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# Petroleum Hydrocarbon Levels Near Offshore Water of Libya

By

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## Abstract

*Petroleum hydrocarbon levels in the offshore area of Libya have been determined during the years 1986 and 1989 by spectrofluorometeyr. The concentrations ranged from 4.1 to 77.6 ug/1. The observed data were compared with values reported in the literature . The possible source of pollution was also identified by using gas chromatographic analysis of the samples.*

## Introduction

Marine pollutin due to petroleum hydrocarbons is of paramount importance to Libya since it is situated with vast extended coasts associated with abundant activities related to petroleum industry. Pollution by oil may arise in the marine environment either accidentally or operationally whenever oil is produced, transported, stored, processed or used at sea or land. The major sources of input of petroleum hydrocarbons are ballasting/deballasting operations of tankers, refinery efluents, discarded lubricants and other oils, accidents and offshore exploration and exploitation. The types of pollutants encountered near offshore are crude oil, lubricating oils and oil mixtures (Butt et al, 1986). The ultimate fate of discharged hydrocarbons in sea depends on various oceanographic, metereologic, physical and biological factors such as spreading, drifting, evaporation, dissolution, emulsification, photooxidation, sedimentation and biodegradation etc. (Geyer, 1980). The toxic effects of petroleum hydrocarbons released to sea on marine life and in turn to human health are well documented, Neff and Anderson (1981) Elark, (1982) and Davies et al (1984). One of the possible sources of petroleum hydrocarbon inputs into Mediterranean Sea is El-Bouri field offshore operations which is situated about 120 km north of Sabrata, Libya and necessiates periodical monitoring of petroleun hydrocarbons near and around this area.

In the present paper the data from the monitoring studies of hydrocarbons during last four years are described, discussed and compared with that of other values reported near offshore in the literature.

## Sampling Procedures and Methods of Ananlysis

The sampling locations and areas are shown in Fig. 1. Sea samles of 2.0 l from these locations were collected in amber coloured bottles containing 50 ml of carbon tetrachloride by following the standard procedures, IOC/WMO/UNEP/MED-MRM Supp 2 (1977).

As soon as the samples were collected, they were immediately shaken vigorously to disperse carbon tetrachloride completely and then left to settle down in a separating funnel for half an hour. Further, the extraction was similarly repeated by using several portions of carbon tetrachloride. All the extracts of carbon tetrachloride portions were pooled together and left over-night in the presence of anhydrous sodium sulphate to remove traces of water. These extracts were evaporated to dryness at 60 °C using rotary evaporator under suction (0.4-0.6 bar) and then these dried samples were dissolved in n-haxane to make the total volume to 10 ml. After that the samples were analysed for total hydrocarbon contents by using a spectrofluorometer at 360 nm (excitation at 310 nm).

