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Sharm Obhur: Environmental Consequences of 20 Years of Uncontrolled Coastal Urbanization

A.S. Basaham, A.E., Rifaat, M.A. El-Sayed and N. Rasul*

Faculty of Marine Sciences, KAU, and
**Saudi Geological Survey, Jeddah, Saudi Arabia*

Abstract. Sharm Obhur is a coastal creek located about 35 km north of Jeddah City and is an attractive recreational area. Urbanization of its coasts is progressively increasing since the eighties. This manuscript aims at the assessment of the impact of human activities on the natural environment of the Sharm through: 1) observation of the morphological changes of its shore using available aerial and satellite images, 2) carrying out an underwater survey to record the present status of the bottom, 3) using geochemical indicators to assess the possible changes in sediment properties. The present study indicates that the Sharm has suffered considerable changes since the eighties. Between 1986 and 2000 the area of the Sharm has been decreased by about 800,000 m^2, which represents an average annual loss of about 60,000 m^2 due to filling processes. This loss is actually a loss of coral reef ecosystem and its particular habitat. Physical and chemical characteristics of sediments appear to be altered compared with previous observations. Underwater photography showed that the bottom is densely covered with litter composed mainly of plastic bottles, cans and tyres, witnessing the absence of sufficient environmental awareness. To stop or slow the degradation of the area, the following measures are suggested: 1) enforcement of legislation related to management of coastal and marine areas, 2) carrying out studies and programs of coral reefs rehabilitation, 3) enforcement of public awareness activities for coral reef conservation, 4) effective control of dredging and filling, and 5) upgrading of wastewater collection and treatment.

Keywords: Red Sea, Sharm Obhur, Environmental hazards, Uncontrolled urbanization.

Introduction

Jeddah, the major city on the western Red Sea coastal plain of Saudi Arabia known as Tihama coastal plain, has grown fast during the past decades in all aspects of life. The urban area is greatly increased. The industry, transportation, trade, etc., have developed so fast that their effect on the environment especially air and sea, are very prominent. One of the parts affected by the development that took place is an attractive recreational coastal inlet known as Sharm Obhur or Obhur creek located about 35 km north of the Jeddah City.

The area south of Sharm Obhur represents the lower part of Tihama coastal plain and consists of a level or gently sloping flat surface of coralline limestone sometimes covered by a thin layer of coralline and shelly silty sand. In the area north of Sharm Obhur, a coastal strip of raised reefal limestone about 0.5 km wide lies between the coast and the relatively lower inland areas covered with soil. The soil area in the northeastern part is the lowest in elevation. This area, along with a slightly higher strip on its west, has a salt encrusted surface and, together, they constitute a coastal sabkha. Basaltic lava flows ranging in age from Eocene to Holocene occur in abundance and cover the sedimentary sequence to the east of the area, (Ali and Hossain, 1988).

The aerial and satellite images showed clearly the progressive urbanization of Sharm Obhur area since 1976. Numerous studies have been carried out on the marine environment off Jeddah and its vicinity (*e.g.* Durga Prasada Rao & Behairy, 1982; Osman, 1982; El-Rayis *et al.*, 1982; Beltagi, 1983; Dowidar, 1983; Behairy & El-Sayed, 1983; Meshal *et al.*, 1983; El-Sabarouti, 1983; El-Sayed, 1985; Basaham & El-Shater, 1994; Basaham, 1998; and El-Sayed & Niaz, 1999). While interesting, these studies are scattered and focus on diverse environmental aspects. None of these studies considered the adverse effects of urbanization, tourism and recreational activities on the coastal environment. The objective of this study is to evaluate the changes that may have resulted from the uncontrolled development and the unaware use of the resources of Sharm Obhur. The assessment process is based on the morphological and geochemical changes that took place during the past two decades.

Area of Study

Sharm Obhur is a natural cut through the coralline limestone in the Tihama coastal plain. It is an elongate water body having a length of 9.2 km and a general trend N45ºE (Fig. 1). It opens to the Red Sea proper at its southwestern end through a narrow outlet having a width of 264 m (Fig. 2). The bathymetry of Sharm Obhur was described by several authors who assigned varying estimates to its maximum depth. According to Behairy *et al.*, (1983), the maximum depth of

