Hydrocarbons and trace elements in the waters and sediments of the marshland of southern Iraq

Article · January 2009

CITATIONS
4

READS
31

4 authors, including:

Hamid T. Al-Saad
University of Basrah
184 PUBLICATIONS **428** CITATIONS
SEE PROFILE

Ali Douabul
University of Basrah
76 PUBLICATIONS **698** CITATIONS
SEE PROFILE

Mesop. J. Mar. Sci., 2009, 24 (2): 126 - 139

Hydrocarbons and trace elements in the waters and sediments of the marshland of southern Iraq

H.T. Al-Saad, S.M. Al-Taein, M.A.R. Al-Hello and A.A.Z. DouAbul
Marine Environmental Chemistry Department, Marine Science Centre
University of Basrah, Iraq

Abstract The levels of petroleum hydrocarbons and trace elements were determined in the water and sediment samples from different locations in the marshland of southern Iraq. The Mean concentrations of TPH in the waters ranged from 0.012 µg/l at Al-Barkha to 0.037 µg/l at Al-Baghdadia 1, while in the sediment samples the mean values ranged from 0.030 ug/g at Um-Alneach to 0.96 µg/g dry weight at Al-Baghdadia 2. Distribution of trace elements in water and in sediment showed variations in concentration with sampling site. The mean values of the elements in the water were : 1.13-3.68 for Co, 0.16-1.37 for Mn, 0.66-2.37 for Ni, 0.28-1.51 for Fe and 0.10-0.28 mg/l for Cu, while in sediments the mean range were: 39.25-88.0 for Co, 408.6-506.3 for Mn, 52.2-90.3 for Ni, 6923-9910 for Fe and 16.36-38.30 µg/g dry weight for Cu. Grain size analysis and Total Organic Carbon (TOC) also determined in these samples. All the levels of both hydrocarbons and trace elements in the water and sediment samples were low, indicating minimum pollution in these areas. Concetrations of these pollutants could be due to natural and anthropogenic sources. These concentrations are within the range values reported for other comparable regions.

Introduction

The land to sea transfer of organic pollutant is a major topic in environmental marine chemistry that still has many fundamental aspects to be elucidated. The study of coastal and open sea and sediments has often provided important clues for a better understanding of budget, transport routes and biochemical cycles. The sediment afford an integrated picture of the hydrophobic pollutant arriving at the water column, and their trace organic composition is more constant than in other environmental compartments such as air and water, or even organism. However, the trace organic composition of the aquatic sediment depends on numerous physical, chemical and biological processes that are particularly important in the river-marine exchange system of coastal area. These processes tend to modify the sedimentary composition in different ways, generally increasing the dispersion of concentrations of organic pollutants (Grimalt *et al.*, 1992).

For at least two reasons, pollution can be consider as the main, most widespread, and most dangerous factor of anthropogenic impact on the hydrosphere. First, pollution accompanies most kinds of human activities, including offshore oil and gas production and marine oil transportation. Second, in contrast with land ecosystems, in the water environment, pollutants quickly spread over large distances from the sources of pollution. In the freshwater and inland ecosystems, the effect of pollution is obvious. Among all the diversity of human activities and sources of pollution, pollutants enter the marine environment by three ways (GESAMP, 1993):

- Direct discharge of effluents and solid wastes into the seas and oceans (industrial discharge, municipal waste discharge, coastal sewage and others).
- land runoff into the coastal zone, mainly by rivers,
- Atmospheric fallout of pollutants transferred by the air mass onto the seas' surface.

Certainly, the relative contribution of each of these channels into the combined pollution input into the sea will be different for different substances and in different situations. Quantitative estimates of these processes are difficult because of the lack of reliable data and the extreme complexity of the natural processes, especially at the sea-land and sea-atmosphere boundaries.

For a number of pollutants (metals, nitrates, phosphates, oil and some other hydrocarbons), this task is even more complicated. They are distributed in the marine environment in the background of natural biogeochemical cycles of the same substances. There are numerous examples when extremely high concentrations of oil and gas hydrocarbons, heavy metals, radionuclide, nutrients and suspended substances are not connected with human activity at all. It can happen as a result of such natural processes as volcanic activity, oil and gas seepage on the bottom, splits and breaks of the earth's crust, algae blooms, mud flows, river flooding and many others. These phenomena should be taken into consideration in order to get the objective assessment of anthropogenic impact and its consequences in the hydrosphere (Patin, 2006).

Recognizing these complications explains why many earlier conclusions about the levels, flows and balance of many substances in the hydrosphere are currently under revision. Developing new approaches and more precise analytical methods to determine trace amounts of contaminants allowed to get more reliable estimates of the contribution of different channels into the total contamination of the marine environment. The data show that land-based and atmospheric sources account for about two-thirds of the total input of contaminants into the marine environment, constituting 44% and 33%, respectively. Main pollutants fall on the shelf zones and especially on the coastal areas (Alagarsamy and Zhang, 2005).

Iraqi southern marshes form large triangular region bounded by three major southern cities: Nasiriyah to the west, Amarah to the northeast and Basrah to the south. Their vast area covers 20,000 square kilometers of open water, and includes both permanent and seasonal marshes. Three major areas are Al-Hammar, the Central and the Al-Hawizeh Marshes form the core of the marsh land of southern Iraq. Such specific wetlands of the southern part of Iraq play a vital role in the maintenance of biodiversity in the Middle East, primarily because of their large size, the richness of their aquatic vegetation and their isolation from other comparable system (Bedair *et al.*, 2006).

