

Organic matter content in Kuwait Bay sediments as an index of pollution

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ABSTRACT

The present study has been carried out to determine the organic matter content in Kuwait Bay sediments and the factors influencing its distribution. This area is characterised by a low organic matter content as compared to the calculated world average for nearshore sediments (i.e. 2.5% organic carbon). Human pollution has supplied more organic matter to the Kuwait Bay sediments than the organic production itself. This production is extremely low due to abnormally high salinity. The areas of the highest organic carbon content are situated just near the places of greatest human production of organic matter. Currents in the Bay prevent total pollution of the water by carrying a great part of the organic matter in suspension out to the open Arabian Gulf.

INTRODUCTION

The Kuwait Bay is long, broad and with the shape of an inclined V. It is located in the northwestern part of the Arabian Gulf. Its bottom is nearly flat except at the entrance to the Bay where colk is present. Owing to the lack of direct fresh-water drainage reaching the coast and the aridity of this area, the main detritus is supplied mostly by the northwest wind (Shamal). Part of the detritus may also be derived from Shatt Al-Arab. Into this area, the Kuwait City sewage is being pumped.

TECHNIQUE USED

Twenty-two samples were collected from an area of about 900 km² with coordinates between longitudes 47° 55' and 48° 40' E and latitudes 29° 20' and 29° 30' N with depth varying between 3 and 20 m (Fig. 1). The samples were collected in July 1976. About 20 g of washed dried samples were powdered to pass through a 200 mesh sieve using an automatic mortar. They were then preserved in clean and well-stoppered containers for analysis. The organic matter content was determined using the method described by El-Wakeel & Riley (1957) and expressed as organic carbon. The data derived from analysis are listed in Table 1, together with some other data collected from the works of Mohamed & Al-Shamlan (1977) in this area.