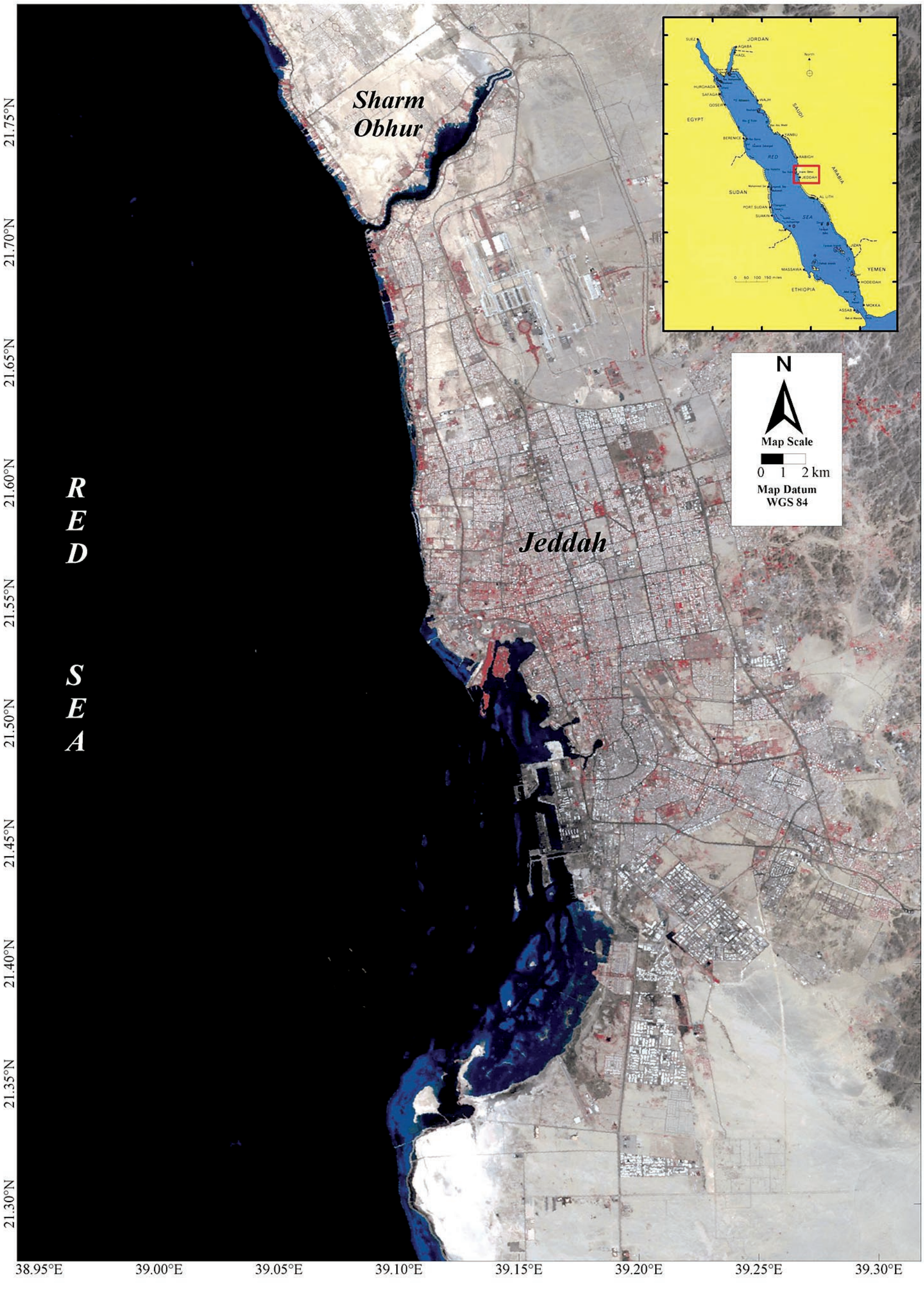

Fig. 1. The area of study (35 km north of Jeddah City, Saudi Arabia).

Fig. 2. Sharm Obhur entrance and the present time shore occupations:
(a) Sharm Obhur in 1978 (after Bemert and Ormond, 1981).
(b) Sharm Obhur in 2006.

the Sharm is 50 m. El-Abd and Awad (1992 a,b) mentioned that the maximum depth is 60 m while Basaham and El-Shater, (1994) gave an average depth of 35 m. The Sharm is shallow at the northeastern extremity (1 m) and its depth increases gradually to the opening where it reaches the maximum depth of ~50 m.

The water temperature in Sharm Obhur varies from 24.4ºC in winter to 32.2ºC in summer and increases gradually from its entrance to its upper extremity. The water salinity ranges between 39.1 and 40.2 and follows a similar increasing pattern as water temperature (Ahmed and Sultan, 1993). The hydrographic structure shows evidence of three water masses at the entrance: a surface water mass characterized by high temperature and salinity; an intermediate water mass distinguished by minimum salinity with core at 10-20 m depth, and a bottom water mass that reaches maximum salinity. This structure yields a two-layer flow at the entrance; inflow of low salinity water at both surface and intermediate depths and outflow of more saline water at the bottom. The evaporation rate ranges between 0.599 cm/day (in May) and 0.815 cm/day (in February). The water inflow rate ranges between ~151 m^3/sec (in November) and ~302 m^3/sec (in February), the outflow rate ranges between ~151 m^3/sec (in November) and ~402 m^3/sec (in February) (El-Rayis and Eid, 1997).

Usually coastal lagoons and sharms in the Red Sea are areas of coral growth. Because of their sheltered nature, they also furnish nursery grounds for many marine and aquatic fauna and flora. Bemert and Ormond (1981) identified more than 100 species of marine organisms dwelling in Sharm Obhur.

Materials and Methods

Field Survey

The coastal zone of Sharm Obhur was surveyed to record and photograph the types of shore occupation, activities and to recognize its present status.

The satellite images of Sharm Obhur Landsat TM (7 bands) for the years 1986 and 2000 were processed to extract the information concerning the changes that took place along the Sharm's shores during this period. The process comprised rectification of the images so as to define the exact coordinates. The rectification and processing steps went as follows: first, the Landsat TM image for Sharm Obhur (1986) was rectified using a set of admiralty charts and topographic maps (scale 1:50,000) from the Saudi Ministry of Petroleum and Mineral Resources (Edition 1-SA-ASD). The Landsat TM image for Sharm Obhur (2000) was then rectified using image to image rectification to realize complete matching of the coordinate systems for both the 1986 and 2000 images. The high-resolution vector maps were digitized from the rectified images of 1986 and 2000 and digital high-resolution vector outline maps for the shores of Sharm Obhur were compiled. Based on area calculation, the shoreline changes between 1986 and 2000 were computed.

Thirty-five samples from the bottom sediments of Sharm Obhur were collected using a Van Veen grab sampler. The sampling grid was designed to cover evenly the entire study area, and selected sites at the entrance and the middle part of Sharm Obhur bottom were photographed to record the present status (Fig. 3). The grain size analysis and the statistical parameters (Folk, 1980) were carried out to identify the type of bottom sediment.

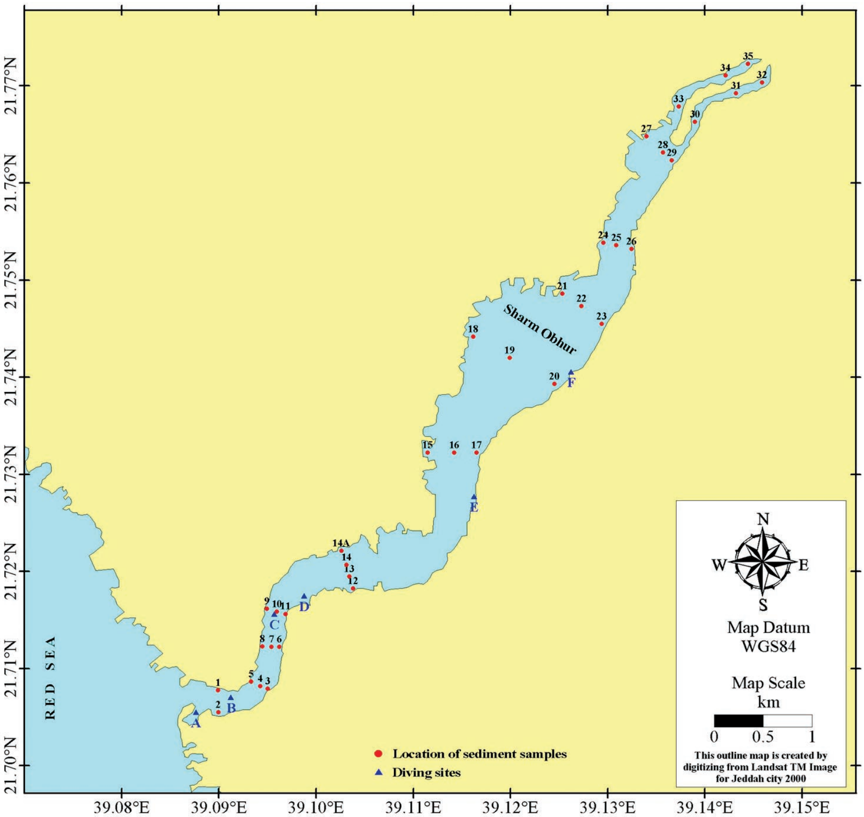

Fig. 3. Locations of the bottom sediment sampling and bottom photographs sites.