Despite of much information on trace metals and hydrocarbons in different kind of natural water and sediment, information on quality and distribution of hydrocarbons and trace metals in water and sediment of all the marshes of southern Iraq is scarce. This paper gives a light on the source and distribution of both hydrocarbons and trace metals in water and sediment samples of the Mesopotamian marshlands after their rehabilitation.

Materials and Methods

Water and sediment samples were collected during 2006. This study was carried out involving 6 fixed stations as shown in Fig. 1: Four stations at Hor Al-Hammar marsh (Al-Barka, Al-Nakara and Al-Baghdadia 1 and 2), and the other two locations at Hor Al-Hwaaiza (Um Al-Warad and Um Al-Neiach). Large samples of water (20 l) were collected from each station, with a clean amber-glass bottle of 5 liters capacity. Hydrocarbons in water were solvent extracted following the procedure of UNESCO (1976). For this, 100 ml of Nani grade carbon tetrachloride (CCL4) were used in two successive 50 ml extractions and the extracts were combined. The mixture was vigorously shaken to disperse the CCL4 thoroughly throughout the water samples. Shaking was repeated several times before decanting the CCL4. To these extract a small amount of anhydrous sodium sulfate was added to break any emulsion and to remove excess water. The CCL4 extracts were reduced in volume to less than 5 ml by using rotary evaporator. The reduced extracts were carefully pipetted into a precleaned 10 ml volumetric glass, making sure any residual particles of sodium sulfate were excluded and evaporated to dryness by a stream of pure nitrogen.

Although CCL4 is ideal solvent for the extraction process, it is not suitable for spectrofluorescence analysis; therefore CCl4 must be replaced by a solvent, such as n-hexane which does not absorb light in 300-400 nm range. The flask was then rinsed with fresh hexane and the rinsing used to make the samples volume up to exactly 5 ml prior to ultraviolet fluorescence (UVF) analysis.

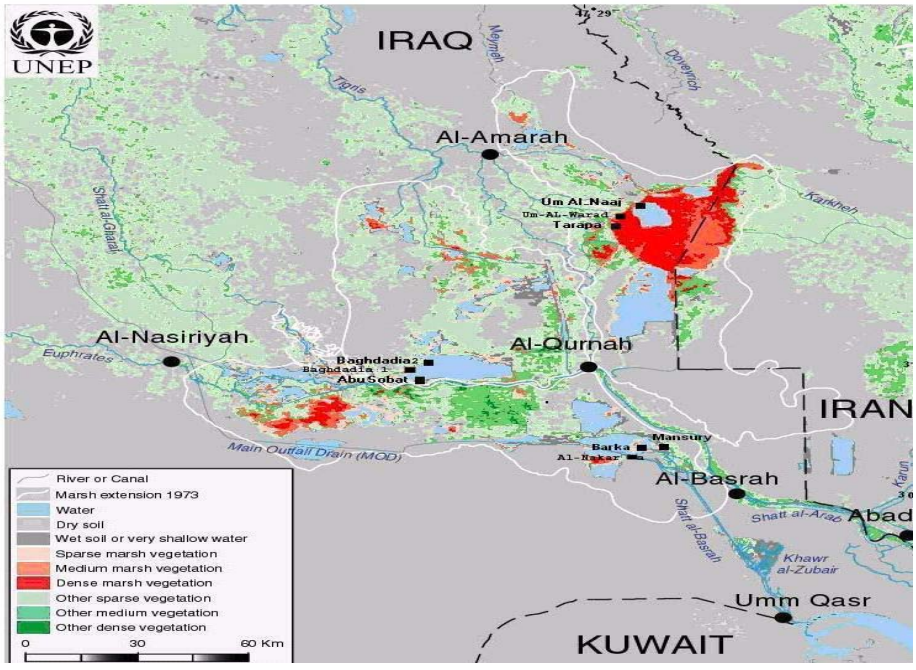

Figure 1. Map showing the main marshland of south Iraq and sampling locations.

Sediment samples were also collected from the same locations by means of a Van Veen grab sampler. Undisturbed, triplicate samples were taken. After retrieval of the sampler, the water was allowed to drain off, avoiding disturbing the surface layer of the samples. As soon as the samples were retrieved, they were divided into two parts, the first was wrapped in aluminum foil for hydrocarbons analysis and the second was placed in plastic bag for trace metal analysis and immediately frozen at -20 °C. Before analysis, sediment samples were freeze-dried, ground finely in agate mortar and sieved through a 62 µm metal sieve. The extraction and clean-up procedure for the determination of petroleum hydrocarbons in the sediment were made following Al-Saad (1995). Sediments were placed in a pre-extracted cellulose thimble and soxhlet extracted with 150 ml methanol: benzene (1:1) mixture for 24 hours. At the end of this time, the extract was transferred to a storage flask and the samples were further extracted with a fresh solvent.

The combined extracts were reduced in volume to ca 10 ml in a rotary evaporator. It was then saponified for 2 hours with a solution of 4N KOH in 1:1 methanol: benzene. After extracting the unsaponified matter with hexane, the extract was dried over anhydrous sodium sulfate, concentrated by a stream of N2 for UVF analysis. Concentrations of trace metals in environmental samples are usually determined by Atomic Absorption Spectrophotometer after a certain analytical processes. Water samples of 5 L each required for trace metal analysis. Water samples were analyzed according to the method of Riely and Taylor (1968) and Sturgeon *et al.* (1982).

