EGYPTIAN JOURNAL OF AQUATIC RESEARCH **ISSN 1110-0354**
VOL. 30(A), 2004:142-149

SEDIMENTOLOGICAL AND PETROGRAPHICAL CHARACTERISTICS OF SUBSURFACE SEDIMENTS IN EL-DEKHEILA HARBOR, ALEXANDRIA, EGYPT

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Key words: *El-Dekheila harbor, lagoonal environments, ridges, Late-Pliestocene*

ABSTRACT

In the framework of project for construction of new jetty at El-Dekheila harbor, ten boreholes have been drilled, ranging in depth between 15 and 30 m. The vertical distributions of sedimentological units throughout the investigated boreholes revealed that, the whole basin subsurface consists of five different layers, reflecting the interaction of marine and fluvial lagoonal environments. Based on lithological characteristics, these sediments may have been deposited in a low energy environment

INTRODUCTION

The area of Dekheila harbor is considered as a transitional area between the Nile Delta and the limestone terrain, which extends along the northwestern coast of Egypt i.e. of fluviatail and marine environmental characteristics.

Coutellier and Stanley (1987); Arbouille and Stanley (1991); Stanley et al. (1992) and Chen *et.al.* (1992) have demonstrated that, as in case of most delta shorelines modifications in the northern Egypt coast through time have been induced by eustatic sea level and climatic oscillation, subsidence (compaction, isostatic depression, neotectonism) and sediment transport processes (Broussard, 1975 & Coleman 1982).

MATERIALS AND METHODS

In the framework of project for construction of new jetty at El- Dekheila harbor, 10 boreholes have been drilled, ranging in depth between 15 and 30 m (Fig. 1). The newly constructed El-Dekheila harbor lies to the west of Alexandria city, between El-Mex and El-Agami at a Latitude 29° 47' and Longitude 31° 10', with surface area of about 12.5 km^2 and a depth ranging from 6 to 19 m with an average of 12.4 m. El-Dekheila harbor was constructed to serve basically Alexandria Iron and Steel Factory. The harbor as a part of El-Mex Bay is subjected to several sources of wastewater. The existing seabed level in the investigated area (Fig. 1) ranged between - 4.8 m and - 11.6 m sloping gently northwards. The coastal front is of about 2.25 km. and marine offshore distance is 1850 m.

The general Sedimentological characteristics and lithology of the subsurface sediments was studied. Selected sediments were studied by scanning electron microscope. Samples were mounted on aluminum stubs and left to dry then coated with gold and then investigated using Joel (JSM 5300) electron microscope. Scanning was carried out at 25-30 kV.

Geological setting

The northwest coastal plain of Egypt comprises a sequence of carbonate ridges. A comprehensive review on earlier works is found in Shukri et al. (1956). Butzer (1960)

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studied the geomorphology of these ridges and proposed that, at least eight transgressions above sea level took place during Pleistocene. Hilmy (1951) regarded the oolitic ridges as wind blown material derived from the Tertiary limestone of the western desert, which later have been reworked by agitating water movements of beach waves. The hypothesis concerning the origin of these deposits could be grouped under three categories as follows;

- Continental (Hilmy, 1951; Paver, 1954; Shata, 1955).
- Epicontinental (El-Shazly et al., 1964 & Selim, 1974).
- Marine (Anwar et al., 1981 and Shata 1987). Shata (1987) studied the origin and the diagenesis of the coastal ridges in the area from Sidi Abd El-Rahman to Mersa Matruh. He emphasized that, the mineralogical diagenesis proceeds through four stages starting with aragonite and ending with the more stable carbonate form i.e. calcite. The last stage of diagenesis proceeds in the third ridge (Tyrrhenian). Short –term local diagenesis with transformation of aragonite into Mg-calcite is observed. He also followed up the chemical changes during the course of diagenesis and postulated marine origin for the coastal bars, which subjected later for diagenetic processes and consequently to both mineralogical and chemical variations.

