

**STUDY OF CARBONATE FRACTION OF THE SHELF SEDIMENTS
OFF THE NILE DELTA.**

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ABSTRACT

The carbonate fraction of the shelf sediments between Agami and Arish was studied by means of their carbonate content and mineralogical composition. The highest concentrations were found west of Rosetta reaching their maximum content off Agami. On the other hand, the content of carbonate decreases east of Rosetta attaining its lower content off Port-Said, then gradually increases up to Arish. X-ray diffraction analysis shows that aragonite is the dominant carbonate mineral in Agami/Abu Qir region with subordinate calcite and Mg-calcite. None of the carbonate minerals was recorded east of Rosetta. These minerals are substituted by quartz, feldspars and mica indicating that the Nile terrigenous sediments are generally close to quartz sands and pelitic muds. The present study shows that the investigated area can be divided into two regions: Agami/Abu Qir characterized by high carbonate content and Rosetta/Arish region characterized by low carbonate content.

INTRODUCTION

The continental shelf sediments off the Nile Delta have been intensively studied (see El-Sabrouiti and El-Sammak, 1990). Off the Delta, the muds and sands of the inner and middle shelf contain very little biogenic carbonate. By contrast, the muds and mud-sand mixture from the outer shelf are moderately calcareous. The mud fraction of these eastern deposits is dominantly terrigenous, by contrast with the carbonate sediments of the western facies, which contain mainly fine-grained and calcite. The terrigenous muds contain abundant mica and plant fragments in their sand fractions. Mollusks, echinoids, benthonic foraminifera dominate the terrigenous sands and muds. Summerhayes et al. (1978) attributed that these organisms appear to be recent inhabitants of these deposits and their remains appear fresh. Marl, in which branching coralline algae dominate over encrusting ones, and over bryozoa and mollusks, covers much of the outer shelf between Rosetta and Damietta. Further east, encrusting coralline algae are dominated, forming an algal reef-sand assemblage associated with rugged, reef-like structure. Summerhayes et al. (1978) mentioned

that chunks of algal reef built mainly from encrusting coral and algae, were dredged from one of these structure at 30°01.2' N, 31°23.8' E. Live algae covered the surface of these blocks, and several specimens of branching and encrusting algae from the marl and reef sand were also alive. Most were reworked and iron-stained, and must be relict. Bryozoans are minor compounds of these sediments. Mixture of mollusks and planktonic foraminifera occurs in the muddy sediments near the shelf edge. The calcareous sediments west of the delta, consist predominantly of biotrital mixtures of coralline algae, mollusks, benthonic foraminifera, echinoids and fecal pellets. On the outer shelf these components are mixed with planktonic foraminifera, pteropods and bryozoan. Carbonate pelletoids mixed with this detritus dominates the sand fraction on the middle shelf (El-Sayed, 1974). In general, the sediments derived from the Nile river contain very little carbonate content due to the solubility of CaCO_3 in fresh water, (El-Wakeel and El-Sayed, 1978).

The present work aims to study the carbonate fraction of the bottom sediments between Agami and Arish.

MATERIALS AND METHODS OF ANALYSIS

The investigated area covers the continental shelf and part of the continental slope. Twenty six surface samples were collected using Pettersen grab sampler from the area between Agami and Arish along nine cross sections and ranging in depths from 8 to 250 m (Fig. 1). For the determination of total carbonate the pressure-calci-meter method adapted by Pressley (1975) was used. About 200 mg of each of the dried samples were attacked with 2N HCl in the calcimeter and the volume of the evolved CO_2 gas was measured using liquid barometer that the pressure of the evolved gas and hence its volume. A standard curve was plotted using different known weights of calcium carbonate and the corresponding volume of CO_2 gas. The percentages of the total carbonate of the studied samples were estimated by simple substitution of the amounts of evolved gas on the standard curve. The mineralogy of samples was determined by using x-ray diffraction technique. The powdered samples were mounted on aluminum holders and scanned at 2° min^{-1} intervals.