Major and trace elements analyses were carried out using powdered sediments. The samples were completely dissolved using a mixture of nitric and hydrofluoric acids in Teflon vials heated, under reflux, at 140ºC. Extracts were then heated to near dryness and the residue was taken up in 20 ml of 0.1M HCl. The metal concentrations were determined against standard metal solutions using Atomic Absorption Spectrophotometry technique (Varian 250+ SpectrAA). Carbonate content was determined by leaching weighed portions of sediments with 20% HCl. The accuracy and precision of our results were checked by analyzing ten replicates of sediment reference material LKSD-4 supplied by the Canadian certified reference materials project (CCRMP), and sample BCSS-1 supplied by the National Research Council of Canada (NRCC). The results indicated good agreement between the certified and the analytical values.

Results and Discussions

Shoreline Setting

The entrance of Sharm Obhur at its southwestern part is narrow (264 m) relative to its length (9.2 km). This entrance is occupied at the southern bank of the Sharm by a wavebreaker constructed recently. This wavebreaker protects the boats and vessels against waves during sailing through the entrance, although it reduces the water exchange between the Sharm and the open Red Sea and minimizes the rejuvenation of the Sharm's water. The entire shore of Sharm Obhur is now occupied by summer resorts, hotels, villas and other recreational facilities such as jetties and marinas. Field observations showed that most of the backreef zone along Sharm Obhur was subjected to filling, dredging and cutting processes. Furthermore, uncontrolled disposal of municipal sewage mostly untreated has been observed along the shores of the Sharm. Analysis of Sharm Obhur's Landsat TM images for the years 1986 and 2000 (Fig. 4a,b) reveals the shore modification that took place between the respective years. Figure (4a), is produced by laying Landsat TM image 1986 over that of 2000, and the process yields the areas of dredging that took place between the respective years. Figure (4b), is produced by reversing the superimposition process, and the areas of filling were delineated. Using area subtraction, it appears that the sharm has lost 788,729 m^2 of its total area. Environmentally, this means an equivalent loss of coral reef and related living communities.

Bottom Status of Sharm Obhur

Between 1974 and 1979 more than 100 different species of marine fauna and flora have been identified and photographed in Sharm Obhur (Bemert and Ormond, 1981). The underwater survey and photography in the frame of this study showed the presence of diverse fish and coral species such as the clownfish, butterfly-fish, parrot-fish, sponges, branched coral, gorgonian coral, faviid coral, massive coral, brain coral, encrusting coral, anemone-like coral (Goniopora), Acropora, and bivalves. However, many of the species reported by Bemert and Ormond (1981) could not be observed. Photos (1 and 2) show the disastrous impact of human activities on the bottom environment as huge quan-

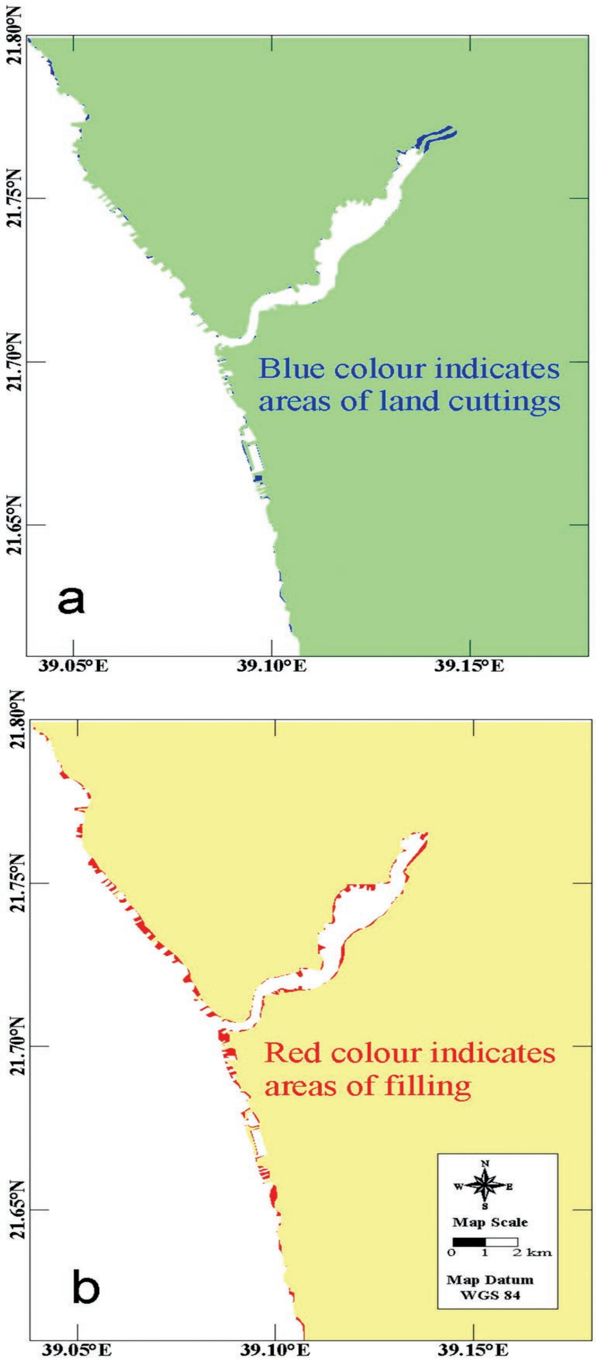

Fig. 4. The filling and dredging features along Sharm Obur shores: (a) Dredging areas, (b) Filling areas.

Photo 1. The litter covering the bottom of Sharm Obhur at site E (see Fig. 3).

Photo 2. The litter covering the bottom of Sharm Obhur at site F (see Fig. 3).

tities of cans, ropes, pipes, glass, tyres and other metallic objects are covering wide areas on the bottom of Sharm Obhur. The anthropogenic wastes covering the bottom increase from the entrance eastward; the bottom is densely covered by litter at site F (Fig. 3). In addition, the anchors of yachts and boats are destroying the coral substratum and the noises produced jet-skies engines and similar machines may disturb the environment and contribute to the decrease of the biodiversity. The impact of uncontrolled practices on the different aspects of marine environment was reported in detail by Davenport and Davenport (2006).

Major and Trace Elements

Most of the detrital sediments are conveyed to the Sharm basin via intermittent runoff from Wadi Al-Kura (at the eastern end of the Sharm), wind and vigorous filling processes taking place on both sides of the Sharm. Sandy sediments are mostly composed of biogenic carbonates resulting from the erosion of coral reefs and debris of calcareous organisms (Basaham and El-Shater, 1994 and Al-Lihaibi *et al*., 1999) and they are concentrated on the northern side and the entrance of the Sharm where agglomerations of living corals are present.

Distribution of the elements Al, Fe, Mn, Cu, Zn, Ni, Cr and V in the bottom sediments revealed that concentrations are higher in sediments of the axial deep channel than in sediments of the shallow near shore zone particularly the northern border of Sharm (Table 1 and Fig. 3). Evidence of the dominance of a detrital (terrestrial, lithophellic) origin for this group of elements is given by the reverse relationship between all the elements and the carbonate content in the sediments (Fig. 5).

