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Texture and chemistry of the bottom sediments and beach sands of the Gulf El-Kanayis, western Mediterranean coast of Egypt

Teksturalna i kemijska svojstva sedimenata dna i pješčanih plaža u zaljevu El-Kanayis, Zapadna Mediteranska obala Egipta

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INTRODUCTION

The Gulf El-Kanayis forms a part of the N-W shelf of Egypt and extends for about 85 km between Sidi Abdel Rahman and Ras El-Kanayis (Fig. 1). The average width of the continental shelf in the gulf is 7.5 km. The shelf has a diverse and patchy sediment cover. The sediments are highly calcareous with very little clastic material and contain varying proportions of molluscs, foraminifera, bryozoans, ostracods and algal carbonates. The beach sediments are composed of white well polished and well rounded calcareous sands. The present study deals with the texture and chemistry of the sediments covering the shelf area and the beach sands in this gulf.

MATERIALS AND METHODS

Thirty-nine sediment samples were collected from the shelf, using a Pettersen grab sampler from depths ranging from 18 to 71 m. Besides, 17 beach samples were obtained by pressing a plastic tube into the surface to secure a uniform sample (Fig. 1). The samples were washed with fresh water to remove the salts and then dried. Detailed granulometric analyses were made by standard sieve and pipette methods. The graphical method adopted by Folk and Ward (1957) was used in calculating the statistical parameters (mean, standard deviation, skewness and kurtosis) from the grain size

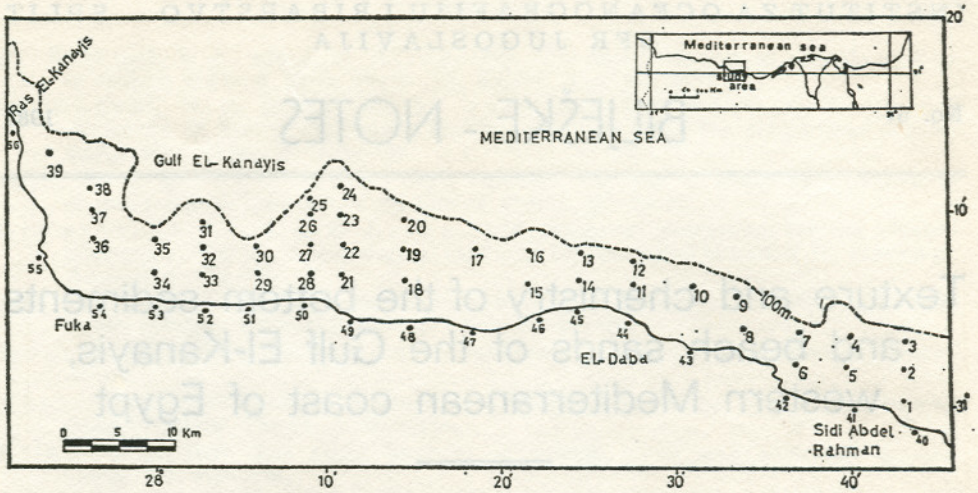

Fig. 1. Area of study and location of samples.

data. Organic carbon was determined by the direct oxidation method described by El-Wakeel and Riley (1957). The percentages of organic carbon were multiplied by a factor of 1.8 for calculation of total organic matter (Trask, 1932). The ammonium-nitrogen content was colorimetrically determined following the method of Growther and Larye (1956). The versenate method of Riley (1958) was adopted for determination of calcium and magnesium oxides. The total carbonate was determined, using calcimeter »Dietrich-Furuhling«.

RESULTS AND DISCUSSION

Texture of sediments

The statistical parameters of the bottom sediments and beach sands of the Gulf El-Kanayis are shown in Table 1. The distribution of the various size grades is presented in Fig. 2. There is a wide variation in the grain-size of the shelf sediments and the inclusive graphic mean varies from —1.88 to 5.73 Ø, with an average of 0.83 Ø. The eastern shelf, from Sidi Abdel Rahman to El-Daba is mainly covered with medium sand. However, in the western shelf, coarse to very coarse sediments are dominant, with medium sand covering the most western part. Fine sand and silty sand occupy a very small portion of the shelf. The inclusive standard deviation, a measure of sorting, fluctuates between 0.36 ond 1.93 Ø, with an average of 0.99 Ø. Most of the sediments are poorly to moderately well sorted. The inclusive graphic skewness varies from —0.47 to 1.0, with an average of 0.047. The major part of the shelf is covered with fine to coarsely skewed sediments. The inclusive graphic kurtosis, ranging from 0.71 to 3.07 with an average of 1.124, shows irregular distribution in the shelf. Mesokurtic and leptokurtic sediments constitute 77%