RESULTS AND DISCUSSION

Figure 2 shows the areal distribution of carbonate in the study area. The highest contents were found west of Rosetta, where the concentration reached its maximum at Agami. In this section the values ranged between 57.6 in the outer shelf and 83.2 % in the coastal zone. On the other hand, the content off the area from Rosetta eastward was much lower and the values ranged between 0.83 and 8.80% (Table 1). Except for Burullos section (av. 3.7%) the mean values of each section decreased from Rosetta (av. 2.48%) eastward reaching a minimum (1.08%) at Port Said section. East of Port Said the mean concentration increased reaching a

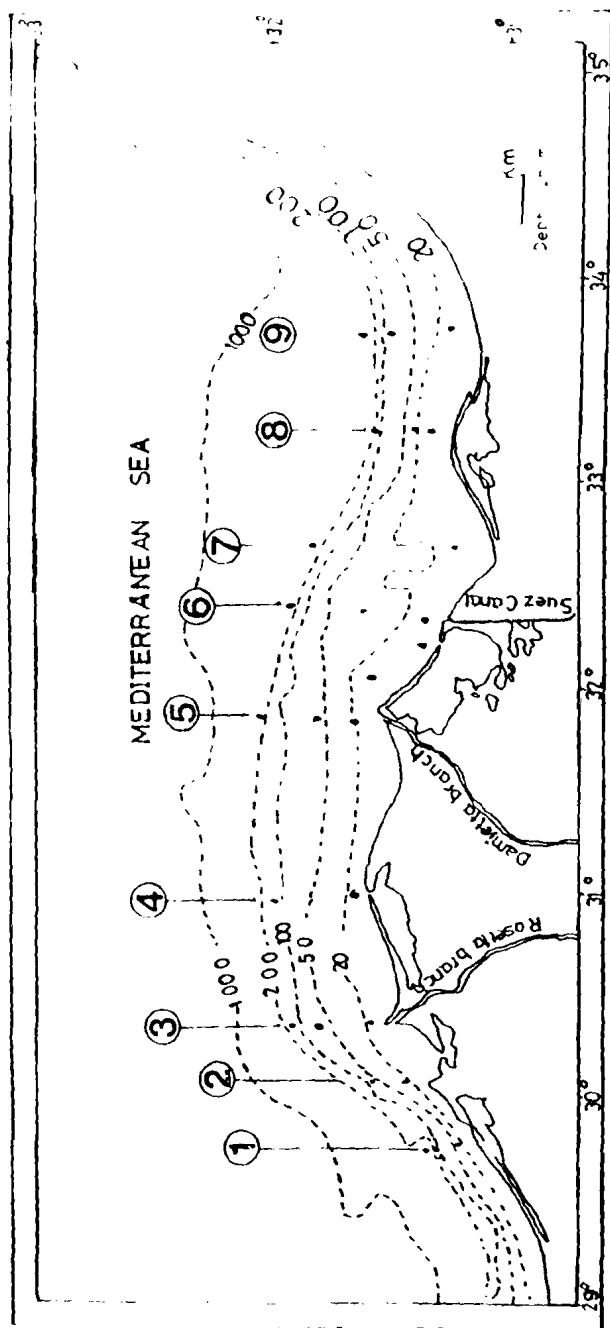


Fig. 1

Area of the study and stations sampled

1 = El-Ahamei	2 = Abu Qir	3 = Rosetta
4 = Burullus	5 = Damietta	6 = Port-Said
7 = El-Tena	8 = El-Bardawil	9 = El-Arish.