Table 1. Grain size parameters, carbonate content and metal concentrations in the bottom sediments of Sharm Obhur.

S. no.	Sand %	Silt %	Clay %	$CaCO_3$ %	Al ppm	Fe ppm	Mn ppm	Cu ppm	Ni ppm	Zn ppm	Cr ppm	V ppm
1	75.1	21.4	3.5	80.5	5513	13577	108	18	16	32	59	103
2	76.5	22.1	1.4	30.5	14191	30036	311	29	28	51	70	158
3	64.1	32.5	3.4	64.5	10931	17567	120	16	20	35	49	93
4	50.3	45.1	4.6	73.5	7504	13017	109	14	15	32	50	85
5	54.3	41.8	3.9	78.5	7899	8773	118	9	10	21	53	88
6	21.4	74.7	3.9	62.0	8283	20228	186	21	25	40	58	94
7	11.4	85.1	3.5	46.5	9334	24770	208	28	30	49	63	103
8	94.1	4.1	1.8	75.5	5828	6230	54	8	13	22	47	90
9	80.1	16.4	3.5	76.5	4282	6219	51	9	7	20	40	81

Table 1. Contd.

S. no.	Sand %	Silt %	Clay %	$CaCO_3$ %	Al ppm	Fe ppm	Mn ppm	Cu ppm	Ni ppm	Zn ppm	Cr ppm	V ppm
10	2.4	93.0	4.6	50.5	12990	27402	244	25	28	45	68	101
11	95.8	2.5	1.6	47.5	1294	1696	8	2	3	14	34	75
12	7.4	87.9	4.7	50.5	11527	27531	240	24	26	45	65	104
13	6.5	90.8	2.7	61.0	9953	22437	190	19	18	36	61	93
14	18.8	78.8	2.4	82.5	8138	7824	81	8	4	23	35	63
14A	54.5	40.5	5.0	86.5	5168	4590	51	5	5	23	36	68
15	94.8	3.1	2.2	86.0	2688	2474	22	5	2	13	38	80
16	7.3	88.9	3.8	50.5	10610	30857	264	26	27	43	73112	
17	50.3	45.2	4.4	69.0	6249	15806	133	15	15	32	50	90
18	84.0	11.7	4.3	73.5	5268	8159	81	9	12	21	52	93
19	12.5	83.5	4.0	50.5	12716	30582	246	24	28	48	64	96
21	76.9	18.2	5.0	70.5	2645	7827	82	10	8	27	56	94
22	9.5	87.8	2.7	22.0	22387	42479	358	42	42	61	96	137
23	34.1	63.6	2.3	31.0	23491	33306	313	30	33	46	86	143
24	21.1	73.8	5.1	32.0	9924	40915	329	42	44	58	98	155
25	15.2	82.6	2.2	10.5	14181	46589	382	45	48	73	106	164
26	22.8	73.7	3.5	10.5	22272	39213	390	45	47	62	123	186
27	16.8	80.3	3.0	18.0	17320	47404	369	45	49	66	116	166
28	49.6	47.5	3.0	16.5	37923	40979	409	40	49	64	94	153
29	6.2	91.0	2.8	21.5	12295	34702	313	37	36	48	64	129
30	3.5	93.7	2.8	36.0	12466	33713	302	32	29	48	63	142
31	18.2	79.3	2.4	35.5	14343	29321	263	28	27	40	77	148
32	29.6	68.1	2.3	24.5	15155	36058	401	38	38	51	102	172
33	35.7	62.4	1.9	27.5	12197	37081	277	30	35	58	73	135
34	18.4	77.3	4.3	50.5	7930	31352	272	33	31	47	49	98
35	4.1	92.7	3.2	22.0	14531	18034	321	23	17	33	5	34
Mean	37.8	58.9	3.3	49.3	11412	23964	217	24	25	41	65	112
St. D.	30.8	30.7	1.0	23.9	7116	13738	123	13	14	16	25	36
Max.	95.8	93.7	5.1	86.5	37923	47404	409	45	49	73	123	186
Min.	2.4	2.5	1.4	10.5	1294	1696	8	2	2	13	5	34

