

Research Article

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Distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in Surface Sediments from Red Sea Coast of Yemen

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ABSTRACT

Field work has been carried out to identify the occurrence of oil and oil by-product pollution along the Red Sea Coast of Yemen. The total concentration of Polycyclic Aromatic Hydrocarbons (PAHs) in sediment samples ranged from 33.7ug/g at Rass-Issa to 5.23ug/g dry wt.at Al-Mukha. This pollution is a consequence of localized oil operation and /or heavy ship traffic.

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Introduction

The widespread of oil pollution in the Red Sea is not surprising [1, 2]. Although enough data are not available for the Red Sea, probably the pattern may be similar to that of the Arabian Gulf, which suggests that the impacts from tanker and ship traffic are most important [3]. It is important to make a distinction between chronic and catastrophic oil pollution. Chronic refers to long-term but constant low level seepage of oil into the marine environment from shipping, deballasting, etc, and may not be immediately apparent. Catastrophic events refer specifically to accidental oil spills which may contaminate either open oceans or coastal shores. A recent paper [4], follows the level of oil pollution in the Arabian Gulf after the catastrophic spills associated with the Gulf War. They noted an interesting result that concentrations of petroleum hydrocarbon in sediments and bivalve molluscs were actually lower in 1991 than those recorded from the pre-war (1983-1986) survey at the same sites. They attribute this to decreased tanker traffic and associated deballasting (i.e. chronic pollution) during and after the conflict. Nevertheless evidence suggests that oil pollution from these sources has a far greater effect on the marine environment than accidental spills. An example of a chronic oil pollution source on the Yemen Coast is the authorized discharge of ballast water effluent of the SAFER(oil terminal) supertanker storage at Ras Isa. Similar problems occur in the Gulf of Aden with vessels deballasting at the Aden refinery. However, the problem of passing vessels deballasting in the Gulf of Aden or the Red Sea appears to be the greater cause of oil pollution in ROY (Republic of Yemen) waters. There are two power stations supplied by underwater pipelines, Ras Katherib and Al-Mocha. Both receive heavy fuel oil via pipeline. The Public Electricity Corporation informed us that frequent accident occur to the pipeline and loading hoses when tankers are subjected to strong winds [5, 6].

The over all severity of effects depends on the nature and quantity of oil spilled in conjunction with other factors such as wind speed and direction, water movements, temperature and probably also salinity. Animals at particular risk include surface swimmers and feeders, marine reptiles and marine animals, in case of oil spill. Oil pollution into the coastal area has seriously, endangered the Red Sea coastal ecosystem along the Saudi Coast [7]. The Red Sea Coast of Yemen is also expected to have been affected. A preliminary survey along the Red Sea coast of Yemen showed that oil-related pollutants concentrated in regions, especially around oil loading terminals and some industrial areas. While beach tar is widespread along Yemeni coast [8].

To the best of our knowledge, there is almost no available information's concerning the quantity and the extent of oil spills, although oil spills and oil sheens have been observed and reported several times by local fishermen and citizens along the shore line and the inter-tidal sediments. The present project is proposed to fill the lacuna in our knowledge on the present status of oil contamination in the Yemen territorial waters in the Red Sea.

Objectives

The objectives of the proposed project are to:

1. Investigate the status of oil pollution in Yemeni territorial waters in the Red Sea, including identifying the potential source/s of oil pollution in this region.
2. Make a preliminary assessment of the status of some critical habitats as a result of oil pollution including the degree of damaged caused by oil spills, thus identifying sites that require urgent protection.
3. Results obtained during the project will serve as a baseline data for further follow-up project in the region.

Material and Methods

Five samples of surficial (20 cm depth) sediments were collected on 30May-10June 2014 from 5 station (I Madi, II Rass-Issa, III Al-Hodiedah, IV Al-Taif, V Al-Mukha) Fig.1, by Smith –MacIntyre grab samples. As soon as the samples had been acquired, they were placed in glass containers and kept frozen at -10°C and analysis. The procedure used for extraction and analysis of APH in the sediments samples was performed according to conventional procedures [9]. A total 10 g of dried sediment was subjected to soxhlet method for methylene chloride and concentrated in Kudma-Danish tube. The extracts were fractionated by alumina:Silica gel (80- 100 mesh) chromatography. The extracts were sequentially eluted from the column with 50 ml of n-haxane using a calibration with Marib light crude. Blank detreminations were carried out by repeating the procedure with pre- extracted samples were dried at 40°C over night and analysed by gas chromatogaohy (HP-5890-GC and HP-5970-MSD Hewitt- Packard, in 2012.