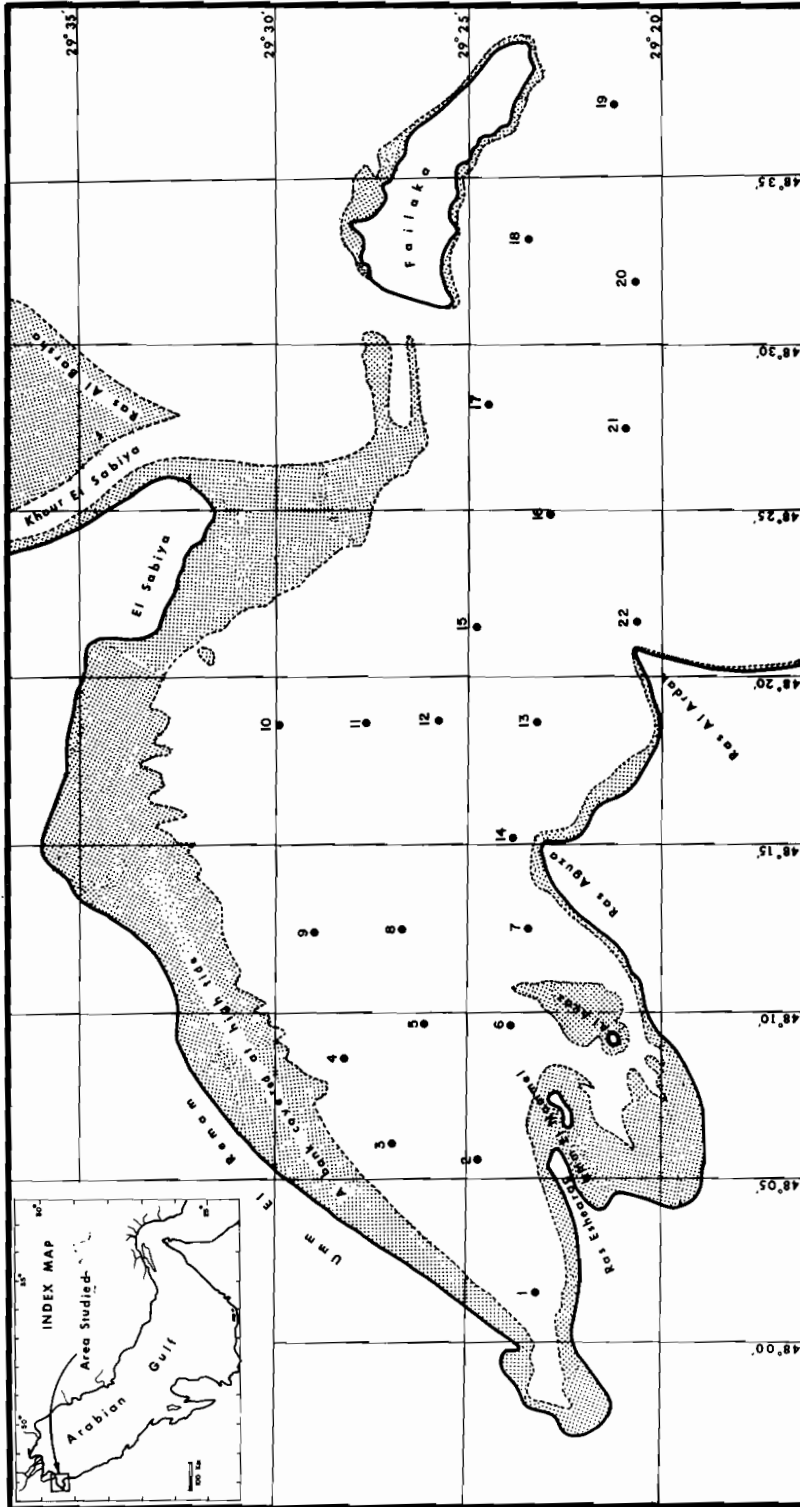


Fig. 1. The area of study and location of samples

Table 1. The data derived from the analysis of bottom sediments and waters

Sample no.	Bottom sediments					Water salinity 1 m above the bottom
	Depth in metres	Median diameter in phi	Carbonate %	Organic carbon %	Organic matter %	
1	4.2	3.20	94.5	0.034	0.058	52.35
2	13.7	5.90	56.3	0.0379	0.065	50.13
3	4.3	5.85	69.1	0.241	0.397	—
4	3.0	6.30	54.5	0.103	0.177	46.00
5	9.9	5.90	50.9	0.276	0.475	48.10
6	10.8	5.50	52.7	0.310	0.533	47.01
7	9.3	5.50	58.9	0.517	0.889	45.82
8	9.1	5.70	56.3	0.448	0.770	—
9	3.0	5.80	54.5	0.369	0.635	45.50
10	3.8	5.90	52.7	0.276	0.475	45.13
11	11.6	5.70	56.3	0.448	0.770	46.17
12	16.0	6.10	63.6	—	—	47.19
13	9.5	5.40	65.4	0.931	1.601	48.01
14	4.4	3.30	72.7	0.655	1.127	50.19
15	20.0	5.70	58.9	0.484	0.832	47.00
16	6.7	5.80	63.6	0.172	0.295	—
17	6.7	5.60	54.5	0.241	0.397	40.00
18	5.5	5.80	60.0	0.586	1.008	47.41
19	6.5	5.65	70.1	0.655	1.127	44.24
20	5.3	5.80	67.2	0.448	0.771	41.47
21	5.0	5.70	52.7	0.586	1.008	40.37
22	19.0	—	—	—	—	51.95

— = not determined.

AREAL DISTRIBUTION OF ORGANIC MATTER CONTENT

From the values of organic matter content at corresponding stations a map was drawn with contour intervals of 0.1% (Fig. 2). This map shows that the lowest organic matter content is present near the western side of the Bay where it reaches 0.058%. In the northern and northeastern parts of the Bay, the organic matter is below 0.5%. The highest amount of organic matter content is present near Umm-El-Nammel Island and the area located between Ras Aguza and the entrance of the Bay. Generally, the amount of organic matter content decreases from the southern side to the north-western and northeastern sides of the Bay where the organic matter content reaches less than 0.5%.

DISCUSSION AND CONCLUSION

In order to interpret the distribution of organic matter content in Kuwait Bay sediments, it is necessary to know the factors affecting its distribution. Therefore, scattered diagrams were made to find out the relation between organic matter content and depth (Fig. 3), organic matter content and median diameter (Fig. 4), organic matter content and salinity (Fig. 5), and organic matter content and carbonate content (Fig. 6). From