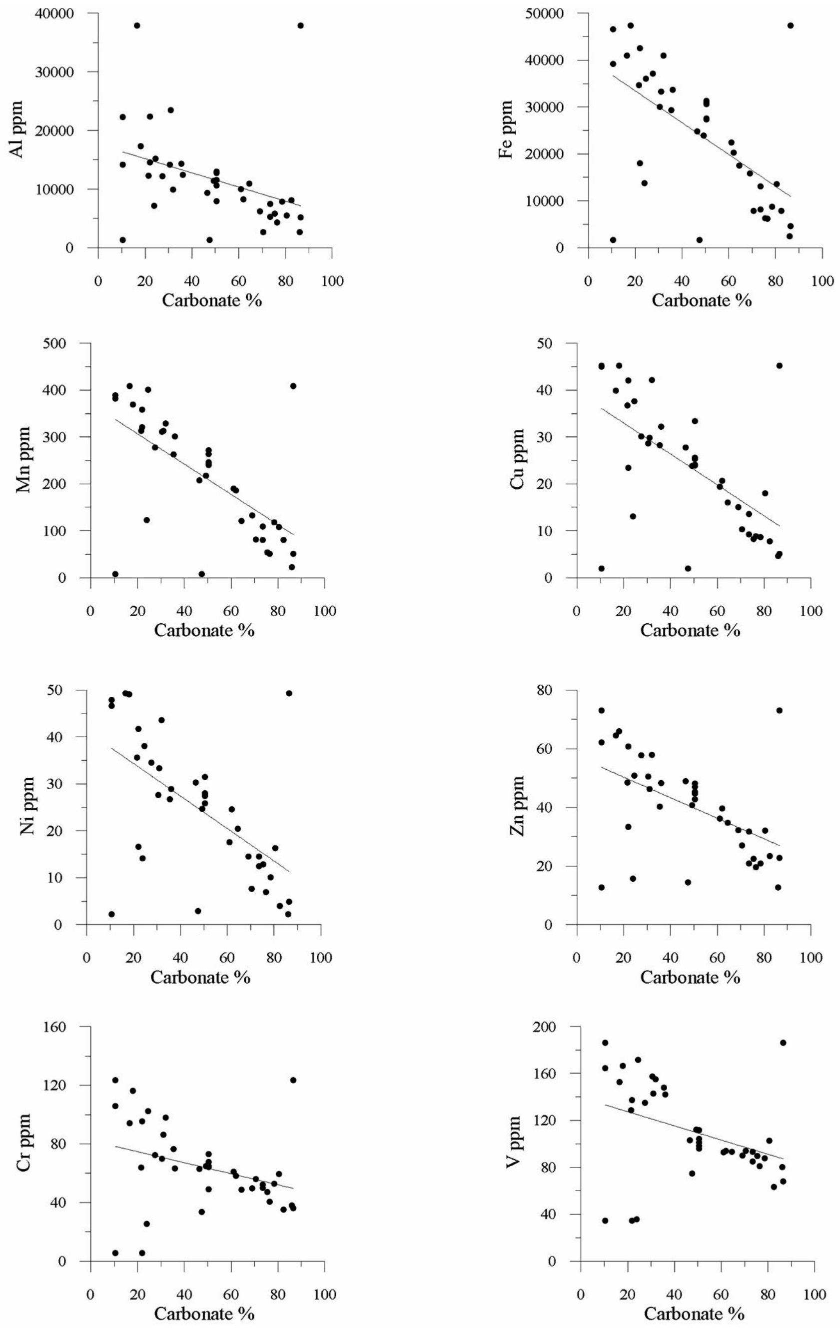

Fig. 5. Plot of the concentrations of metals against carbonate content of the sediment samples. Notice the dilution effect of biogenic carbonate materials.

The major elemental composition generally reflects the composition of the source material. The geologic formation of Jeddah area has been described by several authors (Skipwith, 1973; Behairy, 1980; Behairy *et al.*, 1985; and Spencer *et al.*, 1988). The coastal plain of the area surrounding Jeddah extends to a maximum of 10 km eastward from the coastline. The eastern part of it is covered with thick alluvial deposits derived from the adjacent mountains. Late Quaternary trap basalts occur north of Jeddah. The fringing mountains are mostly composed of granite, granite gneiss, andesite, rhyolite, diabase and greenstone (Behairy *et al.*, 1985).

Comparing the results of this study with the data of Behairy *et al.*, (1985) composition of the eolian dust collected from the area, it appears that Fe concentration is almost the double of its concentration in the dust while Mn as well as Cu are significantly higher in the dust than in the studied sediments (Table 2). It is therefore concluded that wind transport could not account for a great part of the surface sediments of the studied area. Filling and episodic drainage of the coastal plain and fringing mountains are most likely the main terrestrial sediment transport mechanisms to the area. The average Fe concentration in the sediments is twice that of Al and this has been attributed to enrichment of sediment with iron minerals. On the other hand, aluminium is generally associated with fine sediment fraction particularly with clay minerals. The presence of Fe in higher concentrations relative to Al may result from post-erosion processes, during transportation and after sedimentation. Processes such as adsorption and precipitation may lead to trapping of the solubilized iron on the surface of the fine particles and consequently result in the enrichment of iron relative to the conservative Al. The non-conservative behavior of iron in estuarine environment is usually attributed to these processes (Eaton, 1979; Duinker *et al.*, 1982; Edmond *et al.*, 1985; and El Sayed, 1988). Calvert (1976) examined the relationship between iron and aluminium oxides in recent sediments from the Gulf of Paria. The author concluded that any iron exceeding that represented by the average Fe_2O_3/Al_2O_3 ratio of ~0.52 can be used as a measure of the amount of authigenic minerals present in the sediment. Unequal dilution of the terrestrial material with biogenic carbonate is another possibility.

Table 2. Comparison between the average concentrations of Fe, Mn and Cu (μg g^{-1}) in the sediments of the Sharm and in the eolean dust collected in the same area.

Element	Fe	Mn	Cu
Aeolian dust (Behairy *et al.*, 1985)	13600	755	203
Average conc. in sediments (this study)	23264	217	24

The detrital character of Mn, Cu, Ni, Zn, Cr and V is indicated by their high degree of correlation with Fe and Al that are largely detrital in origin (Fig. 6 & 7). This trend means that these elements are mainly transported and held within the lattices of the detrital minerals. The better agreement with iron (Fig. 6) suggests that all the elements are preferentially associated with iron oxide which may exist, besides being within the lattice, as particle coating or dispersed oxide.

The carbonate fraction of the sediments of Sharm Obhur constitutes approximately 50% ± 23.9, nevertheless, higher values reaching 80%, are found on the northern borders and at the entrance. Carbonate sediments are evidently poor in trace and major elements (except Ca, Mg, Sr and Ba) and will certainly play the role of diluter with respect to these elements. However, the dilution effect may be differential which means that not all the elements will be diluted in the same proportion due to the possible incorporation of some trace elements in biogenic carbonates (Comans and Middelberg, 1987; and Rifaat *et al.*, 1992) and the presence of discrete heavy minerals in the coarse sand fraction of the sediment.

This possibility was examined by plotting the element/iron ratio against the sand fraction. The plots (Fig. 8) show that the ratios of Cr, V, Zn, and to a lesser extent Cu, to Fe gently increase with the increase of the sand contribution to the bulk sediment. This increase is suddenly accelerated when the sand content became greater than about 80%. Mn and Ni ratios to iron are almost constant over the entire range of concentration of the sand fraction. The possible interpretation of this relationship is that Fe which is predominantly found associated with the fine (silt) fraction is much more diluted by the coarse carbonate fraction than Cr, V, Zn and Cu probably due to the incorporation of these elements in the calcareous shells (Basaham and El Sayed, 1998). The sudden increase in the element-iron ratio at higher sand content may result from the presence of discrete heavy minerals bearing these heavy metals. These same elements showed the same relationship with the carbonate content in the sediments of the Arabian Gulf (Basaham and El Sayed, 1998). When the ratios were plotted against the carbonate content, the relationship was disturbed at high carbonate concentration, which means that the sudden increase may result from the presence of heavy minerals.

Past and Present

Figure 9 shows the results obtained for the content of Fe, Al, Mn, Cu, Ni, Zn, Cr and V elements in Sharm Obhur sediments together with those reported previously by Behairy *et al.*, (1983 at Sharm Obhur), El-Rayis (1990 at Jeddah, south of Sharm Obhur), Rifaat (1994 at Jeddah, north of Sharm Obhur) and El-Sayed *et al.*, (2002 at Jeddah, just south of Sharm Obhur). It is evident from