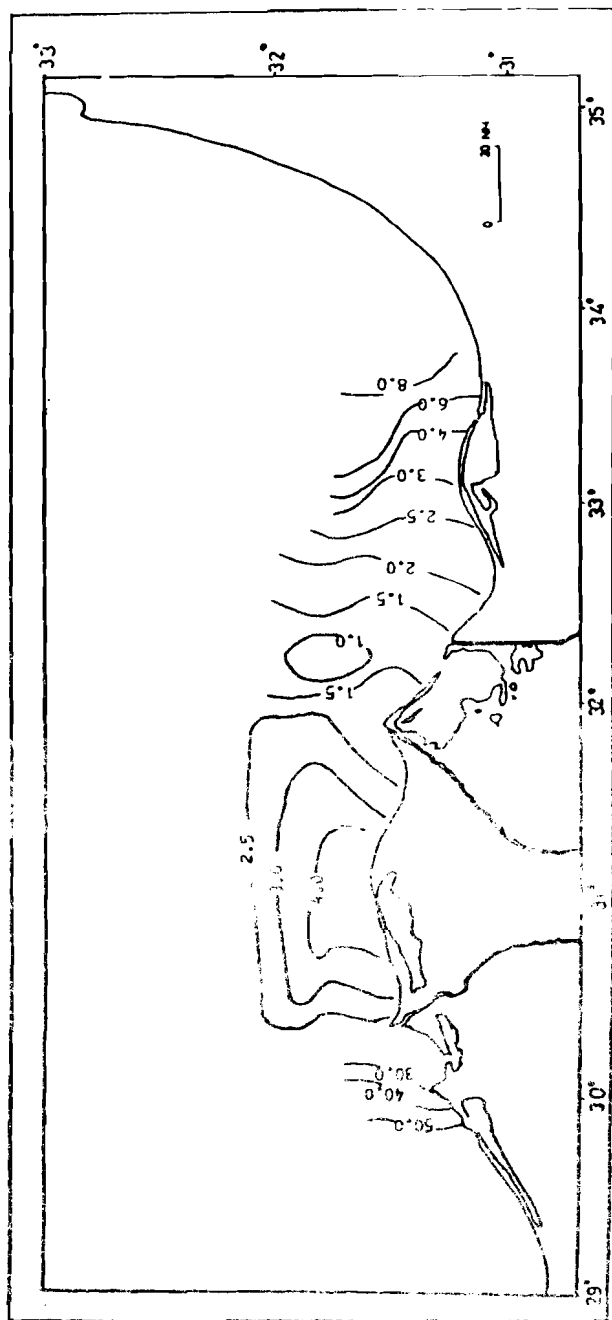


Fig. 2

Areal distribution of total carbonate in the surficial sediments of the study area (%).

Table 1.

Carbonate content of the sediment
samples

Section	Station	Depth (m)	Carbonate (%)
El-Agami	I	30	83.2
	M	115	59.9
	O	250	57.42
Abu-Qir	I	23	32.06
	M	86	43.71
Rosetta	I	14	2.58
	M	80	2.05
	O	168	2.83
Burullus	I	25	4.9
	O	125	2.46
Damietta	I	19	1.995
	M	64	2.52
	O	210	2.55
El-Diba	I	17	2.5
El-Gamil	I	9	1.25
Port-Said	I	15	1.06
	M	33	0.82
	O	240	1.35
El-Tena	I	8	2.15
	O	235	1.95
Bardawil	I	14	3.33
	M	46	3.23
	O	179	6.37
El-Arish	I	16	7.51
	M	58	8.84
	O	246	8.21

maximum of 8.2% at Arish. It is worth to mention that in Burullus section, the carbonate content in the inner shelf was comparatively high and almost double that in the outer shelf. On the other hand, in the area east of Damietta the isopleths run almost parallel nearly perpendicular to the coast. The difference between carbonate contents in the inner and outer shelf areas in this section is almost insignificant, except in Bardawil section, where the highest value (6.33%) was recorded in the outer shelf and the lowest (3.3%) reported in the inner and middle shelf. The increasing of carbonate content east of Port-Said may be attributed to the gradually increase by deposition from the water. In addition the area off Sinai is subjected to some supplementary contribution from sea cliffs and the seasonal streams of Sinai. On the whole, the mean value of carbonate in the area east of Rosetta increases seaward. The mean values in the outer, middle, and inner were 3.65 ± 2.2 , 3.49 ± 2.8 and 3.03 ± 1.9 respectively. These differences, however, statistically is insignificant.

