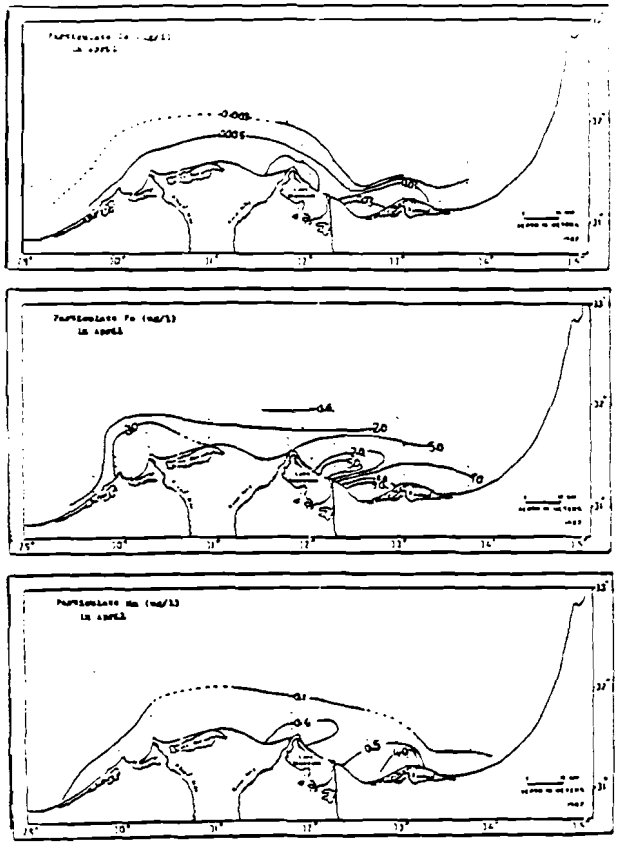

Fig. (2)
Spatial distribution of Co, Fe and Mn in the study area during April, 1982.

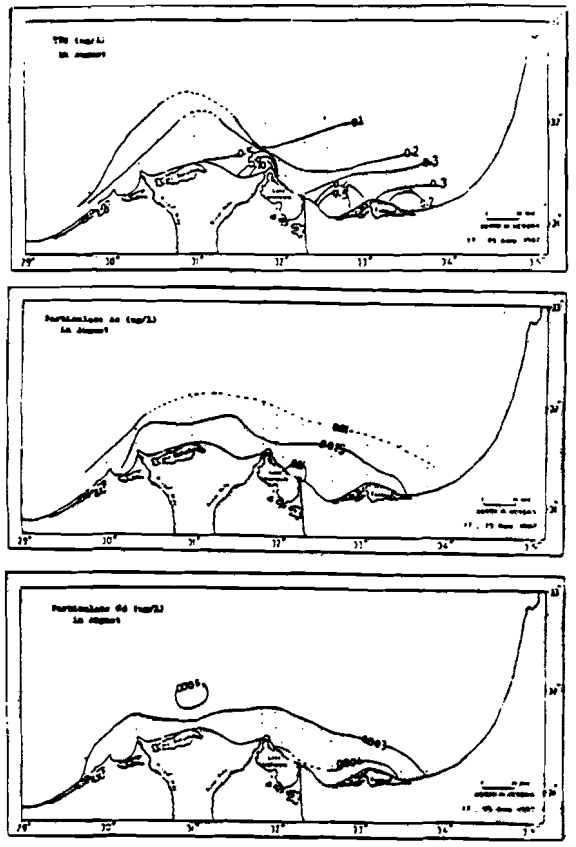

Fig. (3)
Spatial distribution of TPM, As and Cd in the study area during August, 1982.

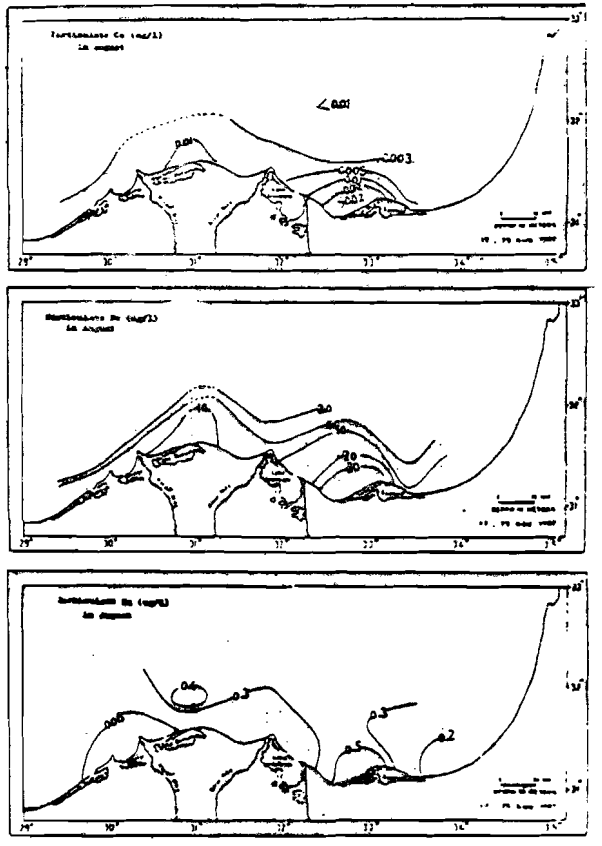

Fig. (4)
Spatial distribution of Co, Fe and Mn in the study area during August, 1982.

(r = 0.96) was found between the dissolved and particulated forms of this metal. In the study area the concentration of As was much lower than that reported from Mediterranean regions. In Rhodes Island and Saronikos Gulf the total As varied between 2.0 and 3.5 µg/l (Papodopoulou, 1972).