Trace metals analysis was performed on the <63 µm fraction of the sediment which has been separated by sieving after drying and grinding. The determination of trace metals in sediment samples was done according Sturgeon *et al.* (1982). Concentrated HCl and HNO3 (1:1) were added to each sample and evaporated to near dryness on a hotplate at 80 °C, then a mixture of concentrated HCLO4 and HF (1:1) were added. After heating to near dryness, 20 ml of 0.5 HCL were added and cooled for 10 min. The extraction was decanted into 25 ml plastic volumetric flask. This step was repeated twice and all supernatant were combined. Finally samples were stored prior to trace metals analysis using a Pye-Unicam Atomic Absorption type SP9 Pye-Unicam.

Grain size analysis of the sediment was done according to Folk (1974), the Total Organic Carbon (TOC) of the sediment was determined using the wet oxidation method as described by El-Wakeel and Riely (1957).

Results and Discussion

The mean concentrations of Total Petroleum Hydrocarbons (TPH) in water ranged from 0.012 µg/l in Al-Barkha to 0.037 µg/l at Al-Baghdadia 1, while in the sediment samples the mean values ranged from 0.030 µg/g at Um-Alneach to 0.96 µg/g dry weight at Al-Baghdadia 2 (Table 1).

Hydrocarbons in the water body could be associated with sediments and accumulated in 0-20 cm layer in the bottom soil.

The degree of petroleum hydrocarbons pollution in southern Iraqi marshlands was very low and mainly came from Tigris and Euphrates rivers.

Fractions of petroleum hydrocarbons as pollutants in the southern Iraq marshland area were given little attention during the period before desiccation

1980 - 1990 in which n-alkanes were detected in water and sediments from Al-Hammar marshes (Al-Saad and Al-Timari, 1994) and polycyclic aromatic hydrocarbons, as a class of carcinogenic compounds, were studied in sediments from the same area (Al-Saad and Al-Timari, 1989). Al-Saad and Al-Timari (1993a), outlined the sources of hydrocarbons in sediment of the marshes of southern Iraq. Al-Saad and Al-Timari (1993b) studied the seasonal variations of dissolved normal alkanes in the marshes of Iraq. Al-Saad and Mustafa (1994) reviewed the pollutants in the sediments of Iraqi marshes. Al-Timari *et al.* (1997) studied the distribution and sources of n-alkanes in sediment cores from Al-Hammar Marshes, southern Iraq. For these studies capillary gas chromatography was adopted. Total petroleum hydrocarbons (TPH) were detected in Aquatic plants from Al-Hammar marsh by means of spectrofluorometry (Al-Saad, 1994). Al-Imarah *et al.* (2006) investigated the distribution and variations of petroleum hydrocarbons in the southern Iraqi marshlands after rehabilitation in 2003. Concentrations of TPH recorded in water from Iraqi marshlands were in the range of 0.6–46.82, 20.48–39.87, 14.28–26.16 and 11.78–17.45 µg/ml during winter, spring, summer and autumn of the year 2004, respectively and were 29.12–103.80, 23.84–43.51, 15.17–61.89 and 14.37–48.14 µg/g dry weight for the sediment during the same period, respectively. The highest levels were during winter for both water and sediment samples. During winter 2004 and through the early stages of flushing water into the marshlands, levels of TPH's were lower at station 1 (Al-Tarabah within Al-Hawiezah marsh) and were 0.6 µg/ml and 29.12 µg/g dry weight in the water and sediments, respectively. At station 2 (Umm Al-Ward) which is located at the entrance of Al-Hawiezah marsh, highest level of TPH'S were recorded.

This marsh receives water from Tigris river which carry tremendous amounts of suspended particulate matter in which organic matter is absorbed. These materials are mostly deposited at the entrance of the marsh as water current drops appreciably (Al-Saad and Al-Timari, 1989). The situation changes in the same station during Spring 2004, in which high levels were recorded up to 20.48 µg/ml and 93.51 µg/g dry weight in the waters and sediments, respectively. These alterations are explained on the basis of spreading of pollutants due to climate conditions (wind, current, rain...etc). Our data are lower than those previously recorded in the same marshes. It should be pointed out, however, that sediment remote anthropogenic activities may not contain elevated hydrocarbons concentration in the surface sediments.

The marshes are an example of this situation where the two rivers Tigris and Euphrates drain their water into it. A low resident time of the water in the marshes allows most of the rivers born suspended matter to settle. To date, there have been no spills of likely represent the aged background levels of hydrocarbons in the marsh sediments uncontaminated by any known inputs of petroleum. The hydrocarbon distribution in the water and sediments are mostly uniform throughout each marsh, and there is no indication of any point source contributing most of the hydrocarbons to marsh sediments. Hydrocarbons may be carried to the sediment by water adsorbed onto clay and silts (Al-Saad and Al-Timari, 1989). If this is the case in the marshes, any such particulate matter appear to be well mixed with the water column and settle to the marsh floor, but the convective currents associated with the fall season in the marshes apparently erode and redeposit surface sediment, possibly thus eliminating any local variations in hydrocarbons and trace metals (Al-Timari *et al.*, 1997).

Table 1. Concentrations of Petroleum Hydrocarbons in water (µg/l) and in sediment (µg/g) of different stations in marshland of Iraq.