The x-ray diffraction patterns of some selected samples are shown in Fig. 3. The most dominant carbonate mineral in the area west of Rosetta (Agami/Abu Qir region) is the aragonite with subordinate calcite and Mg-calcite. Traces of quartz were also observed. On the other hand, it was found that none of the carbonate minerals noticed west of Rosetta was observed in the area east of it. The most common minerals reported in the sediments east of Rosetta (Rosetta/Arish region) are quartz, feldspars and mica. Emelyanov (1972) indicated that carbonates of fragmental, chemical and diagenic origin are typical for sediments of the Mediterranean Sea and they consist of aragonite and to lesser degree of calcite. The formation of aragonite may be engendered by strontium, in addition to the possibility of inorganic precipitation through biological processes (El-Sayed, 1985). According to Stoffers et al. (1980), El-Sayed (1985) the Sr contents characterize the west flank of Alexandria continental shelf. El-Sayed (1981) identified three mineralogical assemblages of characteristic provinces which were Ar/Ca; Ca/Ar/Qz and Qz/Ca/Ar. Emelyanov (1972) noticed that among the high minerals covering the continental shelf off the Nile Delta, quartz, feldspars and mica are the most common and noted that the Nile terrigenous sediments are generally close to quartz sand and pelitic muds. Quartz sands lie on the shelf, while grains of quartz and feldspars are often covered by ferruginous coating, which may be indicative of their eolian origin. Bartolini, et al. (1975) indicated the presence of quartz and feldspars in the Nile cone sediments and the absence of carbonate. They also noted that both minerals had come from metamorphic rocks in the Sudan-southern Egypt.

Finally we can conclude, on the basis of carbonate contents and mineralogical data, that the study area can be divided into two characteristic provinces: (a) Agami/Abu Qir province, characterized by high carbonate content and rich in carbonate minerals; (b) Rosetta/Arish province,