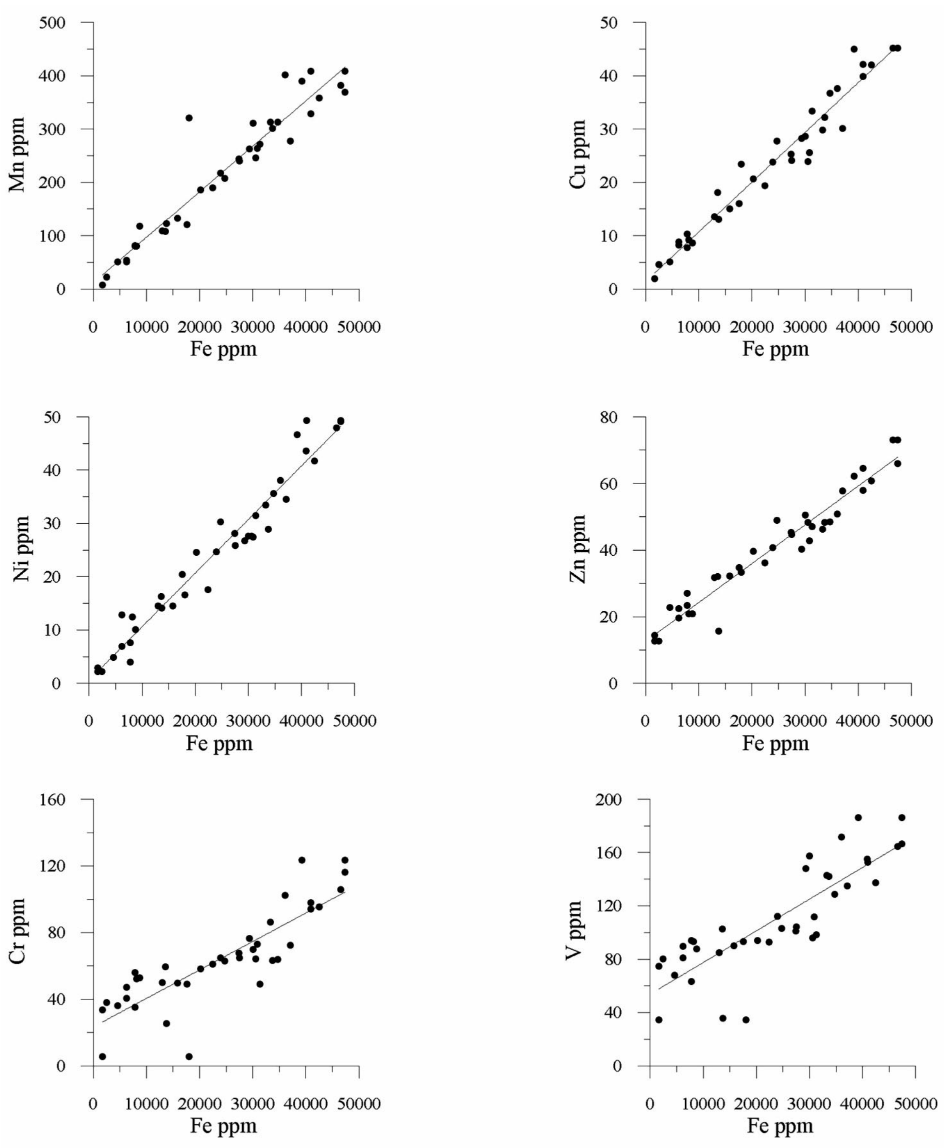

Fig. 6. Relationships of iron content (Fe) and the concentrations of the other metals. The very good agreements are indicative of the detrital origin of the metals.

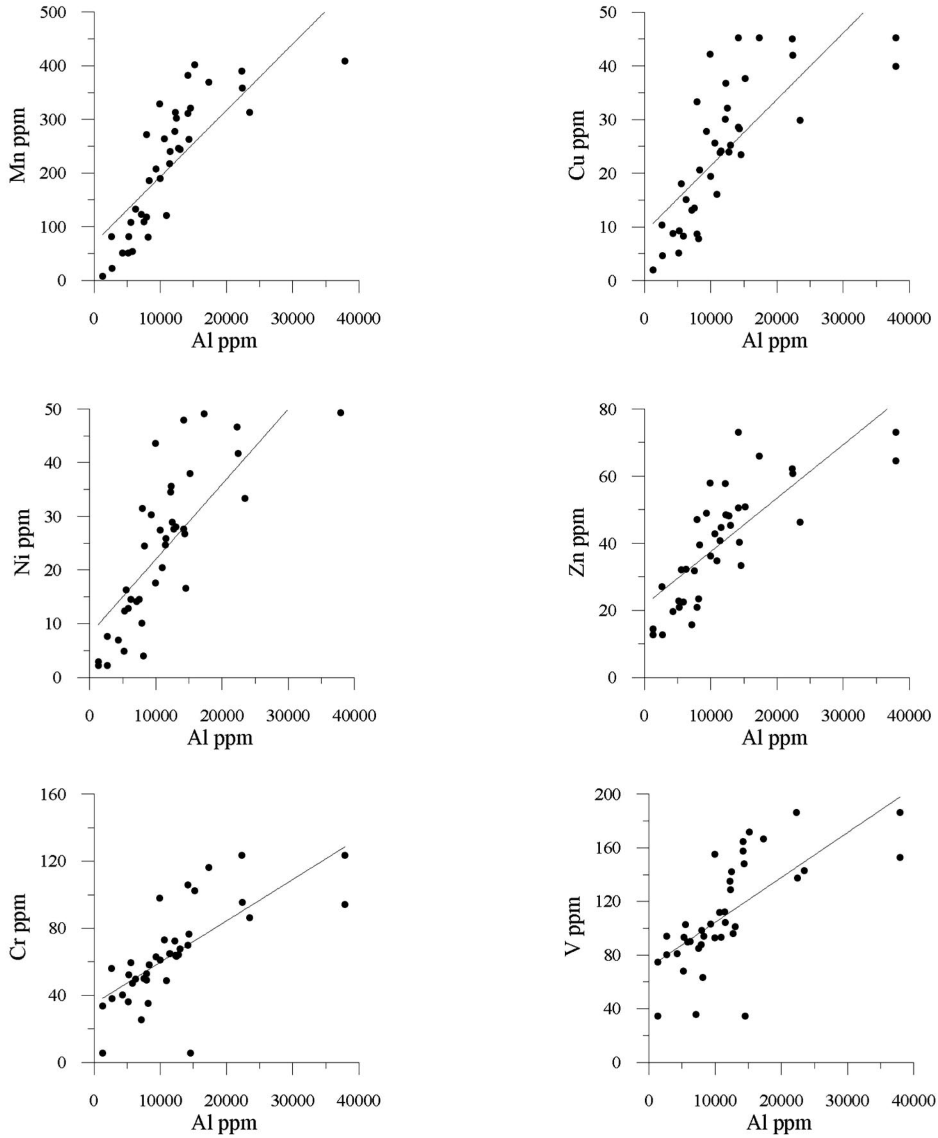

Fig. 7. Relationships of aluminium content (Al) and the concentrations of the other metals. Notice the dispersion of the points relative to that of Fig. 6.