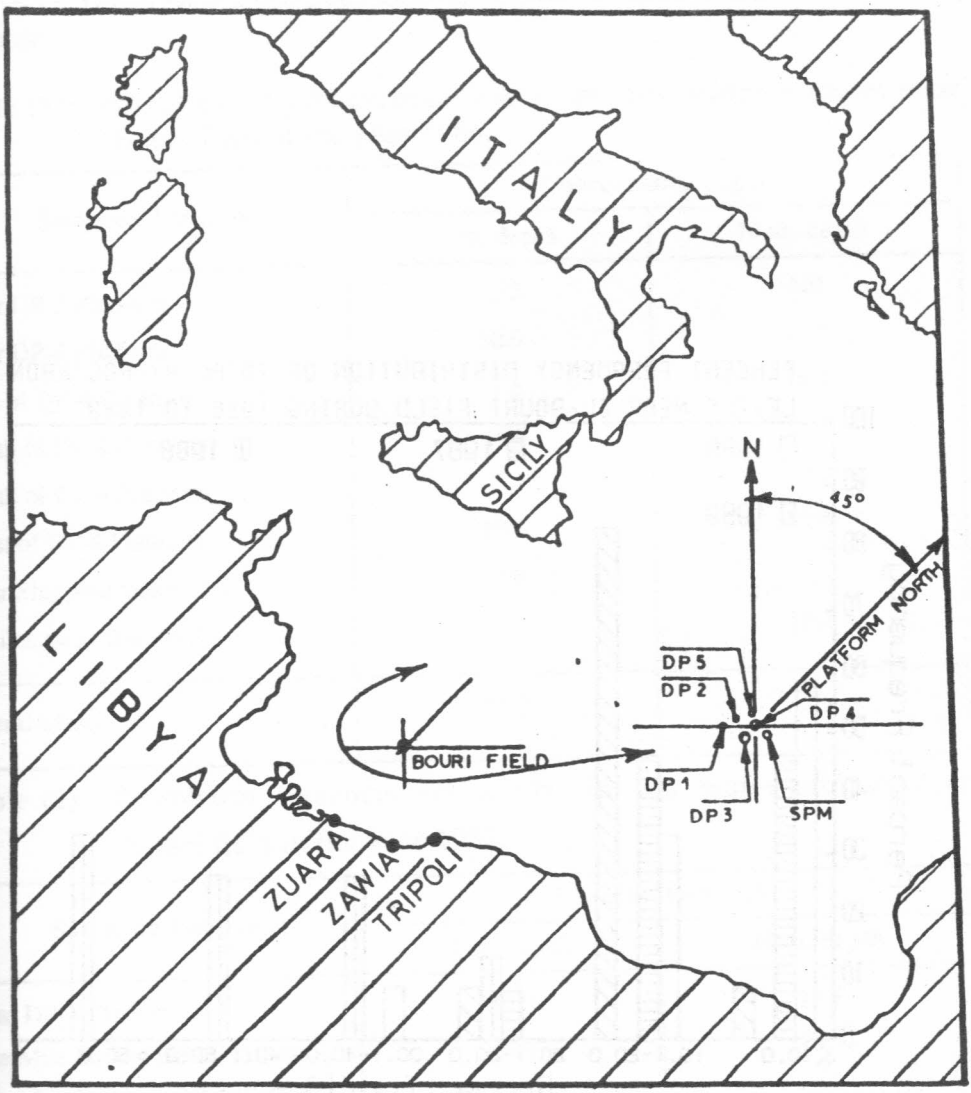
The samples were also analysed by using gas chromatographic technique for n-hydrocarbon composition under the following conditions: the instrument GC used was Packard 419 with flame ionization detector attached with micro-processor integrator. The column used was 10 m long and packed with WCOT fused silica and CP-Sil-5CB. Nitrogen was used as carrier gas (1 ml/min). The temperature of the detector was held at 260°C. A sample of 0.2 ul was injected and the chromatogram recorded. The peaks of the chromatogram were indentified by comaparing their retention time with that of the authentic sample of normal paraffins under the same conditions.

## Results and Discussion

The petroleum hydrocarbon levels measured during the last four years are presented in Tables 1-4. The values ranged from 4.1 to 30.9, 3.2 to 29.8, 26.9 to 70.6 and 9.1 to 20.0 ug/l for the years 1986, 1987, 1988 and 1989 respectively. The overall mean values were observed to be 11.2, 12.7, 45.6 and 16.6 ug/l for the above mentioned periods. Though there is considerable variation in the reported values (Table 5), the mean values noted for the years 1986 and 1989 at El-Bouri field are comparable with that of some levels for Southern part of Mediterranean sea while the overall mean value of 45.6 ug/l for 1987 is much below than the values observed at northern part in the same area in the year 1973 (7).

The comparison of percent frequency distribution of the concentrations is shown in Fig. 1. It is seen from the figure that in 1986 more than 50% of values were falling in class ≤ 10.0 ug/l with distribution being skewed to the left, whereas in the year 1988 the values were distributed mostly in higher classes (> 30.0 ug/l) with skewed distribution to the right suggesting more offshore activity which coincides with initial production time of the oil wells. However, the levels were reduced by the year 1989 where the distribution was normal with most of the values (above 80%) falling in the class 10.1-20.0 ug/l. The distribution of values for 1987 was similar to that of 1986.

In order to identify the possible source of pollution for the above samples they were subjected to gas chromatographic analysis and the trends of n-paraffin concentrations were compared with that of some crude oils of different origin and gas oil by using correlation analysis (8). The correlation coefficients are presented in Tables 6 and 7. It is




CO-ORDINATES (EXPRESSED IN THE HAYFORD SPHEROID)

DP 3 PLATFORM:
Latitude: 33°53'39.079''
Longitude:12°28'23.738''

DP 4 PLATFORM:
Latitude: 33°55'23.188''
Longitude:12°40'51.096''

Fig. (1)