Concerning the textural fabrics of these sediments, Hilmy (1951) noticed the presence of pseudo-oolitic texture of these grains. Some authors have recorded true oolites especially in Late- and Main-Monasterian bars (Shukri et al., 1956; El-Shazly et al., 1964; Selim, 1974; Anwar et al., 1981 and Shata 1987). They observed the formation of true oolites in which the nucleus composed of either shell fragment or quartz grains. Moreover, Shata (1987) has observed formation of poly-ooids in his study along Gulf of Kanayis and Abu Hashaifa Bay. These phenomena attributed to (pencontemporaneous) recrystallization or diagenesis under sub-areal conditions.

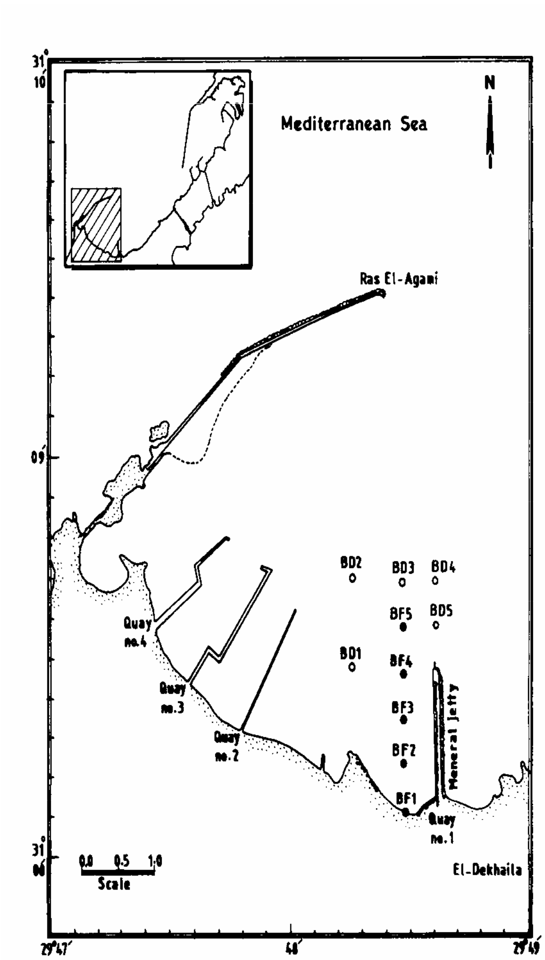


Fig. 1: Area of investigation

RESULTS AND DISCUSSIONS

I - Sedimentological characteristics:

The petrophysical observations of cores indicate that, subbottom sediments comprise layers of landfill, followed by layer of silty sand or silty clay. The bed layer is composed of cemented calcareous sand.

The vertical distribution of sedimentological units is illustrated in (Fig. 2). The identified layers are:

1. The upper most layer consists of landfill material. It shows a range of "N", number of blows per 12" penetration depth, from very weak (N = 1-2) to strong up to (N = 44).
2. The second layer consists of silty clay and sand with organic matter. It is affected by lateral shearing stress arising from the load of land filling materials which lead to squeezing the past organic matter seawards. It shows a range of "N" from 0 to 20/12".
3. The third one consists of organic-rich mud that represents the weakest point dominated in the whole basin, it does not acquire any value of N, inversely it shows a quick penetration without any hammering, and it just goes under its own weight. Moreover, the presence of organic layer consisting of partially or incomplete decomposed marine plants and leaves were noticed at some localities.
4. The fourth layer is made of clay and fine to medium sand, the scattered pattern of this layer exhibits that it follows mainly the underlain bedrock (fifth layer) under squeezed shear action. N ranges from 10 to 40/12".
5. The fifth layer is made of dense cemented sand that attains a depth of about 25m below from seabed, it acquires "N" of about 80/12".

One sample of the basal cemented calcareous sand layer has been subjected to detailed studies including X-ray, chemical analysis and Scanning Electron Microscope (SEM).

The results of chemical analysis, as shown in Table (1), indicate the predominance of carbonate fraction. This is confirmed by SEM results. Plate I shows cross laminated bundels of oragonite needles. Fibrous aragonite cement is shown in Plate II surrounding the quartz grains. Rhombohedral low- magnesium calcite spar lining pores are clearly shown in Plate III (a & b). Plate IV (a & b) shows coralline Red algal fragment in spongy cement.

This study indicates more than one generation of cement and suggests a nearshore marine origin influenced by lagoonal sedimentation. This thick layer could be of Late-Pliestocene origin (Warne & Stanley, 1993). Since then, sedimentation in the bay continued with an increasing of lagoonal influence during the Holocene.