Stations	Water Concentration µg/l (Range)	Mean	±S.D	Sediment Concentration µg/g (range)	Mean	±S.D	Sand %	Clay %	Silt %	Texture	TOC %
Um-Al-Warad	0.016-0.019	0.017	0.538	0.05-0.06	0.053	0.242	15.2	34.8	50.0	Silty clay loam	0.89
Um-Alneach	0.026-0.028	0.027	1.081	0.02-0.04	0.030	0.525	51.3	24.7	24.0	sandy clay loam	0.79
Baghdadia 1	0.036-0.039	0.037	1.623	0.75-0.80	0.77	0.423	23.2	6.8	70.0	Silty loam	1.65
Baghdadia 2	0.102-0.109	0.105	2.133	0.95-0.98	0.96	0.585	39.6	8.8	51.6	Silty loam	1.54
Al-Nkhara	0.013-0.016	0.014	2.726	0.36-0.40	0.37	1.175	15.0	35.0	50.0	Silty clay loam	1.03
Al-Barkha	0.010-0.014	0.012	3.28	0.32-0.38	0.34	1.467	13.4	32.6	54.0	Silty clay loam	1.52

To date there were no major spills of crude oil or fuel oil into the marshes and sewage effluents, which are important source of petroleum contamination (Al-Saad, 1995). The most likely source of continuing lubricating and pyrolysis product released by automobile traffic and fishing boats, rivers, storm water runoff and dust fall out.

The recorded levels of hydrocarbons in the water and sediment samples in the present study are lower than most reported hydrocarbons levels by previous studies. A comparison between the present values and those reported in the water and sediments of other rivers and estuaries elsewhere in the world are presented in Tables 2 and 3, respectively.

The Total Organic Carbon (TOC) values fluctuated between 0.79 % in Um Al-Neach at Hor Al-Huwaiza and 1.65 % in Al-Baghdadia 1 at Hor Al-Hammar.

Sediment texture plays a major role in the distribution of hydrocarbons and trace metals. Sediment collected from the study area were found to be mostly silty clay. It was observed that sediment having silty-clay texture contain more hydrocarbons than those having silty sand texture. One of the reasons might be the higher capacity of area loading of smaller particles (Al-Saad *et al*., 2000). The same conclusion was reached by Al-Saad (1995) in the sediments of the Arabian Gulf and by Sen Gupta *et al*. (1993) in the Arabian Sea sediments.

Table 2. Comparison of oil concentrations in coastal and offshore waters in different parts of the world.

Location	Concentration (µg/l)	References
Southern Baltic sea	2.0 -130	Law & Anrulewicz (1983)
Qatar	1.2 - 428	El- Samra *et al*., (1986)
Saudia Arabia	4.3 - 546	El- Samra *et al*., (1986)
Kuwait	2.1 – 3.6	El- Samra *et al*., (1986)
Winyah bay (USA)	0.23 – 25	Bidleman *et al*., (1993)
Gulf of Thiland	1.9 – 72	Wattayakorn (1991)
River Humber (U.k)	9.3	MAFF (1993)
River Mersey (U.k)	11	MAFF (1993)
River Tees (U.k)	48	MAFF (1993)
River Tyne (U.k)	31	MAFF (1993)
River Wear (U.k)	13	MAFF (1993)
Cortiou (France)	104	Marchand *et al* ., (1988)
Gulf of Lion	18 – 23	Marchand *et al* ., (1988)
Arabian Sea	1.6 –11.1	Sen Gupta *et al* ., (1993)
Shatt Al – Arab & NWArabian Guf	3.25-25.33	Al – Saad (1995)
Shatt Al – Arab & NW Arabian Gulf	2.7 – 86.7	DouAbul (1984)
Arabian Gulf	3.5	Ehrhardt & Burns (1993)
Khor Al-Zuabir	36.8-478.2	Al-Saad *et al*.,(2006)
Marshes of Southern Iraq	0.012-0.105	Present study

Table 3. Comparison of petroleum residues in polluted sediment in different parts of the world.

Location	Concentration (µg/g)	References
Bay of Cortiou (France)	480 – 9166	Marchand *et al*., (1988)
Gulfe of Lion	3.0 – 420	Marchand *et al*., (1988)
Bay of Marseilles	132	Marchand *et al*., (1988)
Tyne River (U.K)	53 – 750	MAFF(1992)
Mersey River (U.K)	1.1 – 240	MAFF(1992)
Shatt Al- Arab &NW Arabian Gulf	2.46-38.33	Al –Saad (1995)
Shatt Al- Arab & NWArabian Gulf	0.4 – 40	DouAbul *et al* ., (1984)
Kuwait	1 – 291	Zerba (1985)
Bahrain	20 – 103	Fowler *et al*., (1993)
UAE	0.10 – 1.7	Fowler *et al*., (1993)
Oman	0.2 – 30	Fowler *et al*., (1993)
Kuwait	13	Fowler *et al*., (1993)
Saudia Arabia	62 – 1400	Fowler *et al*., (1993)
Bahrain	6.0 – 14	Fowler *et al*., (1993)
UAE	5.7	Fowler *et al*., (1993)
Oman	1.0 – 12	Fowler *et al*., (1993)
Saudia Arabia	13 – 540	Ehrhardt & Burns (1993)
Mediterranean	82 – 122	Ehrhardt & petrick (1993)
Khor Al-Zubair	2.07-38.5	Al-Saad *et al.* (2006)
Marshes of Southern Iraq	0.030-0.96	Present study

Distribution of trace elements in the water and in sediments showed variations in concentration with sampling site. The mean values of the elements in the water for Co ranged from 1.13-3.68, Mn from 0.16-1.37, Ni from 0.66-2.37, Fe from 0.28-1.51 and for Cu from 0.10-0.28 mg/l (Table 4), while in the sediments (Table 5) the mean ranged for: Co was 39.25-88.0, Mn was 408.6-506.3, Ni was 52.2-90.3, Fe was 6923-9910 and for Cu was 16.36-38.30 µg/g dry weight.

