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Assessing of organic content in surface sediments of Suez Gulf, Egypt depending on normal alkanes, terpanes and steranes biological markers indicators

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ABSTRACT

The Semi-enclosed Suez Gulf records various signals of high anthropic pressures from surrounding regions and the industrialized Suez countries. The sedimentary hydrocarbons have been studied in 6 coastal stations located in the Gulf of Suez. Non-aromatic hydrocarbons were analyzed by GC/FID and GC/MS to assess organic content in surface sediments of Suez Gulf, Egypt depending on alkanes, terpanes and steranes biological markers indicators. The results showed that the hydrocarbons are originated from multiple terrestrial inputs, biogenic, pyrolytic. Several ratios of hydrocarbons indicated the predominance of petrogenic in combination with biogenic hydrocarbons. Al-Attaqa harbor, Suez oil processing company, Al-Nasr Oil Company, AL-Kabanon and EL-Sukhna of Loloha Beach are the main sources of petroleum contamination.

1. Introduction

The Suez Canal is located in northeast Egypt entrance of Red sea and is limited by latitudes 29° 54′ and 29° 57′N, and longitudes 32° 28′and 32° 34′ E, and extends from Port Said in the north and port Tawfiq in the South with overall length of about 162 km with water depth of about 22.5 m [1]. The area of study comprises the important parts of Suez Canal, which includes Suez harbor, Suez oil processing company (SOPC), Al-Nasr oil company (NPC), Attaqa Electrical station, Fertilizer factory, and beaches in Ismailia city (Fig. 1). The major oil refineries and many other manufacturing industries are gathered in Suez city. Thus, the sediment contamination in this area is a sensible model site. Hydrocarbons come from various origins: ship traffic, fisheries activities, revering inputs, and inputs associated with municipal and industrial sewage waters, especially from storage of crude oil and phosphogypsum at the coast.

The objectives of the present study are: (i) determine the occurrence, distribution and source of *n*-alkane, steranes and terpanes in surface sediments in some parts of the Gulf, (ii) examine the distribution, composition, and relative maturity levels of hydrocarbons in the sediments, and (iii) identify possible sources contamination in the non-aromatic hydrocarbon, (iii) provides data on hydrocarbon contamination of sediments collected in the Suez Gulf. This achieved throughout the analysis of Non-aromatic hydrocarbons by gas chromatography (GC) and gas cgromatography–mass spectrometry (GC/MS). This fraction constitutes the predominant part of crude oils. It contains various hydrocarbons such as *n*-alkanes, isoprenoids, terpanes and steranes which distributions permit to assess the various origins of hydrocarbons.

This study can be seen as a complement of the work already conducted along Suez Gulf. At present, hydrocarbons are naturally occurring compounds and one of the important components of sedimentary organic matter in marine coastal environments. They are formed by biological or digenetic processes (biogenic) and occur at very low concentrations in sediments and their natural composition and distributions in sediments can be altered by various human activities such as accidental oil spills, and industrial and domestic discharges [2].

2. Materials and methods

1. Total of 6 Surface sediment samples were selected to cover about 18.7 km from Suez Gulf coast (Fig. 1). Sediments were collected utilizing a stainless-steel grab. Six grabs were taken from each location from which the top (0–2 cm) were scraped

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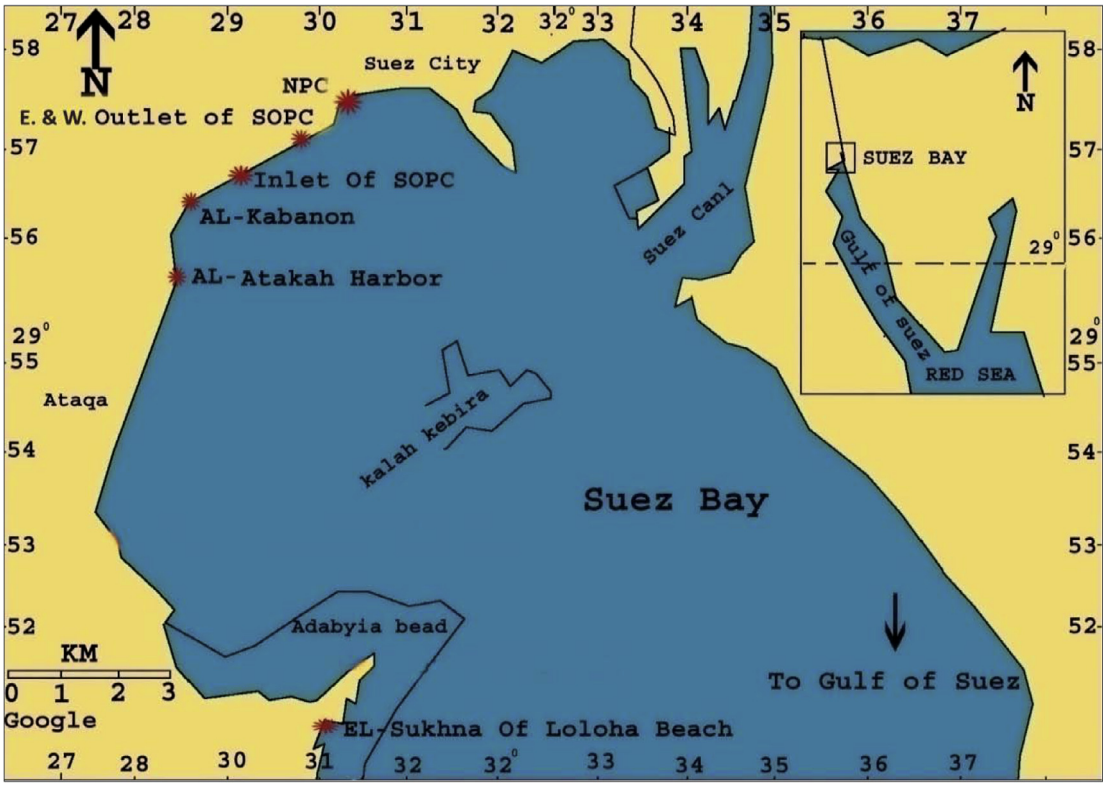