CONCLUSIONS

This study reveals that the basal cemented sand may represent a nearshore marine sediments perhaps of Late-Pliestocene origin. The upper layer showed an increasing influence of lagoonal sedimentation.

Table 1: Percentages of main chemical components of the cemented limestone layer.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	K_2O	Na_2O	Cl
20.30	4.72	3.39	54.3	2.90	2.61	0.28	0.32	0.09

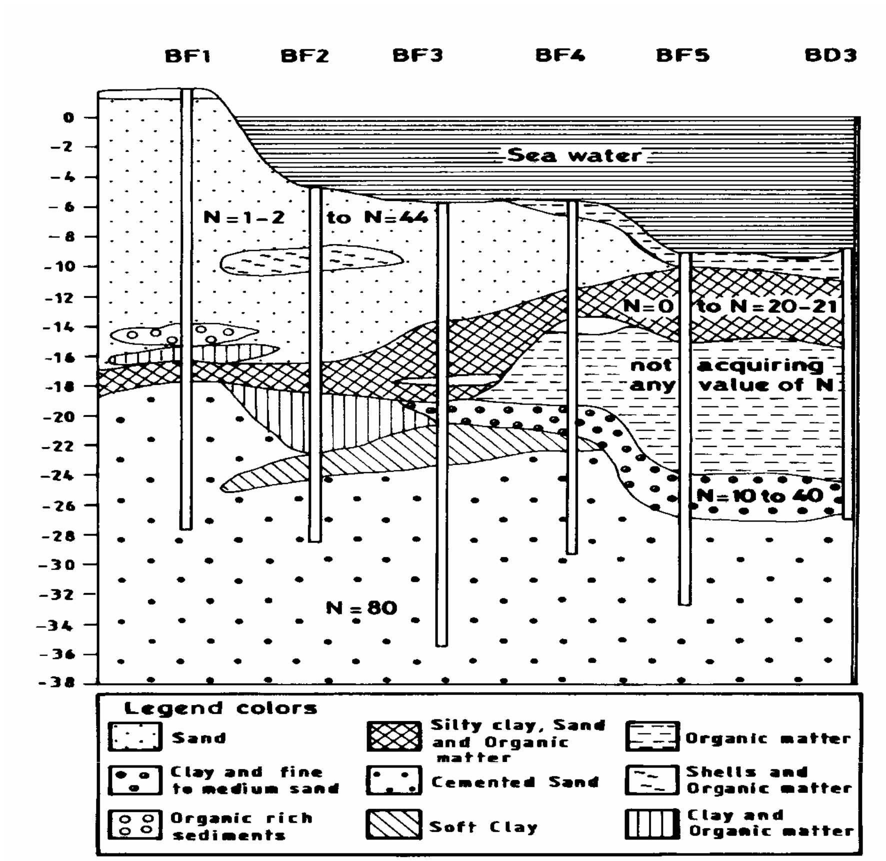


Fig. 2: Geological cross section of the investigated sediments.

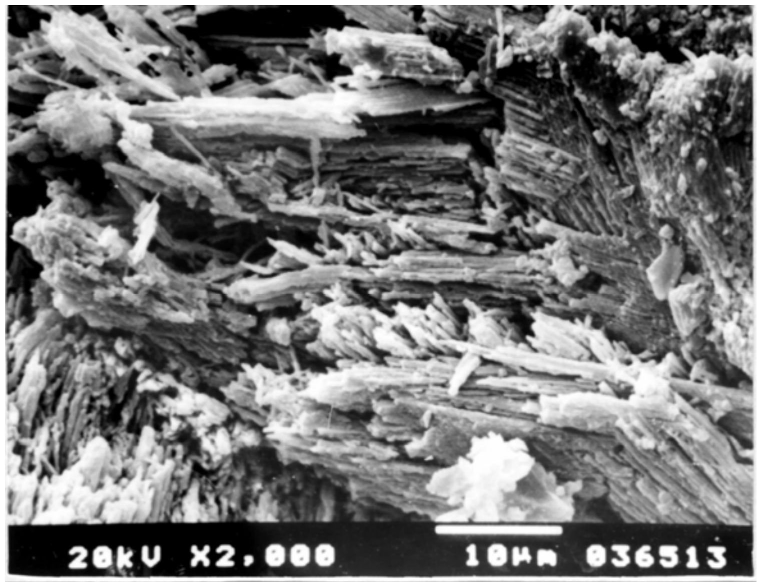


Plate I: Cross laminated bundles of aragonite needles.