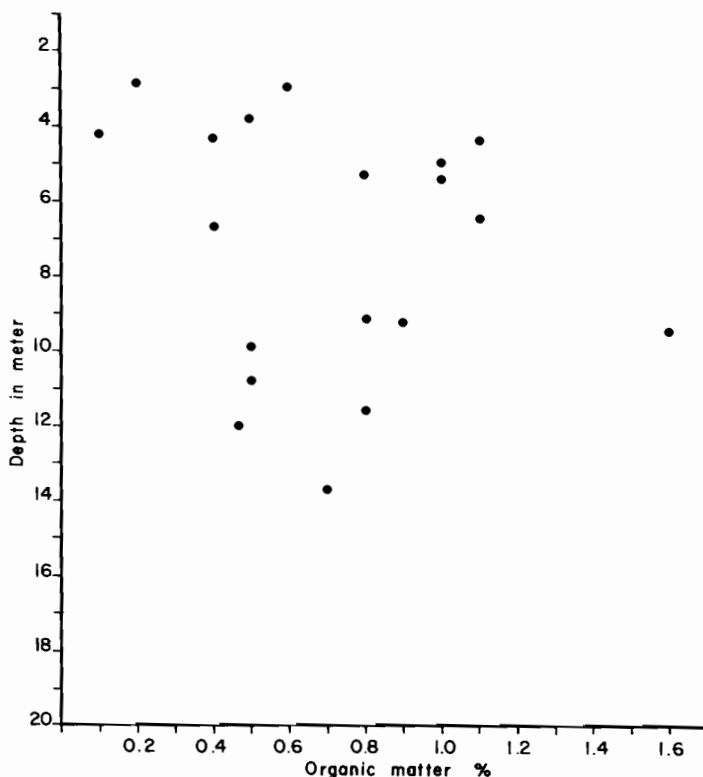


Fig. 3. The relation between depth and organic matter content.

these relations it was found that the depth, salinity and carbonate content have no direct effect on the organic matter content, while the median diameter has little effect.

Most of the bottom sediments of the Kuwait Bay are characterised by the fine deposits in the form of silt and silty clay and are located mainly throughout the northern part of the Bay, while the southern side is characterised by pelletal sand. Moreover, this area is characterised by human pollution which is pumped into it by the sewage of Kuwait City. Trask (1939) stated that both fine particles and organic detritus have similar settling velocity. Consequently, the organic matter contained in the bottom sediments has nearly the same size grades. But the finer organic materials smaller than the local sediment size may be swept out in suspension by currents to the open Gulf. Therefore, the deposition of organic matter is influenced by both the supply of the organic matter in water and current velocity through which the organic matter settles (Trask 1939).

This area is characterised by abnormal salinity which ranges from 40‰ to 52‰ (Mohamed & Al-Shamlan 1977). This may be considered as one of the most important factors limiting the distribution of aquatic organisms in Kuwait Bay (Sugden 1963). Human pollution has supplied a greater share of organic matter to Kuwait Bay sediments than organic production itself. This organic production is extremely low owing to abnormally high salinity (no research has been carried out on organic production in Kuwait Bay so far).

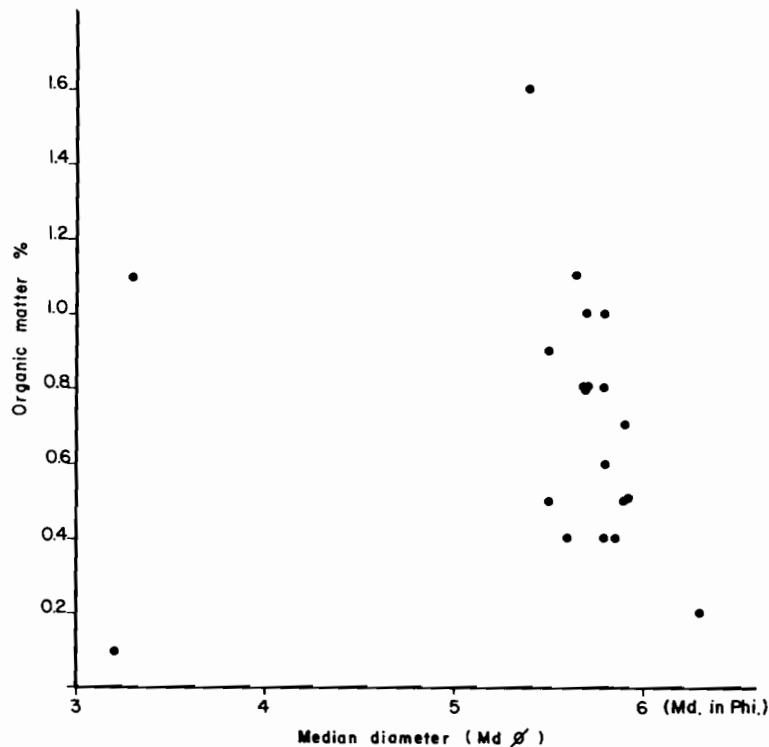


Fig. 4. The relation between median diameter and organic matter content.

