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PETROLEUM HYDROCARBON CONCENTRATION IN SURFACE SEDIMENTS IN CONTINENTAL SHELF REGION ALONG THE CENTRAL WEST COAST OF INDIA

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ABSTRACT

Levels of petroleum hydrocarbons in surface sediments at twenty locations from continental shelf along the Central West Coast of India varied in 0.01-0.20 $\mu\text{g g}^{-1}$ (wet wt., chrysene equivalents) range. High concentrations were observed at stations 1, 19 and 20 around Bombay. In spite of heavy inputs through domestic and industrial wastewater, marine operations and atmospheric fallout; no serious buildup of petroleum hydrocarbons was observed in the sediments.

INTRODUCTION

Continental shelf region along the Central West Coast of India is being exploited for crude oil since 1976. Leakages, accidents, spillage, etc. during production of 21.6 million tonnes per year and its transportation and tanker traffic may contribute substantially to the oil pollution of the region (Clark and MacLeod, 1977; Bhosle et al., 1983; Sood and Raju, 1984; NAS, 1985; Qasim and Sen Gupta, 1988). Secondary sources such as domestic wastewater from 15.2 million population living along 720 km long coastline and effluent discharges from refineries, petrochemical processing units and other industries along 30,400 sq.km coastal zone also may be adding petroleum contamination in the marine environment (Clark and MacLeod, 1977; NAS, 1985; Qasim and Sen Gupta, 1988; DES, 1988). Surface sediments are known to be the sink to these pollutants which may be adversely affecting the marine ecosystem (Nelson-Smith, 1972; Blumer and Sass, 1972; Laws, 1981; McIntyre, 1988). The contamination in the sediment may be an indicator of petroleum hydrocarbon pollution of the ecosystem (Wakeham and Carpenter, 1976). Therefore it was decided to determine the levels of petroleum hydrocarbons in surface sediments in the region.

MATERIALS AND METHODS

Surface sediment samples were collected from Stn 1 to 20 (Fig. 1) during the 48th cruise of ORV Sagarkanya (Dec. 1988-Jan. 1989) using Van veer grab and deep frozen until analysis. Samples were processed by

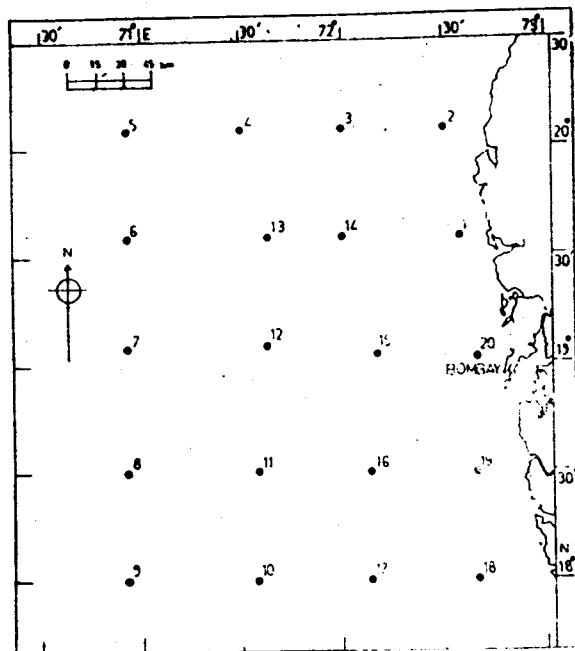


Fig. 1 -- Map showing sampling locations.

following standard procedure (UNESCO, 1982). They were digested in KOH-methanol mixture and column chromatographed using hexane, hexane-dichloromethane and dichloromethane solvent systems. The fluorescence of fractions was measured at 360 nm (excitation at 310 nm) on Perkin Elmer LS 3B (Fluorescence Spectrophotometer using chrysene as the standard. The details are mentioned in Table 1. All values are given on wet weight basis and chrysene equivalent units.