Fig. 1. Map showing the area of study along Suez Gulf shoreline, Egypt.

off using a stainless steel spatula and then scooped into pre-cleaned wide-mouth glass bottles, frozen and transported to the laboratory and stored at −20 °C until analysis. The samples were analyzed for aliphatic hydrocarbons following well established techniques [3]. About 8–100 g of each sample were taken and weighted in an aluminum dish and oven-dried at 105°C to a constant weight to obtain percentage water content for each sample. Studied sites, their locations, activities and distances from the outlet of Suez Oil Petroleum Company (SOPC) are listed in Table 1.

2. Hydrocarbons were extracted from dried sediments (about 8–100 g accurately weighed) by direct saponification via alkaline hydrolysis. Samples were heated under reflux for 2 h in a mixture of 0.5 N KOH in 95% methanol. After filtration on a glass fiber filter and separation, the aqueous phase was extracted with 3–50 mL of *n.* hexane. All *n.* hexane phases containing hydrocarbon compounds were combined dried on anhydrous sodium sulphate, evaporated to a residue and weighed to obtain the total extractable organic matter (EOM).

All the EOM were separated by Micro glass columns 10 cm length and 0.8 mm diameter, filled with activated silica using a three-step scheme providing 3 fractions, saturates; elution with hexane; aromatics, elution with benzene; polar compounds, elution with methylene chloride. Saturated hydrocarbon fractions were subjected to capillary gas chromatography.

The instrument used was Agilent Technologies 7890 gas chromatograph system, equipped with flame ionization detector (FID). Oven temperature was programmed from 100 °C to 300 °C at fixed rate of 3 °C min-1. HP-1 fused silica capillary column (60 m × 0.53 mm × 0.5 μm). The biomarker traces using Perkin Elmer Claruss 500 GC-MS apparatus. Samples were injected onto a fused silica capillary column (30 m in length, 0.32 mm id, film thickness 0.25 μm) coated with HP-5 MS. Helium was the carrier gas with flow rate of 1.5 ml/min. and temperature was programmed from 80 °C to 310 °C at rate of 3 °C/min. The identification of biomarker is obtained through the relative triterpanes and steranes abundance was calculated using the integrated peak areas for the relevant ion *m*/*z* 191 and *m*/*z* 217 chromatograms. These analyses were carried out in the Laborites of the Egyptian Petroleum Research Institute.

Table 1
Studied sites, their locations, activities and distances from the outlet of Suez Oil Petroleum Company (SOPC).

Sit. No.	Location	Activities	Distance
1	AL-Nasr Petroleum Company (NPC)	Petroleum refinery of the crude oil	700 m
2	East the Outlet of Suez Oil Petroleum Company (SOPC)	Wastes of conversion operations of crude oil to refined products along the outlet of petroleum	50 m
3	West the Outlet of Suez Oil Petroleum Company (SOPC)	drainage of Suez Company	300 m
4	Inlet of Suez Oil Petroleum Company (SOPC)	The petroleum company takes water from Suez bay and mixed it with fresh water to utilize in washing the crude oil	1,067 km
5	AL-Kabanon	Mixed sources of pollution (industrial agricultural and domestic sewage)	2300 m
6	AL-Atka Harbor	Loading and un-loading of ships, Producing lubricants oil and sewage wastes, receive fishing ship and fishing boat	3500 m
7	EL-Sukhna of Loloha Beach	Recreational	18,7 km

km: kilometer's.

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