

PAHs and Some Heavy elements in the tidal flat area of Al-Faw city, North- Western Arabian Gulf

Al-Imarah, Faris J. M.*, and Al-Asadi, Manal K. Kh.
Department of Chemistry and Marine Environmental Pollution
Marine Science Centre, Basrah University
Basrah – Iraq.

Abstract

The North Western part of Arabian Gulf is represented by Southern Marine region which is an area covered Al-Faw City as a coast line stretches from Shatt Al-Arab river estuary to the north and Iraqi marine shores to the south. An area which effected heavily by the tidal currents from the Arabian Gulf as well as by the water discharges from Iraqi land via Shatt Al-Arab river. This study area is represented by a long coast covered by mud which is contaminated by different pollutants such as Poly cyclic Aromatic Hydrocarbons (PSAHs) and chemical elements arises from different sources: sinking ships, transportation, atmospheric deposition, ... etc. within this study four sites, Shatt Al-Arab Estuary (ES) and three marine sites (MS1, MS2, and MS3) of mud flats around Al-Faw city were investigated for PAHs and some chemical elements. PAHs were determined by HPLC and chemical elements by AAS. All sites of collected mud were contaminated to a certain levels by both PAHs and chemical elements (Cd, Co, Cu, Pb, and Zn). PAHs were reported in the range 48 µg/g in site MS1 to 186 µg/g in MS3 being the highly contaminated site. Zn was reported to be the highest in all sites ranged between 97.47 µg/g in site MS2 and 117.43 µg/g in site MS3. The lowest levels were for Cd in the range 0.05 µg/g in site MS2 to 6.99 µg/g in site ES. The trend of chemical elements in the mud flats was as follows: Zn> Cu> Pb> Co> Cd. And the levels reported in studied sites following the trend: ES> MS3> MS1> MS2. ES is effected directly by the sinking vessels in Shatt Al-Arab river since the Gulf war 1 and site MS3 is effected by the tidal current of the Arabian Gulf.

Key Words: Mud Flats, Shatt Al-Arab Estuary, Al-Faw Coast, PAHs, Chemical Elements, HPLC, AAS.

Introduction.

Shatt Al-Arab River is made up of the confluence of the Tigris and Euphrates Rivers at Qurna city and continues in the south-eastern direction to end up in the Arabian Gulf south of the city of Faw (Al-Hamad, et al., 2017). During its flow in the south eastern direction, Al-Sewab river which feed water from Al-Hewazah marsh joined Shatt Al-Arab river some 20 km from Qurnah city. further downstream to the south Karun river from the Iranian territories joined Shatt Al-Arab river some 30 km down Basrah city (Figure 1).

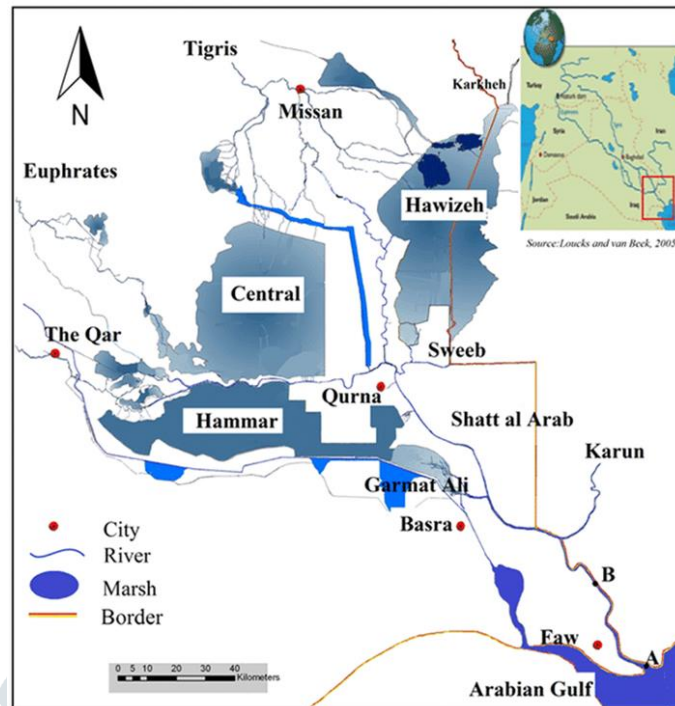


Figure 1. Map of Southern Iraq showing Shatt Al-Arab River supplied by Euphrates, Tigris, Sweeb, Garmat Ali, and Karun rivers.