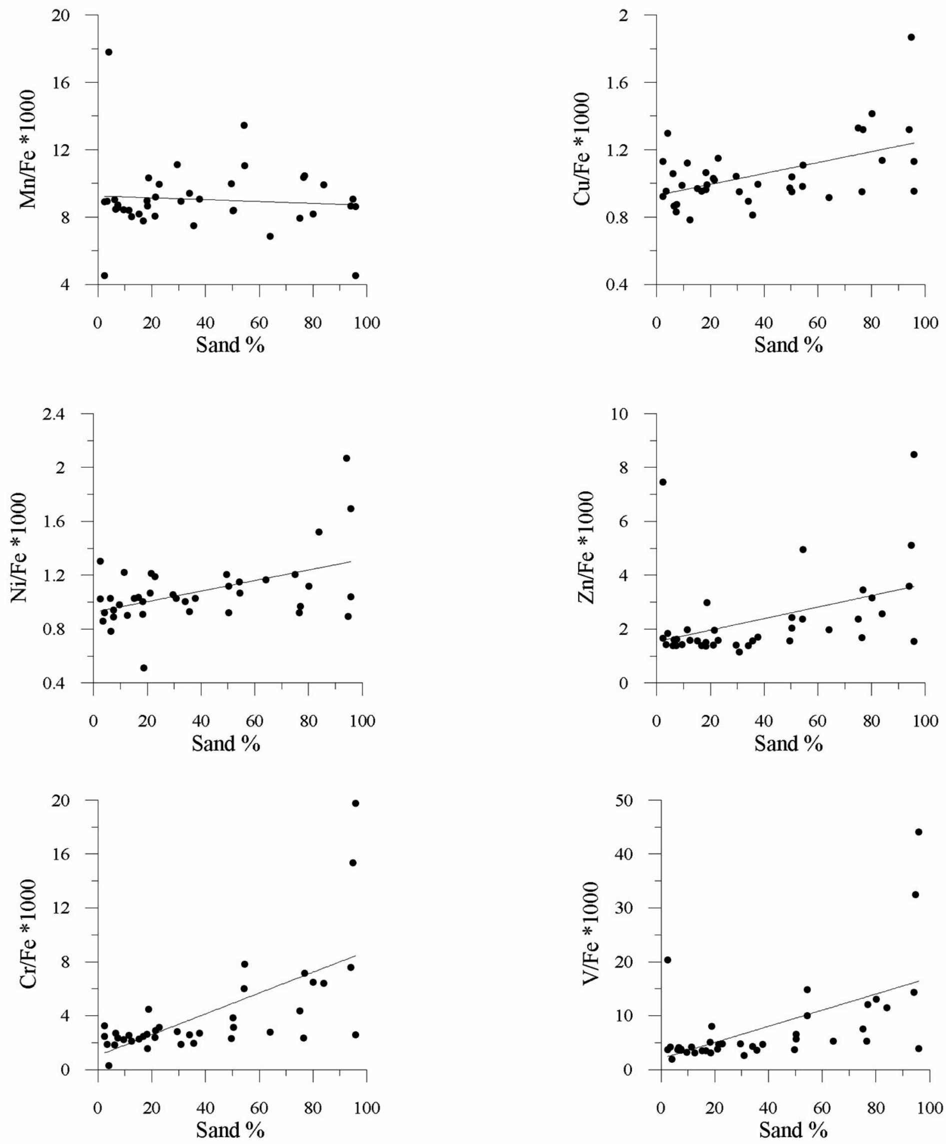

Fig. 8. Plot of the metal/Fe ratios against sand content of the sediment samples. Notice the sharp increase of the ratio for V, Cr and Zn at sand values higher than 80% while homogenous values are observed for the other metals.

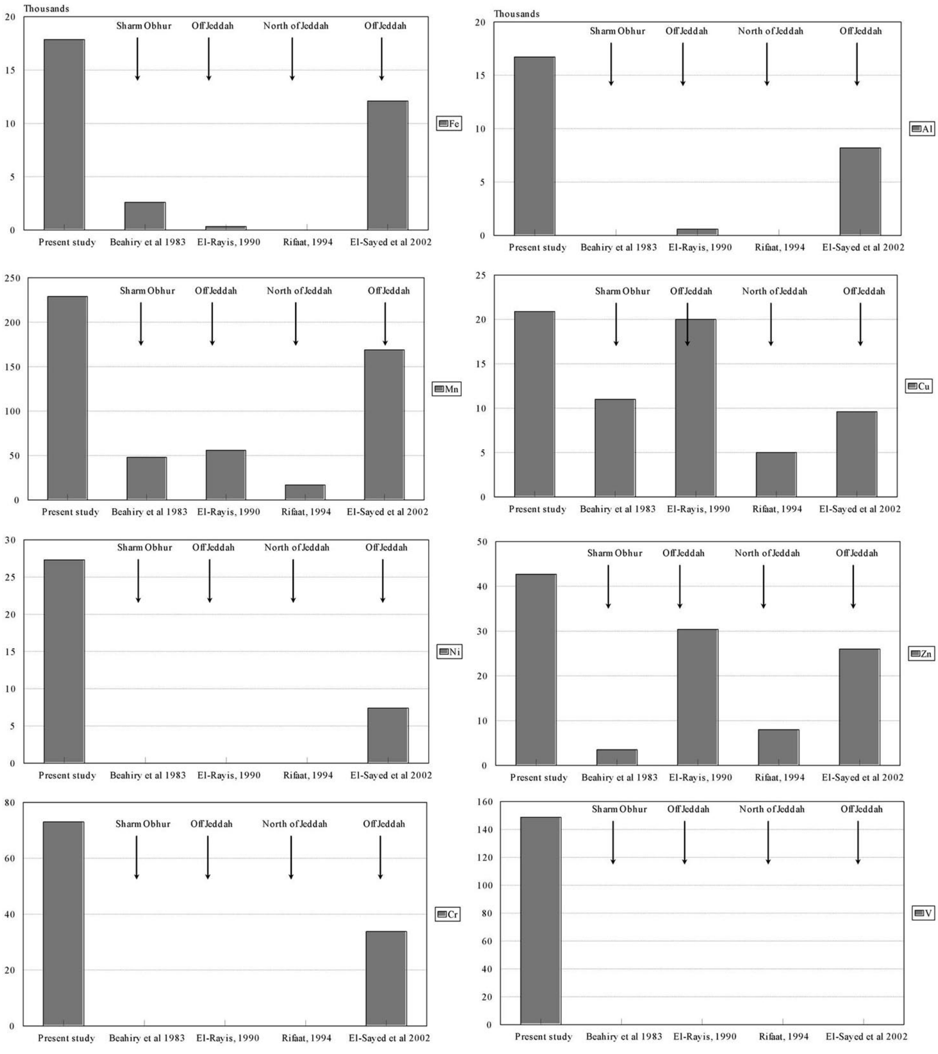

Fig. 9. Comparison of the levels of metals in the present study with those of the previous studies along Jeddah and Sharm Obhur shores. Notice the increase of metals concentrations in the present study relative to the previous studies.