From the data obtained in the present work, it can be concluded that:

1- The concentrations of petroleum hydrocarbons and trace metals were acceptable in comparison with the world standards.
2- Although there were slight increase in concentration of trace metals in some locations, the area may be considered unpolluted by trace metals as well as by petroleum.
3- Hydrocarbons and trace metals contaminants in the water and sediments partially are caused by atmospheric input of local particulates from motor vehicle and also from motor boat in the area with additional rural runoff from Tigris and Euphrates rivers.

Table 4. Concentrations of trace elements in the water samples (mg/l) of the marshland of Iraq.

Stations	Co Range	Mean	Mn Range	Mean	Ni Range	Mean	Fe Range	Mean	Cu Range	Mean
Um-Al-Warad	1.21-1.48	1.36	0.15-0.18	0.16	2.36-2.39	2.37	0.95-0.98	0.96	0.15-0.17	0.16
Um-Alneach	1.09-1.22	1.13	0.24-0.28	0.26	0.76-0.82	0.79	0.76-0.88	0.82	0.27-0.30	0.28
Baghdadia 1	1.46-1.52	1.48	0.26-0.30	0.28	1.08-1.10	1.09	1.28-1.36	1.31	0.10-0.13	0.11
Baghdadia 2	2.58-3.10	2.88	0.38-0.53	0.44	1.09-1.25	1.18	1.42-1.58	1.51	0.18-0.23	0.20
Al-Nkhara	3.46-3.92	3.68	0.15-0.19	0.16	1.59-1.62	1.60	0.49-0.58	0.53	0.10-0.14	0.12
Al-Barkha	1.26-1.39	1.31	1.32-1.42	1.37	0.55-0.82	0.66	0.26-0.30	0.28	0.09-0.11	0.10

Table 5: Concentrations of trace elements in the sediment samples (µg/g) of the marshland of Iraq.

Stations	Co Range	Mean	Mn Range	Mean	Ni Range	Mean	Fe Range	Mean	Cu Range	Mean
Um-Al-Warad	58.75-69.0	63.83	436.2-452.1	445.3	66.5-70.2	68.3	7490-7510	7500	16.28-16.50	16.36
Um-Alneach	38.25-40.5	39.25	400.3-415.2	408.6	48.5-55.3	52.2	6889-6980	6923	18.1-22.6	20.3
Baghdadia 1	71.25-75	73.5	467.3-485.6	476.9	82.1-85.3	83.3	9850-9980	9910	30.9-33.1	32.1
Baghdadia 2	83.75-92	88.0	500.4-510.5	506.3	89.0-92.0	90.3	8790-8850	8816	36.3-39.9	38.3
Al-Nkhara	74.5-77.25	75.5	485.4-495.1	4909.2	70.0-75.0	72.3	8068-8150	8112	25.6-28.9	27.2
Al-Barkha	63.75-67.5	66.0	458.2-467.6	463.3	75.0-80.0	77.6	7850-7900	7880	29.9-32.3	30.76

Table 6. Comparison of the Concentration (mean/range) of trace metals in waters (dissolved phase) (W_d) µg/l and particulate phase (W_p) µg/g from different locations with water of Iraqi Marshlands.

Locations	Trace metals								References
	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	
Port Said W_d	0.15-0.68	-	0.15-2.9	-	-	-	0.38-1.99	0.62-7.62	Abdelmoneim, 1994
W_p	0.00-0.25	-	0.08-0.92	-	-	-	0.1-1.52	.16-9.92	
Gulf of Suez W_d		-	1.6-9.6	-	-	-	1.0	1.62-29.2	Abdel-Salam, 1980
Gulf of Suez W_d	0.14-0.29	-	8.55-10.7	-	-	-	1.79-1.85	9.09-29.5	El-Mosellhy, 1993
Hodeidah, W_d	0.04-2.65	0.024-29.05	5.32-174	3.48-206.5	0.12-8.0	0.12-22.43	0.10-2.85	0.0-9.45	Heba *et al.*, 2004
W_p	0.22-101.36	1.60-534.6	2.72-199	6.20-691.77	98.10-6966.6	4.32-158.0	2.64-832.5	1.11-472.6	
Shatt Al-Arab Estuary, W_d									Al-Saad, *et al.*, 1996
W_p	112.3	193.4	63.7	9466.0	35.7	81.5	22.5	10.04	
NW Arabian Gulf W_d	0.19	0.21	0.47	173.0	1.52	2.85	0.23	0.83	Al-Khafaji, 1996
W_p	46.23	493.65	267.05	2454.0	35.55	101.74	6.07	24.45	
Kuwait Bay W_d	-	1.16	4.23	100.0	2.6	0.8	2.02	36.11	Al-Sarawi, *et al.*, 2002
W_p	-	152.3	90.5	28,000	54.8	37.3	70.4	451.4	
World wide rivers, W_d	0.02	-	7.0	40.0	7.0	1.66	3.0	20.0	Burton, 1976
Water marshes of Iraq			0.10-0.28	0.28-1.51	0.16-1.37	0.66-2.37			Present study

Table 7. Comparison of trace metal concentrations (µg/g) in sediment of various estuaries, seas and oceans