The sediments of the northern part of Arabian Gulf represented the Kuwaiti coasts and the Tigris-Euphrates delta as well as the Shatt Al-Arab estuary show some resemblance in their heavy mineral suite (Elhabab and Adsani, 2013). It is evident, therefore, that the wind-borne sediments carried into the North Western area of Arabian Gulf area during dust storms are the primary contributor of dolomite. On the other hand, the classic heavy minerals are thought to have originated from the surface deposits of the areas lying to the middle sectors of Iraq and to the north and to the west of Kuwaiti offshore zone and to have been transported to the study area as wind-borne and river-borne sediments (Al-Bakri et al., 1984).

The estuary of Shatt Al-Arab River is located in the northern part of the Arabian Gulf, between Longitudes 48°30' and 48°45' East and Latitudes 29°45' and 30°00' north. It is effected by the Tigris-Euphrates delta which extends for about 100 km. Extensive intertidal flats occur in the northwestern part of the Arabian Gulf, fronting the estuarine plain of Shatt-Al-Arab and along the coast of Kuwait. It has an extensive intertidal flat, covered mainly by muddy sediments (Khalaf, 1978).

The coast of Shatt Al-Arab delta is characterized by a relatively wide intertidal flat area, and deposits are classified as fluvial deposits, and effected by aeolian dust fallout, and direct chemical and biogenic precipitation from the Gulf water (Khalaf and Ala, 1980).

The unique environment of Shatt Al-Arab estuary is bound by land to the North and by Arabian Gulf to the south (Subba Rao and Al-Yamani, 1998).

Mudflats occupy extensive areas of the intertidal zone. Their productivity is often enhanced by Cyanobacteria-dominated algal mats. A 2009 study that includes annual water balance data for a common Euphrates-Tigris-Shatt al-Arab Basin before regulation assumes large water losses through evaporation (Isaev and Mikhailova, 2009).

Methods

During the survey of Southern Iraqi shores, mudflats were identified along the whole shore of Faw city and Four sites: 1) Estuarine site and 3 Marine sites as mentioned in table 1 and shown in figure 2, around Faw city were visited for collection of surface mud and pollutants such as polycyclic aromatic hydrocarbons (PAHs) and Certain chemical elements were investigated. The beaches are rocky for protection and the upper Tidd flats are covered by soft mud (Al-Sarawi, et al., 2017), as shown in figure 3

Table 1: Sites around Faw city and their positions for mud collection

Station	Position	N	E
1	Estuarine site (ES)	29°55'-30°00'	48°15'-48°25'
2	Marine site (MS ₁)	29°50'-29°55'	48°30'-48°35'
3	Marine site (MS ₂)	29°48'-29°50'	48°25'-48°30'
4	Marine site (MS ₃)	29°45'-29°48'	48°20'-48°25'



Figure (2) . Location map for Southern Iraq, NW Arabian Gulf showing the study area of mud flats around Faw city.

Four samples were collected from the investigated four stations during the low tide by using hand tools . Samples were stored on board of sampling ship and kept in ice box and transported to the laboratories of Marine Science Centre for PAHs and Chemical Elements analysis. In the lab, muddy samples were treated chemically and according to the pollutant to be analysed and later determined by HPLC for PAHs (Al-Imarah et al., 2017a), and Atomic Absorption Spectroscopy for chemical elements (Al-Imarah et al., 2017b).

Results

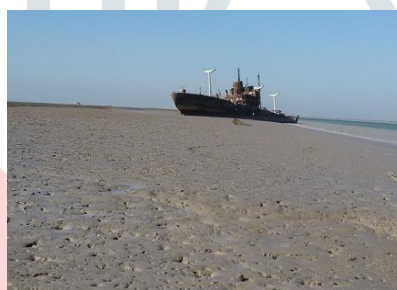
Concentrations of polycyclic aromatic hydrocarbons (PAHs) and certain heavy metals in the mud flats collected from coasts of Faw City, Southern Iraq, NW Arabian Gulf Table are listed in Table 2.

Table 2. Levels of PAHs and certain chemical elements in the mud flats of Al-Faw city coasts, Southern Iraq.

Samples	ES	MS ₁	MS ₂	MS ₃
PAHs ($\mu\text{g/g}$)	70	48	51	186
Cd	6.99	0.65	0.05	0.76
Co	6.86	5.71	5.87	7.55
Cu	42.21	22.57	24.53	27.95
Pb	64.48	26.22	13.46	21.96
Zn	104.11	110.54	97.47	117.43



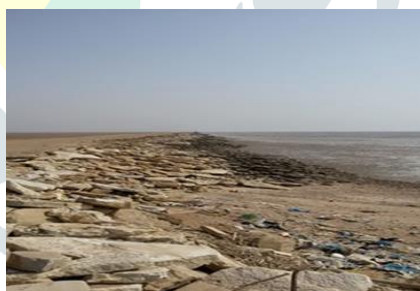
Shatt Al-Arab Estuary Station (ES)



Marine Station 1 (MS₁)



Marine Station 2 (MS₂)



Marine Station 3 (MS₃)

Figure. 3: Four sites of Rocky beach for protection and tidal flats of Al-Faw coast covered by layer of mud.