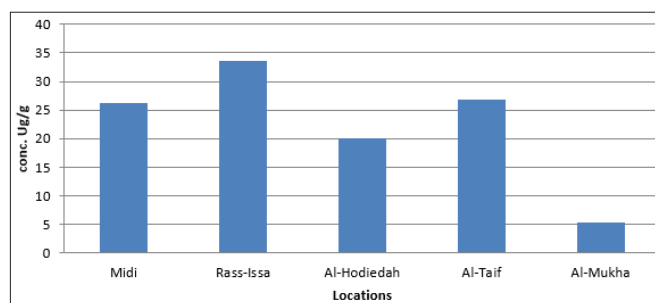
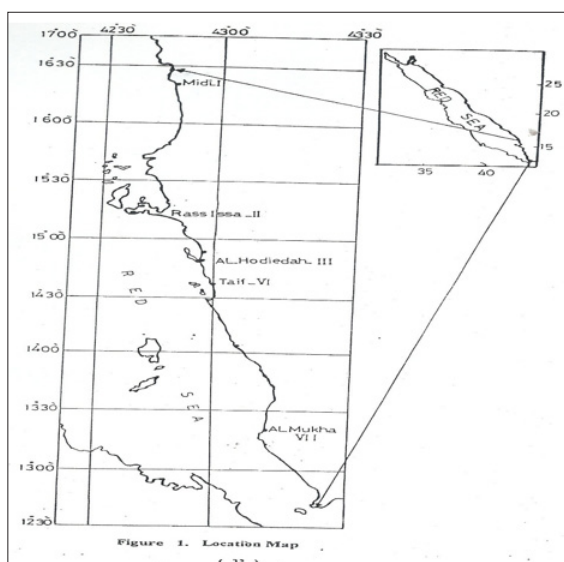


Figure 2: The Distribution of PAHs in Sediment Samples from Some Red Sea Coast - Yemen

Table 2: Comparison of Petroleum Hydrocarbons Contents in Sediments Collected from different region of the world

Area	Concentration (ug/g)	Source
Narragansett Bay (USA)	50000 - 120000	[10].
Soctia Shelf (Canada)	1000 – 94000	[11].
ST. Paul's Bay (Malta)	37800	[12].
Liverpool Bay (UK)	29000	[13].
Coast of Oman	800 – 19000	[14].
Arabian Gulf	400 – 44000	[15].
Gulf of Aden / Arabian Sea	120 – 2100	[16].
Some Coast of Red Sea - yemen	2.6 – 28.1	[17].
Coast of Aden - Yemen	9 – 45	[5].
Some Coast of Red Sea - Yemen	5.23- 33.7	Present Study

Result and Discussion

PAHs	I	II	III	IV	V
Naphthalene	13.0	20.1	9.3	17.3	0.1
Acenaph-thylene	0.8	1.2	0.6	0.7	0.4
Acenaph-thene	0.4	1.8	0.5	0.5	0.2
Fluorene	1.5	1.6	0.9	0.9	0.5
Phenanthrene	2.5	1.6	1.8	2.3	0.3
Anthra-cene	0.6	0.5	0.9	0.7	0.8
Fluoran-thene	0.9	1.4	0.8	0.6	0.2
Pyrene	0.8	0.8	0.6	0.6	0.4
Benz(a)anthra-cene	0.4	0.8	0.5	0.3	0.1
Chrysene	0.9	0.6	0.3	0.4	0.3
Benz-fluoran-thenes	0.7	0.7	0.5	0.6	0.4
Benz(e)pyrene	0.8	0.6	0.8	0.3	0.2
Benz(a)pyrene	0.7	0.3	0.7	0.4	0.3
Perylene	0.6	0.5	0.7	0.5	0.2
Indeno(1,2,3cd)pyrene	0.5	0.4	0.5	0.3	0.3
Dibenz(a,h) anthracene	0.4	0.3	0.3	0.2	0.2
Benzo(ghi)perylene	0.7	0.2	0.4	0.3	0.3
Total PAHs	26.2 ug/g	33.7 ug/g	20.1 ug/g	26.9 ug/g	5.23 ug/g

ND= Below the detection limit of 0.1ug/g dry weight sediment.

The PAH appears divisible into two groups: (1) low molecular weight PAH incorporating naphthalene, biiphenyl, and phenanthrene and anthracene, and (2) large molecular weight homologues (fluoranthene, pyrene, chrysene, benzopyrene and perylene). The concentration of PAHs in sediment samples range from 33.7ug/g at Rass-Issa to 5.23ug/g at Al-Mukha (Table, 1 and Fig., 2). It is apparently evident that all of these sites are contaminated to some extents with PAHs, this suggests that PAHs has originated from at least two different sources ; first ,from port areas ,ship traffic and second,probably from natural seep and tank-shipping operations, similar conclusions were reached by [15, 18, 19, 20, 21] the problem petroleum hydrocarbons concentrations found in sediments by other workers are compared to our data in (Table, 2) [22]. has reported that the unpolluted open ocean sediments contain 400 ug/g in coastal sediments and up to 12000 ug/g in highly polluted areas.

Conclusion

The pattern of the distribution of PAHs in the Red Sea Coast of Yemen sediments appears to be governed by its proximity to opotential oil pollution sources (port areas,ship traffic,tank-shipping oprations, etc.)

Recommendations

- These data are the first of their kind for this area and should furnish valuable information for future studies, both that they provide as the backfround values in the event of a major oil pollution incident.
- Sience oil is the major source of pollution to the Red Sea and Gulf of Aden, measure should be taken by EPC to enforce the encating Law No. (16) of 2004 regarding the protection

of marine environment from pollutions , in particular Article (12). Yemen Government is kindly requested to implement international Convention (MARPOL) concerning the protection of the marine environment from pollution in general and oil pollution in particular.

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