The relatively high concentration of organic matter near Umm El-Nammel island and off Ras Aguza-Ras Al Ardah may be attributed to the direct pumping of the sewage of Kuwait City and industrial regions into the Bay. On comparing the organic content in Kuwait Bay sediments (0.034%–0.655%) with that present in the Gulf of Oman (0.071–0.562) and with the entire Arabian Gulf (0.031–0.201), it was found that the organic carbon content in Kuwait Bay sediments is relatively higher than that present in the Gulf of Oman and the entire Arabian Gulf (Emery 1956). However, if we compare the organic carbon content in Kuwait Bay sediments with organic carbon in some other shallow water deposits we find out that the Kuwait Bay sediments are comparatively poor (see Table 2). This low organic matter content may be due to the currents which sweep the greater parts of the organic matter in suspension to the open Gulf, in addition to the low organic production in the Bay. Therefore, it is concluded that the currents in the Bay prevent the continuous accumulation of pollutant material in Kuwait Bay sediments. They wash out the pollutant material in suspension as particulate and dissolved organic matter to the open Gulf.

From the above discussion the following conclusions are reached:

1. The deposition of organic matter content is influenced by both the supply of the organic matter in the water and the current velocity through which the organic matter settles.

2. The human pollution has supplied a greater share of organic matter to the Kuwait Bay sediments as compared to organic production.

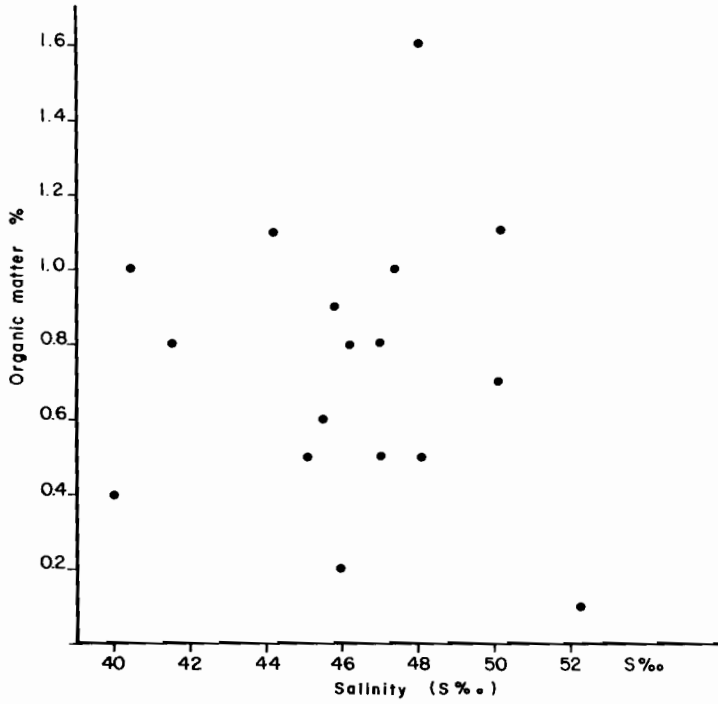


Fig. 5. The relation between salinity and organic matter content.