Location	Cu	Zn	Ni	Mn	Fe	References
Mrghna estuary	0.595-20.695	0.215-4.258	2.578-25.515	5.877-25.005	369.28-991.75	Khan *et al.*, 1998
NE Bay of Bengal Bengladesh coast	28.92	9.56	49.11	60.10	3499.40	Khan and Talukder, 1995
Ganges estuary, India	26	71	32	553	31036	Subramanian *et al.*, 1988
Veller River estuary, India	9	104	-	619	-	Mohanachandran, 1986
Cochin estuary, India	4.81	17.77	-	-	-	Nair *et al.*, 1991
Estuarine, Jave Sea	6-54	33.122	-	ND	-	Everaarts, 1989
Gulf of Thailand	2.6-12.1	15.38	-	-	-	Polprasert *et al.*, 1979
Singapore estuary	10-80	100-500	-	-	-	Sin *et al.*, 1991
North Sea	25-240	400-4000	-	ND	-	Everaarts and Fischer, 1992
River Tees, UK	10-1100	40-2900	-	160-1800	-	Davies *et al.*, 1991
Port Said, Egypt	14	50	-	-	-	Saad *et al.*, 1981
Kuwait	20.7	44.6	96.9	409.9	$1.5*10^5$	Samhan *et al.*, 1979
North-West Arabian Gulf	2.59	13.74	10.07	51.54	2400	Al-Hashimi and Salman, 1985

References

Abaychi, J.K. and Al-Saad, H.T. 1988. Trace element in fish from the Arabian Gulf and the Shatt Al-Arab River, Iraq. Bull. Envirn. Contam. Toxicol., 40: 226-232.

Abaychi, J.K. and Douabul, A.A.Z. 1986. Trace element geochemical associations in the Arabian Gulf. Mar. Pollut. Bull., 7: 353-356.

Abdelmoneim, M.A. 1994. Trace Mwtals distribution in waters and sediments of Suez, Red Sea, Egypt. Bull. High. Inst. Public. Health, 24(4): 973-984.

Abdel-Salam, H. 1980. Occurrence and distribution of some heavy metals in water and in some fish species from Red Sea. M. Sc. Thesis, Fac. Sci. Cairo Univ.

Alagarsamy, R. and Zhang, J. 2005. Comparative studies on trace metal geochemistry in Indian and Chinese river. Current science, 89(2): 299-309.

Al-Edanee, T.E., Al-Kareem, A.A. and Kadum, S.A. 1991. An assessment of trace metals pollution in the Khor Al- Zubair environment, Iraq. Marina Mesopotamica, 6: 143-154.

Al-Hashimi, A.H. and Salman, H.H. 1985. Trace metals in the sediments of the North-Western Coastal of the Arabian Gulf. Mar. Poll. Bull., 16: 118-12

Al-Imarah, F.J.M., Hantoush, A.A., Nasir, A.M and Al-Yaseri, S.T.L. 2006 Seasonal variations of the Total Petroleum Hydrocarbons in water and sediments of Southern Iraqi Marshland after Rehabilitation 2003. Marsh Bulletin, 1(1): 1-8

Al-Khafaji, B.Y. 1996. Trace metals in water, sediments and fishes from Shatt Al-Arab, North West Arabian Gulf. Ph.D. Thesis, Basrah Univ. Iraq.

Al-Mussawy, S.N. and Salman, H.H. 1989. Heavy metals distribution in Khor Al-Zubair sediments NW Arabian Gulf. Marina Mesopotamica, 4: 309-318.

Al-Saad, H.T. 1994. Distribution of petroleum Hydrocarbons in aquatic plants of Hor Al-Hammar marsh, Iraq. Marina Mesopotamica, 9(2): 313–321.

Al-Saad, H.T. 1995. Distribution and sources of hydrocarbons in Shatt Al-Arab Estuary and North-West Arabian Gulf. Ph.D. thesis, Basra Univ., 186p.

Al-Saad, H.T., Abd, I.A., Al-Hello, M.A. and Zukhair, M.K. 2006. Environmental Assessment of trace metals pollution in sediment of Khor al-Zubair, Iraq. Marina Mesopotamica, 21(2): 23-33.

Al-Saad, H.T., Al-Khafaji, B.Y. and Sultan, A.A. 1996. Distribution of trace metals in water, sediments and biota samples from Shatt Al-Arab estuary. Marina Mesopotamica, 11(1): 63-77.

Al-Saad, H.T. and Al-Timari, A.K. 1989. Distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in Marsh Sedement, Iraq Bull. Environ. Contam. Toxicol., 43: 864-869.

Al-Saad and Al-Timari, A.K. 1993a. Seasonal variations of dissolved normal alkanes in the water marshes of Iraq. Mar.Poll.Bull., 26(4): 207–212.

Al-Saad and Al-Timari, A.K. 1993b. Sources of Hydrocarbons and Fatty acids in sediments from Hor Al-Hammar Marsh, Shatt Al-Arab, N.W. Arabian Gulf. Mar. Poll. Bull., 26(10): 559 – 564.

Al-Saad, H.T. and Al-Timari, A.A. 1994. Biogenic and Anthropogenic n-Alkanes in the sediment of the marshes of Iraq. Marina Mesopotamica, 9(2): 277–288.

Al-Saad, H.T., Darmoian, S.A. and Al-Jassim, H.N.A. 2000. State of oil pollution in the sediments of the North-West Arabian Gulf after the 1991 Gulf oil spill. Marina Mesopotamica, 15(1): 145–156.

Al-Saad, H.T., Mustafa, Y.Z. 1994. Pollutants in the sediment of Iraqi marshes: A review. In" Ahwar of Iraq Environmental Approach", Hussain, N.A., (ed). Marine Science Centre Puplication, No. 18.

Al-Saad, H.T., Mustafa, Y.Z. and Al-Timary, A.K. 1994. Concentration of trace metals in aquatic plants of Al-Hammar Marsh, Iraq. Marina Mesopotamica, 9(2): 323-328.

Al-Sarawi, M.A., Massoud, M.S. and Khader, S.R. 2002. Recent trace metal pollution in bottom sediments of Sulaibikhat Bay, Kuwait. Technology, pp. 39-50.