Of the metals studied, the concentrations of Cd and Co were the lowest. Both metals were dominantly present as dissolved species (Table 1).

In the particulate form, the concentrations of both metals (in µg/g) were directly correlated with each other and with As according to the following equations:

$$Cd = 0.487 + 0.270 \quad As$$
$$Co = 12.86 + 0.216 \quad As$$
$$Co = 25.50 + 0.343 \quad Cd$$

The concentrations of Cd and Co in the study area were much lower than in other Mediterranean regions. In the western Mediterranean Fukai and Huynh-Ngoc (1976) reported concentrations of Cd varying between 0.050.51 µg/l. Roth and Hornung (1977) found Cd concentrations between 0.62.9 µg/l in the eastern Mediterranean.

Fe was the dominant elements, amongest the metals studied, its total concentration varied between 17.91 µg/l in the inshore region and 3.99 µg/l in offshore waters. Unlike the forementioned elements. Fe is mostly present in the particulate form, probably as a result of the formation of Fe III in the well oxygenated waters. The mean concentrations of dissolved species varied between 8% and 35% of total Fe, the lowest value was found in the turbid inshore waters.

The iron concentrations reported in the present study are much higher than the mean value (i.e 0.25 µg/l) recorded in the open Mediterranean waters (Kremling and Petersen, 1981). This is mostly due to enrichment from the Nile River and lake water inflow, the possibility for contamination by corroded hydrowires is however not excluded.

Manganese was the second abundant metal after iron, its mean total concentration varied from 1.021 µg/l in coastal waterst to 0.165 µg/l at offshore stations. Like Fe, Mn was mostly present in the particulate form The ratio of dissolved to total Mn varied from 6.80% in the inshore waters of the eastern region to 47.30% in the offshore waters. Both Fe and Mn showed nearly the same pattern of distribution (Fig.5) and a positive correlation (r = 0.68) was found between their particulate concentrations.

$$Mn = -11.35 + 22.98 \quad Fe$$
$$As = 28.746 + 0.33 \quad Mn$$
$$Cd = 15.345 + 0.003 \quad Mn$$

It is to be noted that, the mean and range of Mn concentrations found in the present study are in good agreement with the results given by

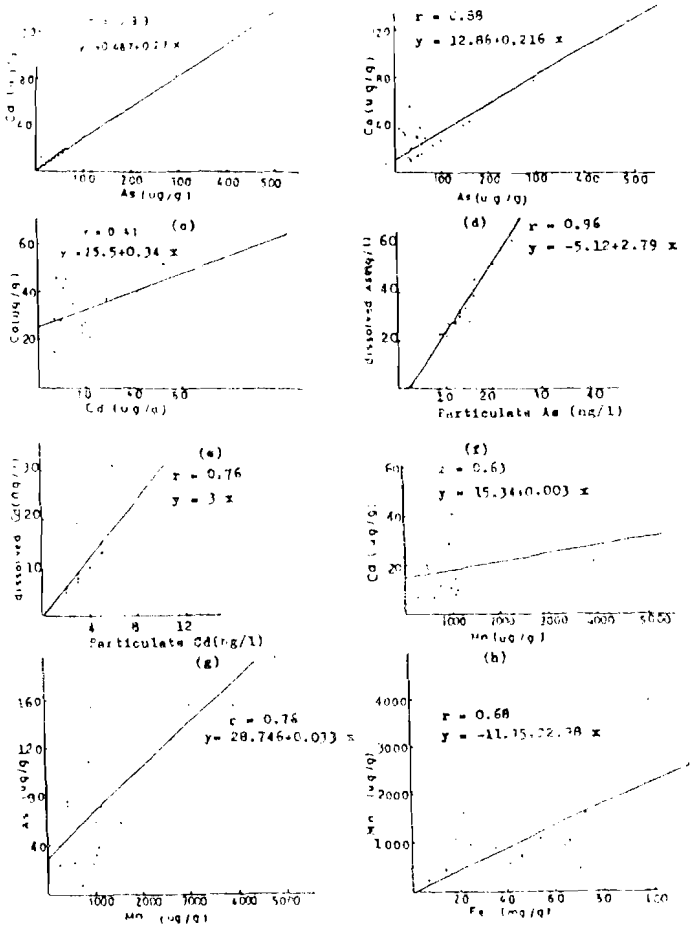

Fig. (5)
Correlation between different metals
in the studied area.

Kremling and Petersen (1981) for the open Mediterranean waters off the Egyptian coast (0.48-1.22 µg/l). However, contrary to our results Kremling and Petersen found in the open Mediterranean waters most Mn is present in true solution.

In the present study the percent of dissolved Mn increases from inshore to offshore waters and the increase was directly correlated with the decrease in TPM. Kremling and Petersen (1981) beleived that the high Mn concentration off the Egyptian coast is mostly due to its remobilization from deposits of river-borne detritus. However, our results indicate that the high concentrations of most trace metals in the coastal area are mostly of allochthonus origin caused by the discharge of large quantities of brackish waters from the northern Delta lakes. The mean concentrations of trace metals in µg/l at the lake sea outlet of Lake Manzalah were Cd, 0.4; Co,0.74; Mn, 21.0; and Fe, 950.0 (Dowidar and Abdel Moati 1984 in press)

These metals occur in the adjoining Mediterranean waters in exactly the same order of abundance but with much smaller concentrations. In comparison with other Mediterranean regions (Bernhard, 1978 and Kremling and Petersen, 1981), it is obvious that, except for the high Fe values, the levels of conentrations of trace metals in the study area are within the order of magnitude usually encountered in normal unpolluted waters.

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