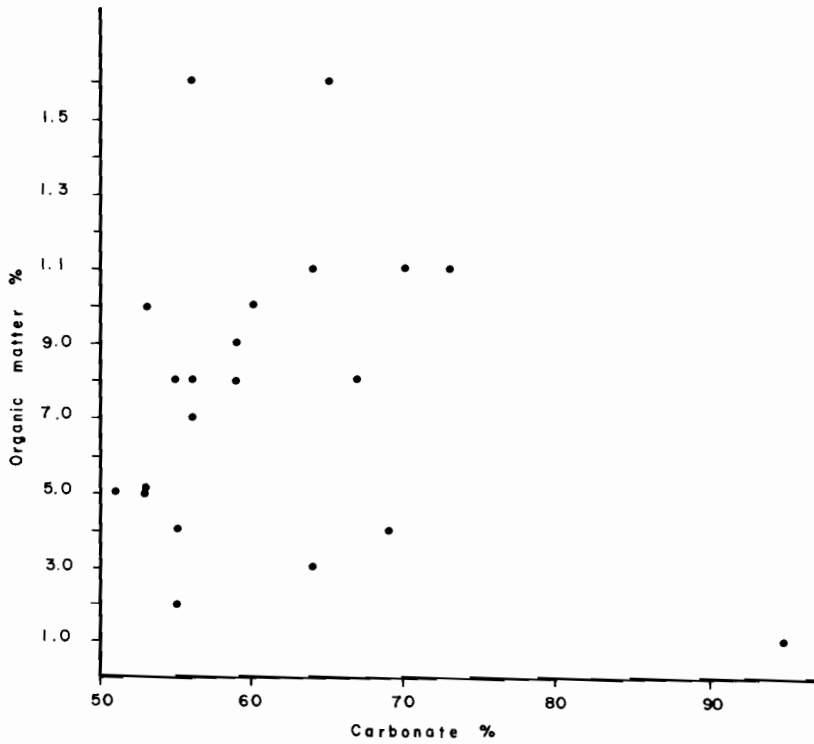


Fig. 6. The relation between carbonate content and organic matter content.

Table 2. The organic carbon content in some world shelf sediments

Location	Organic carbon %	Reference
Mediterranean sea off the Nile		
Delta	0.14-1.12	Mohamed & Anwar (1978)
Northwestern U.S.	1.0-2.0	Gross, McMeans & Ling (1967)
Japan Sea	1-2	Nino, Emery & Kim (1969)
World average for shallow water sediments	2.5	Trask (1939)
Black Sea	Above 5	Stroumov & Volkov (1957)

3. The Kuwait Bay sediments are characterised by low organic carbon content as compared with the calculated world average for nearshore sediments (i.e. 2.5% organic carbon).

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REFERENCES

- El-Wakeel, S.K. & Riley, J.P. 1957. The determination of organic carbon in marine muds: *Journal du Conseil Intern. pour l'Exploration de la Mer* 12: 180-3.
- Emery, K.O. 1956. Sediments and water of the Persian Gulf. *AAPG. Bull.* 40: 2354-83.
- Gross, M.G., McMeans, D.A. & Ling, H.Y. 1967. Continental shelf sediments, northwestern United States. *Jour. Sed. Petrology* 37: 790-5.
- Mohamed, M.A. & Al-Shamlan, A.A. 1978. The factors controlling the distribution of carbonate content in Kuwait Bay sediments. *Geologische Rundschau* 68, (In press).
- Mohamed, M.A. & Anwar, Y.M. 1978. The distribution of organic matter content in the Continental shelf sediments of the Mediterranean Sea north of the Nile Delta. *J. Univ. Kuwait (Sci.)* 5: to be published.
- Nino, H., Emery, K.O. & Kim, C.M. 1969. Organic carbon in sediments of Japan Sea. *Jour. Sed. Petrology* 39: 1390-8.
- Stroumov, E.A. & Volkov, I.I. 1957. The relation of phosphorus, vanadium and organic matter in the sediments of the Black Sea. (In Russian). *Geokhimiya* 6: 518-27.
- Sugden, W. 1963. Some aspects of sedimentation in the Persian Gulf. *Jour. Sed. Petrology* 33: 355-64.
- Trask, P.D. 1939. Organic content of recent marine sediments. In Trask, P.D. (Ed.) 1969. *Recent Marine Sediments*. AAPG, pp. 428-53.

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محتوى المواد العضوية في خليج الكويت كدليل على التلوث

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خلاصة

الغرض من اجراء هذه الدراسة هو تعيين محتوى المواد العضوية في رواسب خليج الكويت ويجاد العوامل المتحكمة في توزيعها . وقد وجد أن هذه المنطقة تمتاز بوجود نسبة قليلة من المواد العضوية وذلك بمقارنتها بالمعدل العالمى للرواسب البحرية الضحلة (٢,٥٪ كربون عضوى) . ويرجع الجزء الاكبر من هذه الرواسب العضوية الى التلوث الادمى في هذه المنطقة ، بينما يرجع الجزء الاصغر الى الانتاج العضوى نفسه . وترجع قلة المواد العضوية في هذه المنطقة الى الزيادة غير العادية في درجة الملوحة . والتيارات البحرية هى العامل المتحكم في منع التلوث الكلى في هذه المنطقة ، حيث أن التيارات تحمل جزءا كبيرا من المواد العضوية الى خارج خليج الكويت في اتجاه الخليج العربى .