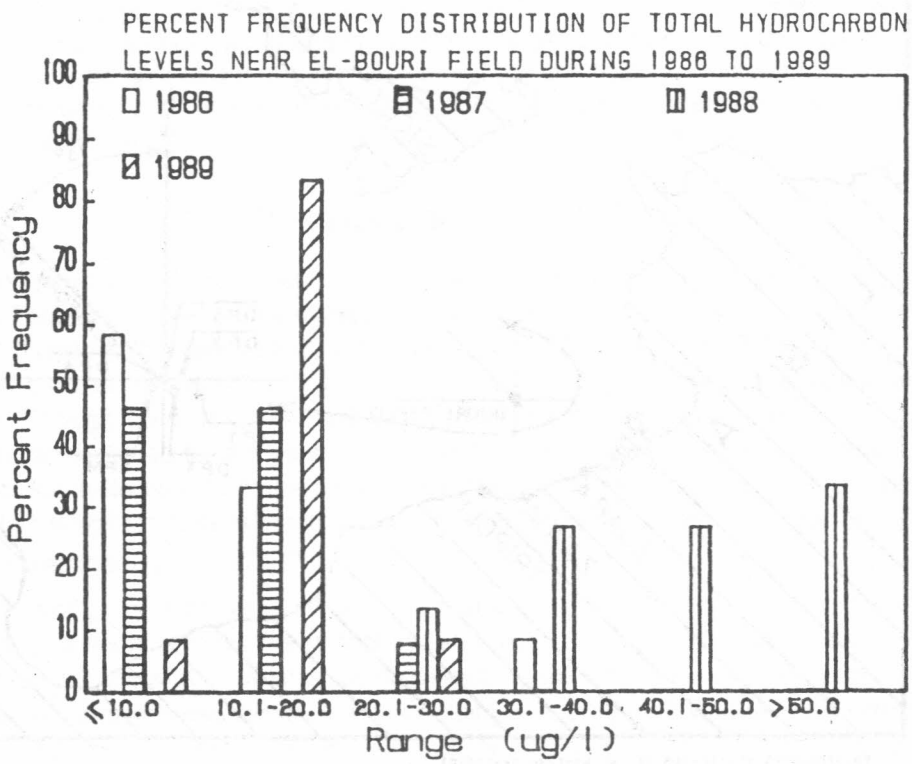

PERCENT FREQUENCY DISTRIBUTION OF TOTAL HYDROCARBON
LEVELS NEAR EL-BOURI FIELD DURING 1986 TO 1989
1986
1987
1988
1989
Percent Frequency
100
90
80
70
60
50
40
30
20
10
0
≤10.0
10.1-20.0
20.1-30.0
30.1-40.0
40.1-50.0
>50.0
Range (ug/l)

Fig. (2)

evident from the tables that highest correlation was observed between sample collected in 1986 and gas oil suggesting that the source of contamination during this period might be from gas oil. While for the samples procured in 1988 the best correlation was observed between Bouri crude oil suggesting the possible spills during initial periods of production.

**Table (1): Petroleum hydrocarbon levels in sea water samples near Bouri field in the year 1986.**

| Sampling Location | Concenration (ug/l) | |
|---|---|---|
| | 1 m. depth | 10 m. depth |
| Near DP-3 Platform | 6.2 | Nil |
| Near DP-4 Platform | 30.9 | 17.2 |
| East of DP-4 Platform | 7.8 | 18.4 |
| South of DP-4 Platform | 4.1 | – |
| North of DP-4 Platform | 5.1 | 3.2 |
| West of DP-4 Platform | 19.4 | 3.6 |
| Near Shipping tanks | 4.8 | – |
| 2 miles away from tanks | – | 10.4 |
| Overal Mean | 11.2 | 8.8 |

**Table (2): Petroleum hydrocarbon levels in sea water samples near Bouri field in the year 1987.**

| Sampling Location | Concenration (ug/l) | |
|---|---|---|
| | 1 m. depth | 10 m. depth |
| Near DP-4 Platform | 16.0 | 10.9 |
| One Mile East to DP-4 Platform | 29.8 | 18.3 |
| One Mile North to DP-4 Platform | 5.1 | 3.2 |
| One Mile West to DP-4 Platform | 19.0 | 3.6 |
| One Mile South to DP-4 Platform | 7.8 | 17.8 |
| Near DP-3 Platform | 6.2 | – |
| Near Shipping tankers | 4.8 | 10.4 |
| Overall Mean | 12.7 | 10.7 |