RESULTS AND DISCUSSION

Petroleum hydrocarbon concentrations (PHC)s as chrysene equivalent units in sediments at twenty locations from continental shelf region along the Central West Coast of India varied in 0.01-0.2 $\mu\text{g g}^{-1}$ range with an average of 0.06 $\mu\text{g g}^{-1}$ (Table 1). The range and average of PHC values at Stn 1, 2 and 18-20 located near the coast were 0.03-0.20 $\mu\text{g g}^{-1}$ and 0.11, $\mu\text{g g}^{-1}$ respectively. The concentrations at other locations appeared to be uniform (Table 1). No data of sediment contamination is available for this region for comparison. Qasim and Sen Gupta (1988) have reported that concentrations of petroleum hydrocarbons in surface sediments in nearshore area of Bombay High oil fields were 4-32 $\mu\text{g g}^{-1}$ (dry wt.). They have not mentioned the standard and the methodology used in the studies. The concentrations are more near the coast and independent of the inputs which might have originated from marine operations. Distribution of PHC in surface water at the same locations has been reported by Kadam and Rokade

Table 1: Distribution of petroleum hydrocarbon concentration (PHC) in surface sediments and water.

Station	Location		Petroleum Hydrocarbon concentration (PHC) as chrysene equivalents.	
	Lat.	Long.	Sediments $\mu\text{g g}^{-1}$ (wet wt.)	Water $\mu\text{g ml}^{-1}$
1	19°35'	72°35'	0.13	0.01
2	20°05'	72°30'	0.08	0.01
3	20°05'	72°00'	0.02	0.01
4	20°05'	71°30'	0.02	ND
5	20°05'	70°55'	0.03	0.01
6	19°35'	70°55'	0.07	0.01
7	19°05'	70°55'	0.02	0.01
8	18°30'	70°55'	0.03	0.01
9	18°00'	70°55'	0.02	0.01
10	18°00'	71°35'	0.01	0.01
11	18°30'	71°35'	0.03	0.02
12	19°06'	71°37'	0.09	0.01
13	19°35'	71°38'	0.04	0.02
14	19°35'	72°00'	0.08	0.01
15	19°03'	72°10'	0.05	0.01
16	19°30'	72°08'	0.05	0.01
17	18°00'	72°08'	0.03	0.02
18	18°00'	72°40'	0.03	0.02
19	18°30'	72°40'	0.20	0.01
20	19°00'	72°40'	0.10	0.02

(1990). The values of concentrations have been mentioned in Table 1 for comparison. In spite of heavy coastal inputs, offshore oil production, other marine operations and atmospheric fallout; no serious buildup of petroleum hydrocarbons was observed in the region.

Higher concentrations observed at Stn 1, 19 and 20 which are located around Bombay may be attributed to the inputs through domestic wastewater and industrial effluents ($1.8 \times 10^6 \text{ m}^3/\text{day}$ and $5 \times 10^5 \text{ m}^3/\text{day}$ respectively), harbour activities and atmospheric fallout (NAS, 1985; McIntyre, 1988; Zingde, 1989). It seems that number of factors may be responsible for these minor contaminations in surface sediments recorded for this region. The contaminants may be getting settled in muddy bottoms at nearshore region. Rokade et al. (1989) have reported that high contamination of aliphatic hydrocarbons in surface sediments near a refinery outfall and in Bombay Harbour might be due to settling of petroleum residue in muddy bottom in shallow water zone. Discharges through Bassein, Versova, Mahim and Thana Creeks which are situated around Bombay carry high suspended particulate matter which may be adsorbing consid-

erable amount of the pollutants and sinking them (Parker and Macko, 1978; Jordan and Payne, 1980; MARPOL, 1989). Most of the petroleum residue being light are accommodated in surface water layer. The currents in the sea in offshore direction during Sept-May may be carrying them away from the coastal region before their settling at the bottom (Gouveia and Kurup, 1977).

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