Fig. 9 that the concentrations of metals in Sharm Obhur sediments obtained in the present study are much higher than those previously mentioned. Regardless of the discrepancy of chemical techniques used to digest the sediments; the increase in metal concentrations in sediments of Sharm Obhur may be the result of either enrichment of natural terrestrial deposits in the sediments of Sharm Obhur or the increasing of human activities in and along its shores compared with sediments from outside the Sharm. The semi-enclosed nature of Sharm Obhur may lead to trapping of the terrestrial deposits and increasing its quantities over those in the surrounding Red Sea proper sediments and it may hinder washing out of the anthropogenic human inputs.

The obtained data on the distribution of Fe, Al, Mn, Cu, Zn, Cr, and V elements in sediments of Sharm Obhur suggest that their concentrations have greatly increased during the past 18 years. The factor analysis statistical processing of data (Table 3) reveals that occurrence of these elements in sediments of Sharm Obhur are mainly controlled by three factors:

Table 3. Factors controlling metal distributions in the bottom sediments of Sharm Obhur.

Variable	Factor 1	Factor 2	Factor 3
Sand	–0.36	–0.88	–0.14
Silt	0.37	0.88	0.11
Clay	–0.24	0.13	0.79
Mean size	0.32	0.91	0.16
Sorting	–0.19	–0.78	–0.03
Skewness	0.17	–0.51	0.51
Kurtosis	0.06	0.34	0.45
$CaCO_3$	–0.85	–0.31	0.22
Al	0.77	0.22	–0.07
Fe	0.91	0.37	–0.01
Mn	0.87	0.42	–0.08
Cu	0.91	0.36	–0.01
Ni	0.94	0.29	0.03
Zn	0.92	0.30	0.04
Cr	0.92	0.00	0.16
V	0.93	–0.06	–0.06
Eigen value	7.68	4.15	1.24
Percent of trace	48.02	25.91	7.77
Cummulative percent of trace	48.02	73.93	81.70

Factor 1

This factor is a detrital-minerals factor in which the elements are partially associated with silt fractions of the sediment while sands act as dilutant. The factor denotes that most of the minerals transported from the land to Sharm Obhur are in the silt size. Moreover, this factor displays that the studied metals in sediments of Sharm Obhur are related to one source and their concentrations are dependent on the mineral types. The other source may be the authigenic/ anthropogenic inputs.

Factor 2

It represents the interaction of an oxidation-reduction potential and sorting factor in which the concentration of iron, manganese, copper, nickel and zinc are controlled by the physicochemical conditions of the ambient water that transform the metals from the dissolved state to the solid phase. This factor shows that these elements are also enriched in the silt fractions and that the fine sediments are the favourable sites for the precipitation/accumulation of metals from solution.

Factor 3

This factor represents a low-energy environment in which the clay fraction of sediment affects the skewness and kurtosis shifting their values to fine skewed and leptokuritc classes. The weakness of the currents prevailing in Sharm Obhur hinders the washing out of the fines from the sediment and favours their precipitation (see section 4 for details). Moreover, the weakness of the currents in Sharm Obhur impedes the washing out of the inputs of human activities leading to increased levels of contamination by metals of anthropogenic origin.

Conclusions

This study showed that the shore and bottom environments of Sharm Obhur have been subjected to deterioration due to the uncontrolled development and the improper practices of humans. The backreef zone in Sharm Obhur is disappeared and consequently the nursery ground for many marine organisms has been vanished. The bottom of Sharm Obhur looks like a litter dumping site. The levels of toxic metals such as nickel, copper and zinc have increased in bottom sediments of Sharm Obhur most probably due to human activities. As a result today’s biodiversity seems less than 20 years ago.

To stop environmental deterioration and permit system recovery, we propose the following measures:

1 – Enforcement of legislation related to management of coastal and marine areas.

2 – Carrying out studies and programs of coral reefs rehabilitation.

3 – Enforcement of public awareness activities for coral reef conservation.

4 – Effectively controlling of dredging and filling operations.

5 – Upgrading of wastewater collection and treatment.

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شرم أبحر: التبعات البيئية للاستخدام العمرانى العشوائى على امتداد عشرين عاما

على سعيد بسحم ، و أحمد السيد رفعت ، و محمد عبد الخالق السيد ، و نجيب رسول*

كلية علوم البحار ، جامعة الملك عبدالعزيز ، جـــدة

* *هيئة المساحة الجيولوجية ، جـــدة - المملكة العربية السعودية*

المستخلص. شرم أبحر (خليج أبحر) عبارة عن ذراع بحري يتغلغل في السهل الساحلي لتهامة ، يقع على بعد ٣٥ كم شمال وسط مدينة جدة ، وهو منطقة جذب سياحي، ومنذ عقد الثمانينات يعاني الشرم من التقدم العمراني والسياحي على شواطئه. ويهدف هذا البحث إلى تقييم تأثير الأنشطة البشرية على بيئة الشرم الطبيعية وذلك من خلال الاستراتيجية التالية: ١) رصد التغيرات المورفولوجية للساحل باستخدام الصور الجوية وصور الأقمار الصناعية، ٢) القيام بالتصوير الفوتوغرافي لقاع الشرم لرصد حالة التلوث، ٣) استخدام بعض الأدلة الجيوكيميائية لمعرفة مصادر الرواسب.

أظهرت الدراسة أن شرم أبحر يعاني تغيرات ملحوظة منذ الثمانينيات، ففي الفترة بين عامي ١٩٨٦ و٢٠٠٠م انخفضت مساحة الشرم بمقدار حوالي ٨٠٠٠٠٠ متر مربع بمعدل سنوي يبلغ حوالي ٦٠٠٠٠ متر مربع وهذة المساحة المفقودة هي في الواقع عبارة عن فقد في مسطحات الشعاب المرجانية وبيئتها الأحيائية، إلى جانب ذلك أظهرت دراسة الخواص الطبيعية والجيوكيميائية لرواسب القاع تغيرات واضحة مقارنة بما كانت عليه في السابق، كما أظهر التصوير تحت الماء أن القاع مغطى بمخلفات صلبة تتكون أساسًا من زجاجات البلاستيك وعلب المشروبات الغازية وإطارات السيارات مما يشهد على غياب الوعى البيئي الكافي. وحتى يمكن إيقاف أو إبطاء التدهور لبيئة الشرم فقد تم اقتراح الإجراءات التالية:

١) استخدام برامج مراقبة (تحذير) دورية يتم من خلالها قياس بعض الخواص الطبيعية والكيميائية وبعض الملوثات العضوية وغير العضوية في مياه ورواسب وأحياء الشرم، ٢) وقف أو الإقلال بقدر الامكان من عمليات الردم وتدمير الشعاب المرجانية وبيئاتها، ٣) وقف إلقاء المخلفات من جميع الأنشطة الموجودة بالمنطقة، ٤) إجراء الأبحاث اللازمة لاستعواض الفاقد من الشعاب المرجانية، ٥) بث حملات إعلامية مرئية ومسموعة تهدف إلى توعية الأفراد بيئيا خاصة عن البيئة البحرية بغرض زيادة الوعى البيئي.