The results revealed that all sites of collected mud were contaminated to a certain limits by both petroleum hydrocarbons represented by PAHs estimated by HPLC as shown in figure 4 and chemical elements represented by Cd, Co, Cu, Pb, and Zn, estimated by AAS. PAHs were reported in the range 48 $\mu\text{g/g}$ in site MS₁ to 186 $\mu\text{g/g}$ in MS₃ being the highly contaminated site.

For chemical elements Zn was reported to be the highest in all sites ranged between 97.47 $\mu\text{g/g}$ in site MS₂ and 117.43 $\mu\text{g/g}$ in site MS₃. The lowest levels were for Cd in the range 0.05 $\mu\text{g/g}$ in site MS₂ to 6.99 $\mu\text{g/g}$ in site ES. The trend of chemical elements in the mud flats was as follows: Zn > Cu > Pb > Co > Cd. And the levels reported in studied sites following the trend: ES > MS₃ > MS₁ > MS₂. ES is effected directly

by the sinking vessels in Shatt Al-Arab river since the Gulf war 1 (The Iraqi-Iranian war) and site MS₃ is effected by the tidal current of the Arabian Gulf.

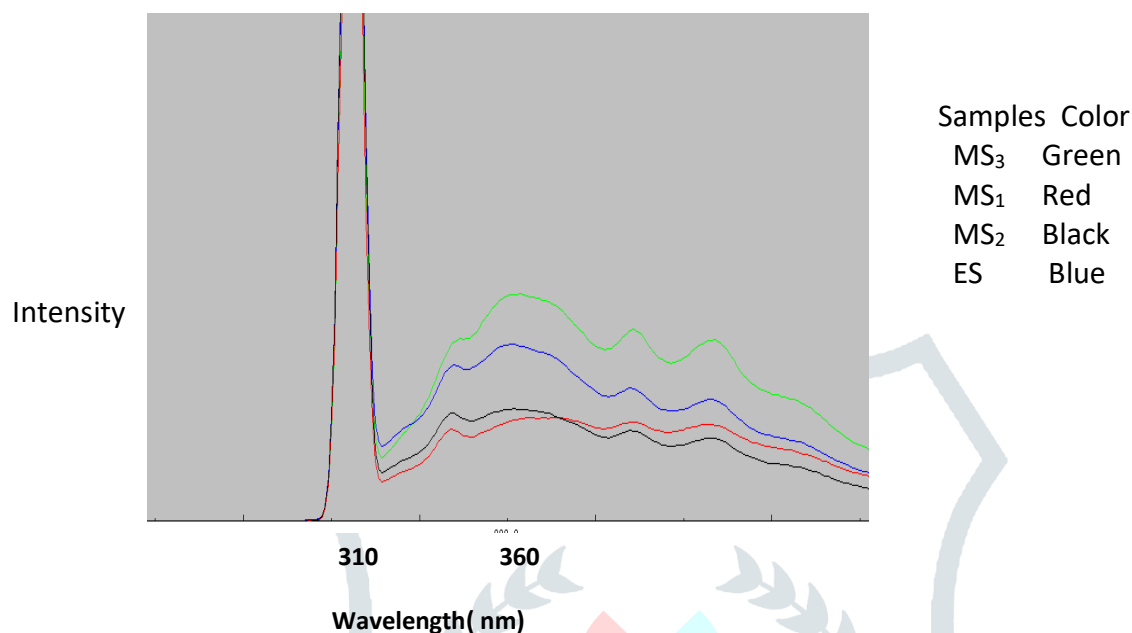


Figure 4: HPLC chromatogram for polycyclic aromatic hydrocarbons in the surface of mud flats from Al-FAW city coast.

Discussion

At least 80 ships were sunk in Shatt Al-Arab River and North West Arabian Gulf during the war, many of which were carrying oil and fuel. These ships, along with those lost during the Iran-Iraq conflict will remain a chronic source of contamination in the North Western parts of Arabian Gulf for many years (Sadiq & McCain 1993).

The beaches of Al-Faw city within Shatt Al-Arab river and its estuary as well as the North Western part of the Arabian Gulf are effected by the tidal currents leading to accumulation of soft mud. More over, this area is effected by anthropogenic deposits, petroleum hydrocarbons as poly cyclic hydrocarbons (PAHs) and chemical elements were found within the surface and subsurface mudflates (Al-Sarawi et al., 2017).