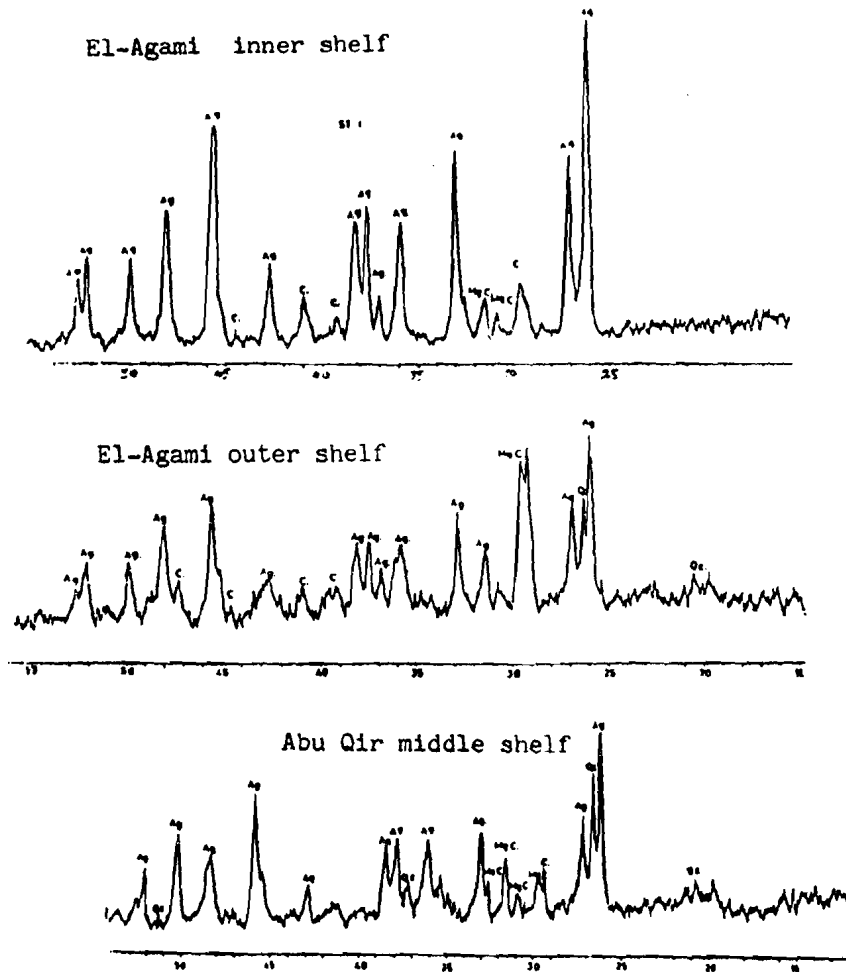


Fig. 3

x-ray diffraction patterns for selected samples
in the study area.

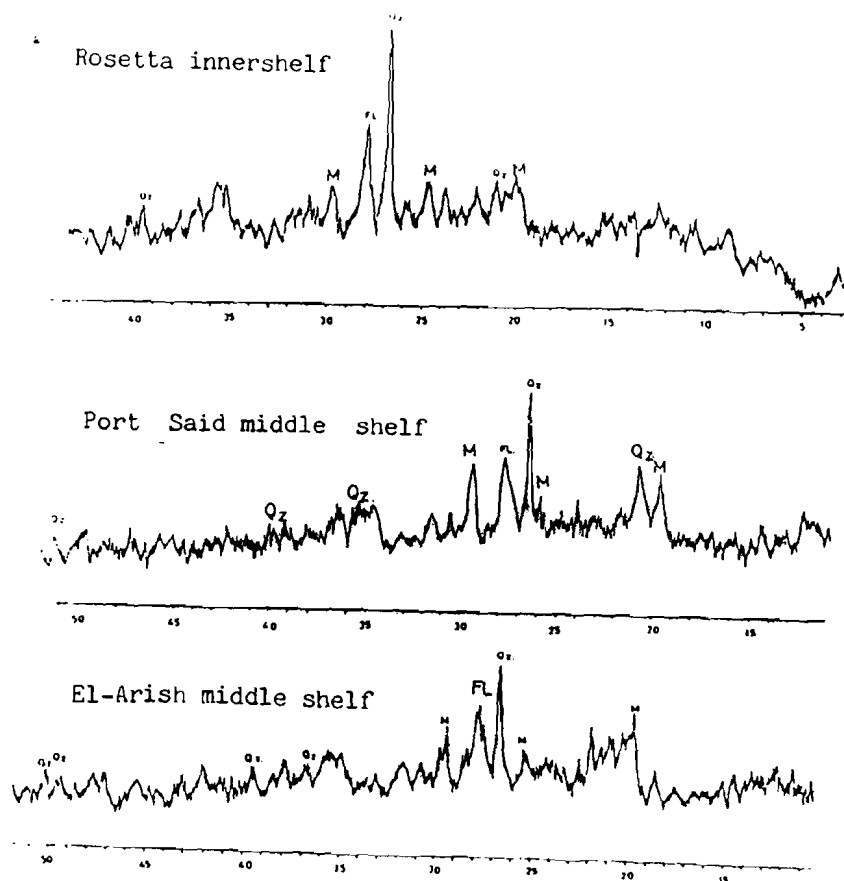


Fig. 3 (Cont.)

characterized by low carbonate content and rich in quartz, feldspars and mica minerals and represent typical Nile sediments.

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