Al-Timari, A.A., Al-Saad, H.T. and Darmoian, S.A. 1997. Distribution and sources of N-Alkanes in sediment cores from Al-Hammar marsh, Southern of Iraq. Marina Mesopotamica, 12(2): 315–330.

Bedair, H.M., Al-Saad, H.T. and Salman, N.A. 2006. Southern marshes something to be conserved: A case study. Marsh Bulletin, 1(2): 99-126.

Bidleman, T.F., Castleberry, A.A., Foreman, W.T., Zaranski, M.T. and Wall, D.W. 1993. Petroleum Hydrocarbons in the surface water of two estuaries in the southern united state. Est. Coas. Shel. Sci., 30:91-109

Bryan, G. W. 1976. Metal concentration in the Sea. Mar. Poll. Bull., 7: 353-356.

Burton, J. D. 1976 Basic properties and processes in esturian chemistry. In: Esturian Chemistry. Burtin, J. D. and Liss, P. S. (eds). Academic Press.

Davies, C.A., Tomlinson, K. and Stephenson, T. 1991. Heavy metals in River Tees estuary sediments. Environ.Technol., 12: 961-972.

DouAbul, A.A.Z. 1984. Petroleum residues in the waters of the Shatt Al-Arab river and the North-West region of the Arabian Gulf. *Environ.Inter.*, 10: 265-267.

DouAbul, A.A.Z., Al-Saad, H.T. and Darmoian, S.A. 1984. Distribution of petroleum residues in surificial sediment from Shatt Al-Arab river, and North-west region of the Arabian Gulf. Mar .Pollut. Bull., 15: 198-200.

Ehrhardt, M.and Burns, K. 1993.Hydrocarbons and related photo-oxidation product in Saudi Arabian Gulf coastal water and hydrocarbons in underlying sediment and bioindicators bivalves. Mar. Pollut. Bull., 27: 187-199

Ehrhardt, M., and Petrick, G. 1993. On the composition of dissolved and particulate-association fossils fuel residue in Mediterranean surface water. Mar. Chem., 42: 57-70.

El-Mosellhy, Kh. M. 1993. Studies on the heavy metals level in some economic fishes in the Suez Gulf. M. Sc. Thesis, Fac. Sci. El-Mansoura University.

El-Samra, M.I., Emara, H.I., and Shunbo, E. 1986. Dissolved petroleum hydrocarbons in the North western Arabian Gulf. Mar. Pollut. Bull., 17: 65-68.

El-Wakeel, S.K. and Riley, J.P. 1957. The determination of organic carbon in marine mud. J. Cons. Int. Explor. Mer., 12: 180-183.

Everaarts, J.M. 1989. Heavy metals (Cu, Zn, Cd, Pb) in sediment of the Java Sea, estuarine and coastal areas of east Java and some deep-sea areas. Neth. J. Sea Res., 23: 404-413.

Everaarts, J.M. and Fischer, C.V. 1992. The distribution of heavy metals (Cu,Zn,Cd,Pb) in the fine fraction of surface sediments of the North Sea. Neth. J. Sea Res., 29: 323-331.

Folk, R.L. 1974. Petrology of Sedimentary Rocks. Hemphill Publishing Co., Austin, Texas, USA, 182 p.

Fowler, S.W., Readman, J.W., Oregioni, B., Villeneuve, J.P. and McKay. 1993. Petroleum hydrocarbons and trace metals in near shore Gulf sediment and biota before and after the 1991 war: an assessment of temporal and spatial trends. Mar .Pollut. Bull., 27: 171-182

GESAMP. 1993. IMO/FAO/UNESCO/WHO/IAEA/UN/UNEP. Joint Group of experts on the Scientific Aspect of Marine Pollution (GESAMP) impact of oil and related chemical and wastes on the marine environment. Report and studies No.50, IMO, London, 180 p.

Grimalt, J.O., Canton, L. and Alonso, B. 1992. Spatial and Temporal variance of hydrocarbon pollution data in a coastal River-influenced sedimentary system. Environ. Sci and Techno., 26(11): 2240-2251.

Heba, H.M.A., Al-Edrise, M.A.M, Al-Saad, H.T. and Abdelmoneim, 2004. Background levels of heavy metals in dissolved, particulate phases of water and sediments of Al-Hodeidah Red Sea coast of Yemen. J. King Abdulaziz Univ., Mar. Sci., 15: 53-71.

Khan, Y.S.A., Hossain, M.S., Hossain, S.M.G.A. and Halimuzzaman, A.H.M. 1998. An environmental assessment of trace metals in the Ganges- Brahmaputra-Megahna estuary. J. of Remote Sensing and Environment, 2: 103-117.

Khan, Y.S.A. and Talukder, A.B.M. 1995. Accumulation of trace elements and organochlorine pesticides from the sediments of the south coast of Bangladesh, Bay of Bengal. M.Sc. Thesis, Institute of Marine Science, University of Chittagong, 82 p.

Law, R. and Andrulewicz, E. 1983. Hydrocarbons in water, sediment and mussels from the southern Baltic Sea. Mar. Pollut. Bull., 14: 289-293.

MAFF 1992. Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1990. Aquatic. Environ. Monit, Rep., MAFF, Direct. Fish, Rse, Lowestoft, 30: 11-66.

MAFF 1993. Monitoring and surveillance of non−radioactive contaminants in aquatic environment and activities regulating the disposal of wastes at sea, 1991. Aquatic. Environ. Monit, Rep., MAFF, Direct. Fish, Res, Lowestoft, 36: 30-32.

