

Interstitial water and authigenic minerals formations in bottom sediments, South of Crimea, Black Sea

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Detailed Study of interstitial water and lithology of the bottom sediments of Yelta region, south of Crimea have been carried out. The aim of this work was to recognize the interaction between different processes leading to metamorphism of interstitial water and separation and formation of authigenic minerals from this water during the Late Quaternary time. Eleven bottom core samples with length of about 3m. have been collected at Yelta region along two profiles from the nearshore to the offshore area (1820m. depth). Detailed lithological investigation for the sediments have been carried out. The interstitial water of these sediments was investigated for pH, Eh, salinity, alkalinity, Cl, SO₄, Ca, Mg, Na, K, NH₄, P, Fe, Mn, Zn, Cu and Ni. Lithological study for the sediment succession showed the presence of eight geological facies differed from each other according to texture, structure and chemical composition. The study of authigenic minerals revealed the occurrence of three types of sulphides (Fine-grained, coarse grained pyrite [FeS₂] and greigite [Fe₃S₄]), two types of carbonates (fine-crystalline calcite and prismatic aragonite [CaCO₃]), iron oxides [Fe₂O₃.nH₂O]. For the first time, barite [BaSO₄] and vivianite [Fe₃(PO₄)₂.8H₂O] have been recorded in the bottom sediments of the Black Sea. Geochemical interpretation of the data may allow us to conclude that the main factors controlling the formation and diagenesis of the interstitial water of the area under investigation could be summarized in the following: 1) Increase of salinity as a direct result of connection of Black Sea with the Mediterranean Sea 9000 r B.P. (Emelyanov and Chumakov, 1962, Sayles et al. 1973, Manheim and Schug, 1978). 2) Biological factor expressed in sulphate reduction and oxidation of organic matter. This factor led to accumulation of biogenic compounds such as NH₄ and P in the interstitial water (Gorsky, 1980) and 3) Ion-exchange between the interstitial water and sediments. This factor led to direct metamorphism (Valyashko, 1981) and formation of a new type of interstitial water which is calcium chloride [CaCl₂] instead of the oceanic type (MgSO₄). Finally, good correlation have been established between different types of authigenic minerals at different horizons and chemical composition of the interstitial water at the same horizons.

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Geochemistry of short core sediments off Alexandria Region

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Since the early twenties of this century, the shelf sediments of the Egyptian coast, specially those of the Nile delta, have been the interest of several geological surveys. Texture, chemistry, mineralogy and microfauna were of prime importance for these investigations. Apart from the long core samples collected during the Swedish Deep-Sea Expedition (1947-48), R/V ALBATROSS and R/V VEMA in the late fifties along the Egyptian coast, attention was only focused to the characteristics of the surficial sediments. The present study aimed to represent the levels of some metals in short core sediments in relation to their organic carbon and carbonate content.

During July 1986, short core samples (18-30 cm) were collected from three different sites located west and east of Alexandria region (figure 1). Station I represents the bottom of a highly oligotrophic water system (24 m depth) while station II is located at the mouth of Rosetta Nile branch (13 m). Station III was sampled at about 25 Km (24 m depth) offshore from station II to represent the corresponding stratification at offshore locations. Collection of samples was carried out using a pheliger core. After collection, samples were kept frozen at -18°C. Organic carbon was determined according to El-Wakeel and Riley (1957) while the method described by Presley (1975) was used for determination of total carbonate content. Residual concentrations of Al, Fe, Mn, Cu and Ni were determined using AAS according to the method described by Tessler et al. (1979). The accuracy of the analytical methods were tested against Standard River Sediments 1645 from NBS and were found satisfactory (C.V. 2-5%).

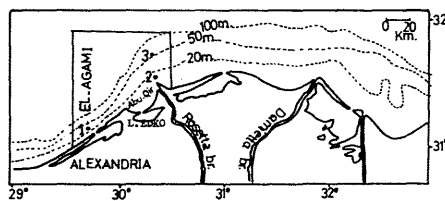


Figure 1. The study area and location of sampled stations.

Figure 2 represents the vertical profiles of organic carbon, total carbonate and studied elements in sediment core samples collected from the three selected stations. Generally, considerable variations appeared between the levels recorded for the inshore stations (El-Agami and Rosetta I). Higher carbonate levels i.e. 32-51% were observed at El-Agami station while carbonate concentrations in Rosetta inshore station do not exceed 11%. The average ratio of carbonate content for inshore/offshore samples in Rosetta region was 0.6:1 indicating the decrease of carbonate content sea-wards. El-Sammak (1987) recorded high carbonate levels in El-Agami area reaching >80% most of which are in the form of pseudo-oolite possibly derived by erosion of coastal formations and beaches while El-Wakeel and El-Sayed (1978) argued the low carbonate content of Nile sediments to the solubility of CaCO₃ in Nile water. Newly deposited Nile sediments represented by the upper few centimeters of the core showed high carbonate content reaching 2-3 times those of middle and bottom layers. However, organic matter showed a reversed trend to that of carbonate (r=-0.65) with higher values for Nile sediments (average 1.37-1.74%) compared to 0.75% found

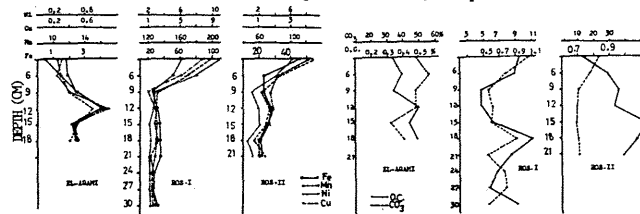


Figure 2. Vertical profiles of O.C. (%), CO₃ (%), Fe (mg/g), Mn, Cu & Ni (ug/g) in core samples. The increase of organic matter (O.Carbon 1.8) content with depth at station I coincided to a more or less extent with the decrease in carbonate content and the oligotrophic nature of the overlying waters. The enrichment of the top layer of Rosetta I core with organic matter could be explained by the increased rate of deposition of fine grain sediments high in organic content at the mouth of Rosetta Nile branch.

The enrichment of all studied elements was observed in the top layer of core samples (figure 2) collected from stations II and III as indicated by the high metal/Al ratio calculated for surface : total column (ex. 0.12X10⁻³ : 0.07X10⁻³ & 0.69X10⁻³ : 0.05X10⁻³ for Cu, respectively). This increase was followed by a sharp decrease then a nearly constant profile to the core bottom. The gradient of metals decrease with depth was maximum between 3-6cm for station II but between 0-3cm for station III due to different depositional regimes. In station I, higher levels of different studied elements were observed at bottom levels (below 9 cm) with maximum values always between 9-12cm (figure 2). The high carbonate content of station I may act as a diluent factor for these elements in sediments. Co-variation between different metals and the carbonate content showed always negative correlations (r = -0.75, -0.62, -0.31 & -0.39 for Fe, Mn, Cu & Ni, respectively). On the other hand, studied elements showed significant positive correlations with organic matter content specially Cu (r=0.66) reflecting their tendency to form organo-metallic complexes. Fe & Mn show a good positive correlation with each other (r=0.95) indicating their incorporation within the sediments. However, the efficiency of MnO₂ particulates to transport Ni ions from the overlying water to sediments was reflected on the high correlation observed between both elements (r = 0.752).

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