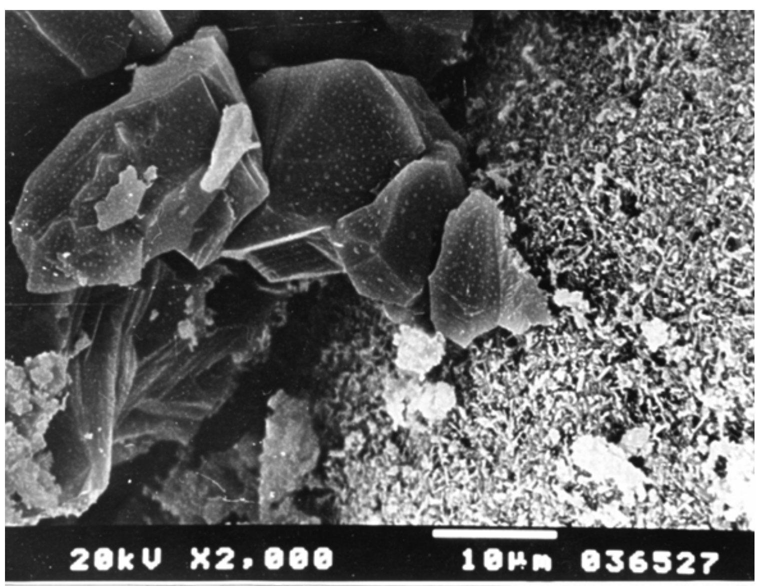
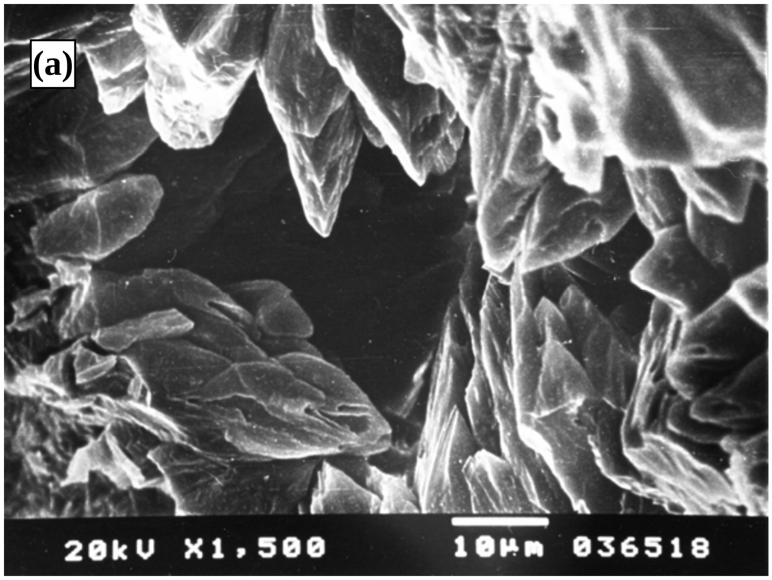


Plate II: Fibrous aragonite cement around quartz grains.



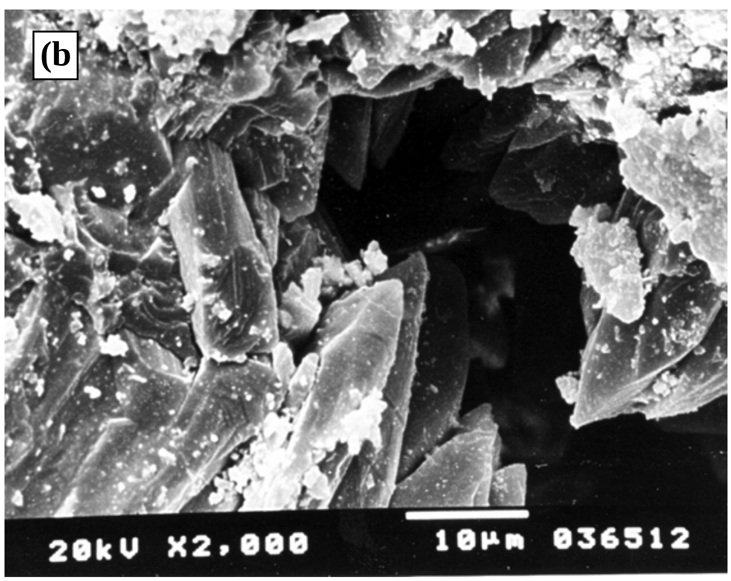


Plate III: Rhombohedral low-magnesium calcite spar lining a pore (a & b)