Mahanachandran, G. 1986. Heavy metal distribution in deltaic and coastal sediments in between Polar and Cauvery River. M. Phill. Dissertation, Jawaharlal Nehru University, New Delhi, India, 156p.

Marchand, J.C., Caprais, J.C, and Pignet, P. 1988. Hydrocarbons and halogenated hydrocarbons in coastal waters of the western Mediterranean (Trance). Mar. Environ. Res., 25: 131-159.

Nair, C.K., Balchand, A.N. and Nambisan, P.N.K. 1991. Heavy metal speciation in sediments of Cochin estuary determined using chemical extraction techniques. The Sci. Total Environ., 102: 113-128.

Patin, S. 2006. Anthropogenic impact in the sea and marine pollution. In (Environmental Impact of the offshore oil and Gas industry. Edt Stanislav, P.) 1-6.

Polprasert, C., Vangvisessomjai, S., Lohani, B.N., Muttamara, S., Arbhabhirama, A., Traichaiyaporn, S., Khan, P.A. and Wangsuphachart, S. 1979. Heavy metals, DDT and PCR in the upper Gulf of Thailand. Research Report. Division of Engineering, Asian Institute of Technology, Bangkok, 316 p.

Riely, J.P. and Taylor, D. 1968. Chelating resins for the concentrations of trace elements from sea water and their analytical use conmjection with atomic absorption spectrophotometry. Anal. Chemi. Acta. 40: 479-485.

Saad, M.A.H., El-Rayis, O.A. and El-Nady, F.E. 1981. Occurrence of some trace metals in bottom deposits from Abu- Kir Bay. Egypt J. Etud. Pollut. CIESM., 5: 555-560.

Samhan, O., Anderlini, V. and Zarba, M. 1979. Preliminary investigation of the trace metal levels in the sediments of Kuwait. K.I.S.R., Ann. Sci. Rep., 93-96.

Sen Gupta, R., Fondekar, S.P. and Alagarsamy, R. 1993. State of oil pollution in the northern Arabian sea after the 1991 Gulf oil spill. Mar. Pollut. Bull., 21: 38-40

Sin, Y.M., Wong, M.K., Chou, L.M. and Normala, A. 1991. A study of heavy metal contents of the Singapore River. Environ. Monit. Assessment, 19: 484-494.

Sturgeon, R.E., Desaulniers, J.A., Berman, S.S. and Russell, D.S. 1982. Determination of trace metals in estuarine sediments by graphic furnace atomic absorption spectrophotometry. Anal. Chim. Acta, 134: 283-291.

Subramanian, V., Tha, P.K. and JerGrieken, R. 1988. Heavy metals in the Ganges estuary. Mar Pollt. Bull, 19(6): 290-3.

UNEP 1980. Report on land based sources of industrial pollution in Kuwait. Draft Report, United Nations Environment Programmer. Kuwait Action Plan-Interm Secretariat Informal Consultation on the Implementation of Group "B" Projects.

UNESCO 1976. Guide to operational procedures for IGOSS pilot project on marine pollution (petroleum) monitoring. Intergovernmental Oceanographic Commission, Manuals and Guide No.7, 50 p.

Wattayakorn, G. 1991. Petroleum pollution in the Gulf of Thailand. Prospects of the coastal offshore engineering in the 21st century. Proceeding regional seminar and coastal and offshore engineering. Dec. 9-11, 1991, Malaysia.

Zerba, M.A., Mohammed, O.S., Anderlini, V.C., Literathy, P. and Shunbo, F. 1985. Petroleum residues in surface sediment of Kuwait. Mar. Pollut. Bull., 16: 209-211.

الهيدروكاربونات والعناصر النزرة في عينات من مياه ورواسب أهوار العراق الجنوبية

حامد طالب السعد، صالح مهدي الطعان، محسن عبد الرسول الحلو وعلي عبد الزهرة دعيبل

قسم كيمياء البيئة البحرية، مركز علوم البحار، جامعة البصرة، العراق

المستخلص تم تقدير مستويات كل من الهيدروكاربونات والعناصر النزرة في مياه ورواسب عدة مواقع من اهوار العراق الجنوبية. تراوح معدل تركيز الهيدروكاربونات في المياه من 0.012 مايكروغرام/ لتر في البركة الى0.037 مايكروغرام/ لتر في البغدادية 1.بينما تراوحت في الرواسب من0.030 مايكرو غرام بالغرام في أم النعاج الى0.96 مايكروغرام/غم كوزن جاف في البغدادية 2. أما انتشار العناصر النزرة في كل من المياه والرواسب فقد بينت وجود تغاير في التركيز مع المواقع. تراوحت معدلات القيم لهذه العناصر في المياه لكل من الكوبلت بين 1.13-3.68 وللمنغنيز 0.16-1.37 وللنيكل 0.66-2.37 وللحديد 0.28-1.51 وللنحاس 0.10-0.28 مليغرام/ لتر بينما في الرواسب فتراوحت معدلات القيم للكوبلت بين 25.39-88.0 وللمنغنيز 408.6-506.3 وللنيكل 52.2-90.3 وللحديد 6923-9910 وللنحاس 16.36 -38.30 مايكروغرام/غم كوزن جاف. تم قياس الحجم الحبيبي وكمية الكاربون العضوي الكلي لرواسب المناطق المدروسة. بينت الدراسة أن مستويات التركيز للهيدروكاربونات والعناصر النزرة للمياه والرواسب كانت قليلة مما يشير إلى قلة التلوث في هذه المناطق، وان هذه التراكيز ذات مناشىء مختلفة منها الطبيعية وغير الطبيعية وأنها تقع ضمن معدل القيم المسجلة لمناطق أخرى.