**Table (3): Petroleum hydrocarbon levels in sea water samples near Bouri field in the year 1988.**

| Sampling Location | Concenration (ug/l) | |
|---|---|---|
| | 1 m. depth | 10 m. depth |
| Near DP-4 Platform | 31.6 | – |
| One Mile from DP-4 Platform | 33.7 | 26.9 |
| Two Miles from DP-4 Platform | 62.1 | – |
| Three Miles from DP-4 Platform | 64.7 | – |
| Near DP-3 Platform | 32.2 | 42.0 |
| Two Miles North to DP-3 Platform | 20.8 | 51.8 |
| One & half Miles North to DP-3 Platform | 44.0 | – |
| Half Mile North to DP-3 Platform | 49.2 | – |
| Half Mile South to DP-3 Platform | 38.9 | – |
| One & half Miles South to DP-3 Platform | 46.6 | 69.0 |
| Two Miles South to DP-3 Platform | 77.6 | |
| Overall Mean | 45.6 | 47.7 |

**Table (4): Petroleum hydrocarbon levels in sea water samples near Bouri field in the year 1989.**

| Sampling Location | Concenration (ug/l) | |
|---|---|---|
| | 1 m. depth | 10 m. depth |
| Near DP-4 Platform | 20.0 | 11.9 |
| One & half Miles from DP-4 Platform | 12.6 | 14.9 |
| Near Shipping tanks | 15.0 | 15.0 |
| One & half Miles from DP-3 Platform | 19.1 | 9.1 |
| Near DP-3 Platform | 13.8 | 14.8 |
| One & half Miles S.E from DP-3 | 19.3 | 21.7 |
| Overall Mean | 16.6 | 14.6 |

**Table (5): Comparison of some reported petroleum hydrocarbon levels for offshore with that of El-Bouri field values.**

| Region & Location | Mean / Range (ug/l) | Type of Sample | Year |
|---|---|---|---|
| Western Mediterranean | | | |
| Northern Part | 448.0 | Surface | 1973 |
| | 15.0 | 10 m. depth | 1973 |
| | 3.3 | Surface | 1975-77 |
| | 1.5-21.1 | Surface | 1981 |
| | 3.5-4.6 | Surface | 1981 |
| | 1.9 | Surface | 1983 |
| Central Part | 0.3 | Surface | 1981 |
| | 0.7 | Surface | 1983 |
| | 1.4 | Surface | 1983 |
| Southern Part | 8.5 | Surface | 1973 |
| | 2.7 | 10 m. depth | 1973 |
| | 6.9 | Surface | 1974-75 |
| | 17.5 | Surface | 1975 |
| | 0.7-0.2 | Surface | 1981 |
| | 1.2 | Surface | 1983 |
| Alboran Sea | 7.9 | Surface | 1974-75 |
| | 0.2 | Surface | 1981 |
| Tyrrhenean Sea | 180.0 | Surface | 1973 |
| | 7.0 | Surface | 1973 |
| | 4.8 | 10 m. depth | 1974-75 |
| | 7.4 | Surface | 1975-77 |
| Near El-Bouri field | 11.2 | Surface | 1986 |
| | 12.7 | Surface | 1987 |
| | 45.6 | Surface | 1988 |
| | 16.6 | Surface | 1989 |

Source: UNEP 87 (ref. 7).

**Table (6): Correlation coefficients and levels of significance for hydrocarbon composition of samples collected in 1986 near El Bouri field versus gas oil and some crude oil samples.**

| Suspected Source | El Bouri field Sample | |
|---|---|---|
| | Correlation Coefficient (r) | Level of Significance (p) |
| Gas oil | 0.959 | < 0.001 |
| Bouri crude oil | 0.512 | < 0.100 |
| Hamada crude oil | 0.402 | N.S |
| NC-100 | 0.389 | N.S |
| Sarir crude oil | 0.139 | N.S |

**Table (7): Correlation coefficients and levels of significance for hydrocarbon composition between samples collected in 1987 near various locations at El Bouri field and Bouri crude oil.**

| Samples at El Bouri field | Bouri crude oil | |
|---|---|---|
| | Correlation Coefficient (r) | Level of Significance (p) |
| S1 | 0.414 | N.S |
| S2 | 0.921 | < 0.010 |
| S3 | 0.599 | < 0.020 |
| S4 | 0.300 | N.S |
| S5 | 0.424 | N.S |
| S6 | 0.167 | N.S |
| S7 | 0.209 | N.S |

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