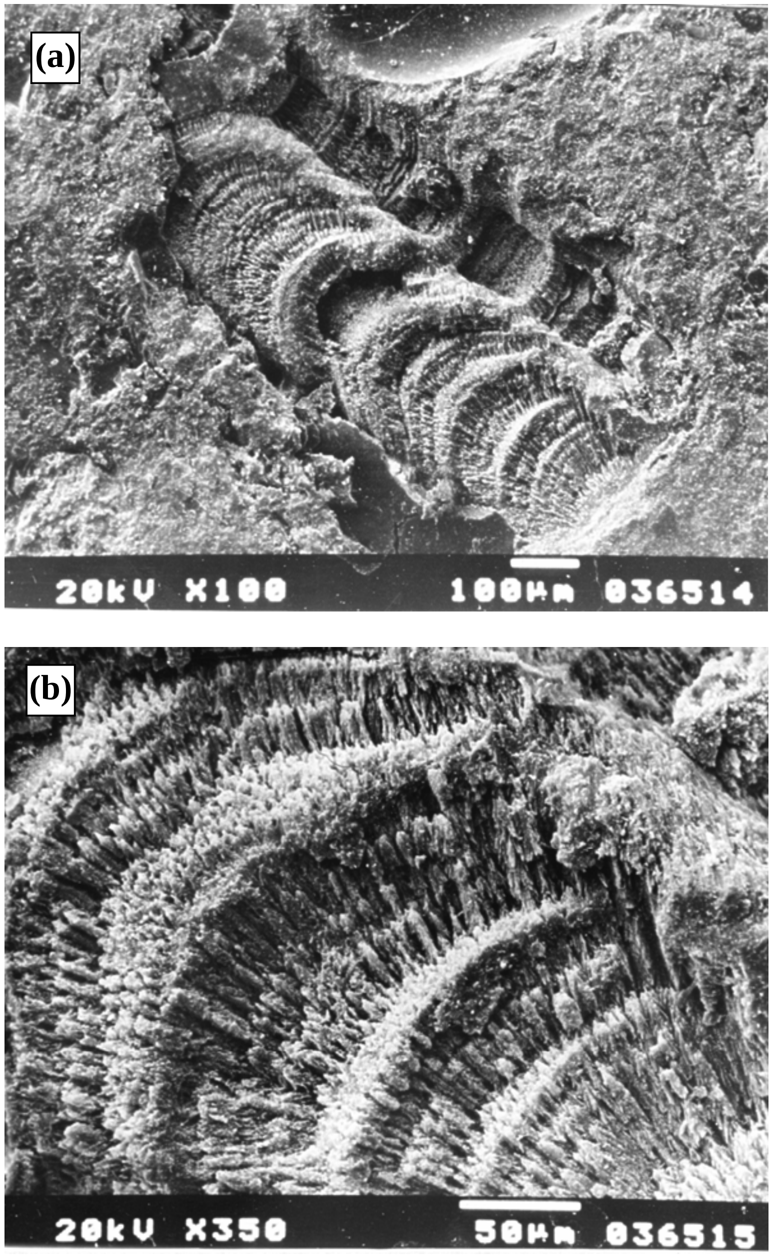


Plate IV: Coralline red algal fragment in spongy cement (a & b)

ACKNOWLEDGEMENTS

The authors wishe to express their deepest gratitude to staff member of project for construction of new jetty at El- Dekheila harbor. Special thanks are offered to Prof. M.B.Awad for his scientific and kind guidance Also kindly acknowledgment is offered to him for providing the material used in this work.

Our deepest gratitude are offered to Prof. A.A. Moussa for his careful revision of the manuscript.

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