The studied area is expected to be polluted by dfferent pollutants such as the chemical elements because Shatt Al-Arab River is assigned to be the main source of pollutants to the estury of Shatt Al-Arab river and to the Northern parts of Arabian Gulf (Abaychi and DouAbul, 1985).

The City of Basrah is a major source of pollutants which were encountered in the waters of Shatt Al-Arab. Al-Imarah et al. (2003) reported the following mean concentrations for pollutants in surface sediments of the Shatt Al-Arab during 1995, they were in the range 2.63 - 15.39 µg/g for total petroleum hydrocarbons (PHCs), 53.52 - 81.6 µg/g for Nickel, and 32.6 - 62.04 µg/g for Vanadium.

Conclusion

Levels determined for polycyclic aromatic hydrocarbons (PAHs) and certain chemical elements (Cd, Co, Cu, Pb, and Zn), in the mud flats areas around the coast of Al-Faw city, Southern Iraq revealed that all sites are contaminated to a certain extent depending upon the distance from the sources of pollution. This pollution has a great effect upon fishes and will affect the fishing in the area.

Contribution of Authors

Prof. Dr. Faris J. M. Al-Imarah is the team leader and responsible for PAHs and Chemical elements analysis and manuscript writing.

Ass. Prof. Dr. Manal K. Kh. Al-Asadi has done the area investigation, sample collection, treatment of samples, and store extracts for analysis of PAHs and Chemical elements.



Prof. Dr. Faris J. M. Al-Imarah



Ass. Prof. Dr. Manal K. Kh. Al-Asadi

Acknowledgments:

The authors would like to thank the administration of Marine Science Centre/basrah University for providing their ship and tools for collecting mud samples and analysis of the PAHs and Chemical Elements.

References

- Abaychi, J. K., and DouAbul, A. A., (1985). Trace metals in Shatt Al-Arab river, Iraq. *Water Research*, 19:457-462.
- AL-Bakri, D.H., Khalaf, F., Al-Ghadban, A., (1984). Mineralogy, genesis and source of surficial sediments in the Kuwait marine environment, northern Arabian Gulf. *J Sediment Research*, 54: 1266-1279.
- Al-Hamad, S. S., Albadran, B. N., and Pournelle, J. R., (2017). Geological History of Shatt Al-Arab River, South of Iraq. *International Journal of Science and Research* 6(1), On line
- Al-Imarah, F.J.M., Al-Saad, H.T. and Al-Kaabi, A.A.W. 2003. Comparison study between levels of petroleum hydrocarbons and nickel and vanadium in Shatt al-Arab sediments before and after 1991. *Marina Mesopotamica*, 18 (2): 95-103.
- Al-Imarah F. J. M., AL-Timari A. A., and Naser A. M., (2017a). Concentrations of Polycyclic Aromatic Hydrocarbons (PAHS) in rain water fallen at Basrah City, Southern Iraq, 2011-2015. *Asian Acad. Res. J. of Multidis.*, 4(6):55-65.
- Al-Imarah, F. J. M., Amteghy, A. H., Al-Najar, G. A., and Hammood, A. Y., (2017b). Seasonal variation of some heavy metals in the tissues of two important Marine Fish Species *Epinephelus coioides* and *Euryglossa orientalis* from Iraqi marine waters, north west

Arabian Gulf. *Mesopo. Environ. J*, 3(3):30-41.

- Al-Sarawi, M., Jasser, S., and Khader, S., (2017). Recent Trace Metals Pollution in Bottom Sediments of Khor Al-Sabiya, Kuwait. *J Coast Zone Manag.*, 20(451):1-18
- Elhabab, A. A. A., and Adsani, I. (2013). Geochemical and Mineralogical Characters of the Coastal Plain Sediments of the Arabian Gulf, Kuwait. *J Geol Geosci*, 3:137.
- Isaev, V. A., and Mikhailova, M. V., (2009). The hydrography, evolution, and hydrological regime of the mouth area of the Shatt al-Arab River. *Water Resources*, 36(4):402–417.
- Khalaf FL (1978) Intertidal flat sediments of Kuwait. Kuwait Institute for Scientific Research, Research Report.
- Khalaf, F., and Ala, M., (1980). Mineralogy of the Recent intertidal muddy sediments of Kuwait – Arabian Gulf. *Marine Geology*, 35(4):331-342
- Sadiq, M. & McCain, J.C. (1993) *The Gulf War Aftermath, an environmental tragedy*. Kluwer Academic Publishers, Boston, Massachusetts.
- Subba Rao, D., and Al-Yamani, F. (1998). Phytoplankton ecology in the waters between Shatt Al-Arab and Straits of Hormuz, Arabian Gulf: review. *Plankton Biol. Ecol.* 45 (2): 101-116, 1998.