of the shelf. The beach sands are, to a great extent, coarse to medium-grained, with an average grain size of 0.921 Ø. The inclusive standard deviation fluctuates between 0.32 and 0.98 Ø, with an average of 0.519 Ø. Most of the beach sediments have nearly symmetrical skewness values, with a mean of 0.005. The kurtosis values show variation from 0.72 to 1.38. The interrelationships of the grain-size parameters are very poor.

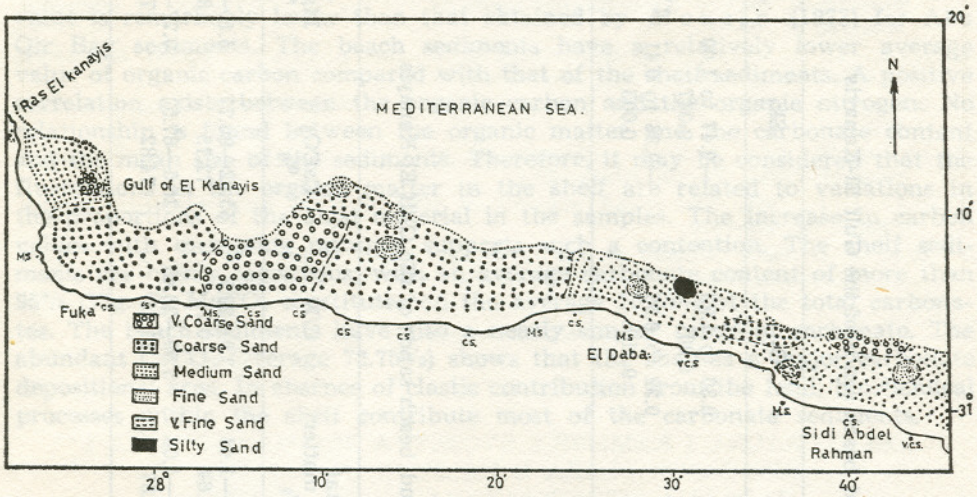

Fig. 2. Areal distribution of the bottom sediments and beach sands of the Gulf El-Kanayis.

The patchy and irregular distribution of the various size-grades of the bottom sediments indicates that the environmental conditions rather than the physical processes in the shelf control largely the texture of the sediments. Wherever the grapestones are present the sediments are coarser. Further, the differential breaking of the shell fragments and growth of the oolitoids within the shelf also contribute to differences in the grain-size distribution of the sediments. Mallik (1976) related the polymodal distribution of the sediments in the Kavaratti Lagoon, Arabian Sea, partly to the structural breakdown of the skeletal products and partly to the processes operating in the environment. The sediments on the shelf seem to be unaffected by the current action. Poor sorting of the sediments supports such an inference. Though the textural characteristics of the beach sands and the shelf sediments are to a great extent the same, there is no evidence on the contribution of the sediments to the shelf from the beach. If the sediments are derived from the beach there should be a gradual decrease in the grain-size offshore with decreasing wave energy. However, such distribution of the grain-size was not observed in the shelf region. Therefore, it can be concluded that the shelf sediments are mostly relict in nature and the textural characteristics are mainly dependent on the local biological and chemical conditions.

Table 1. Statistical parameters of the bottom sediments and beach sands of the Gulf El-Kanayis

		MZ	O_I	Sk_I	K_G
Bottom sediments	Range	— 1.88 to 5.73	0.36 to 1.93	— 0.47 to 1.00	0.71 to 3.07
	Average	0.83	0.99	0.047	1.124
Beach sands	Range	— 0.45 to 2.22	0.32 to 0.98	— 0.36 to 0.41	0.72 to 1.38
	Average	0.921	0.519	0.005	1.04

Table 2. Chemical characteristics of the bottom sediments and beach sands of the Gulf El-Kanayis

		Organic carbon %	Organic nitrogen %	Total organic matter %	C/N	$CaCO_3$ %	$MgCO_3$ %	Total carbonate %
Bottom sediments	Range	0.09—0.82	0.014—0.109	0.16—1.48	3.8—22.7	55.82—90.77	5.19—29.75	75.66—99.00
	Average	0.36	0.03	0.64	10.1	72.75	18.25	95.72
Beach sands	Range	0.19—0.57	0.10—0.064	0.35—1.03	5.59—28.48	26.5—87.5	9.77—29.76	85.03—98.91
	Average	0.32	0.03	0.57	11.12	74.82	17.72	93.37

Chemistry of sediments

The chemical characteristics of the bottom sediments and beach sands are given in Table 2. The average organic matter content of the shelf sediments is 0.64%. There is a wide range of variation of organic matter in the sediments that have a narrow range of carbonate values. The C/N ratios fluctuate between 3.8 and 22.7, with an average of 10.1. Nasr (1978) and El-Wakeel and El-Said (1978) obtained almost the same ratio for the sediments of the Arab's Bay and off Alexandria, respectively. However, this value is remarkably lower than that obtained by *Moussa* (1973) for Abu Qir Bay sediments. The beach sediments have a relatively lower average value of organic carbon compared with that of the shelf sediments. A positive correlation exists between the organic carbon and the organic nitrogen. No relationship is found between the organic matter and the carbonate content and the mean size of the sediments. Therefore, it may be considered that the fluctuations in the organic matter in the shelf are related to variations in the proportions of the algal material in the samples. The increase in carbon values with increasing nitrogen supports such a contention. The shelf sediments are highly calcareous, with an average carbonate content of more than 95% (Fig. 3). $MgCO_3$ constitutes on the average 18.25% of the total carbonates. The beach sediments have also a nearly similar range of carbonate. The abundant $CaCO_3$ (average 72.75%) shows that the shelf is a major carbonate depositional area. In absence of clastic contribution from the land, biochemical processes within the shelf contribute most of the carbonate sediments.

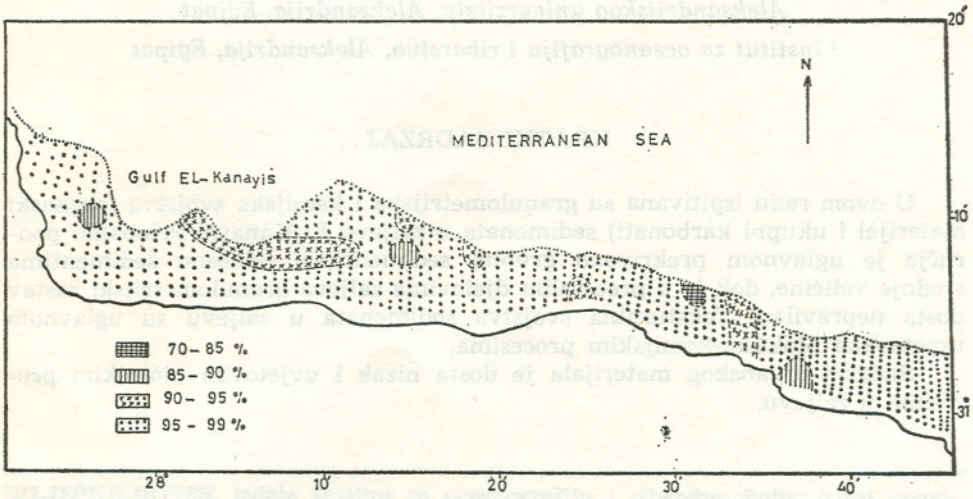

Fig. 3. Areal distribution of total carbonate in the bottom sediments of the Gulf El-Kanayis.

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TEKSTURALNA I KEMIJSKA SVOJSTVA SEDIMENATA DNA I PJEŠČANIH PLAŽA U ZALJEVU EL-KANAYS, ZAPADNA MEDITERANSKA OBALA EGIPTA

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KRATKI SADRŽAJ

U ovom radu ispitivana su granulometrijska i kemijska svojstva (organski materijal i ukupni karbonati) sedimenata u zaljevu El-Kanays. Priobalno područje je uglavnom prekriveno grubim sedimentima, odnosno sedimentima srednje veličine, dok je u preostalim djelovima zaljeva granulometrijski sastav dosta nepravilan. Teksturalna svojstva sedimenata u zaljevu su uglavnom uvjetovana biološko-kemijskim procesima.

Sadržaj organskog materijala je dosta nizak i uvjetovan biološkim procesima u zaljevu.