Paleoenvironments and Episodic Stagnation of the Eastern Mediterranean during the Brunhes Epoch

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Paleoenvironmental Reconstructions

Faunal composition and oxygen isotopic analyses of foraminiferal shells were utilized to reconstruct the paleoclimatic and paleohydrologic history of the Eastern Mediterranean during the last 500 K years. The main factors considered important in determining the composition of planktonic foraminifera and pteropods are temperature, salinity, food and oxygen.

Paleotemperature and paleosalinity reconstructions were made separately for surface and intermediate water. *Globigerina bulloides*, *Globigerinoides gomitulus*, *Globigerinoides ruber* and *Globigerinoides sacculifer* were employed for surface water, while *Globorotalia inflata*, *Globigerina pachyderma* and *Globorotalia scitula* were utilized for intermediate water paleoenvironmental interpretations. The reconstruction was done by mapping recent fauna in core "tops" deposited during the Holocene and their calibration against observed present-day temperatures and salinities in the water column. The broad data base, using published faunal distributions from the world ocean covers a wider range of temperatures and salinities and a combination of these factors, than those which are thought to have existed during glacial periods in the Mediterranean. The longest, nearly continuous record, spanning ~ 500 K years is contained in Lamont-Doherty Geological Observatory core RC9-181 (Herman, 1981). This core was less affected by tectonic activity than other cores, although in the upper 150 cms reworked upper Miocene coccoliths were observed. Within the time interval represented by RC9-181 six major cold-warm cycles, correlateable to Emiliani's isotopic stages 1-12 (Emiliani, 1970) were recognized. Calcareous nannoplankton biostratigraphic and biochronologic framework have been utilized for estimating rates of sedimentation and ages. Two important datum levels were recognized: the extinction of *Pseudoemiliania lacunosa* between 899 and 936 cms, suggesting an age of 0.44-0.46 m.y. for this level and the first appearance of *Emiliania huxleyi* 0.26-0.27 m.y.a., between 455 and 479 cm depth in core (Herman and Backman, 1986).

During glacial temperature minima, surface water temperatures were ~ 3°C lower in summer and ~ 3-4°C lower in winter (Herman, 1981). Stadial and interstadial salinities were variable, reaching highest values (at least 1o/oo higher than today) during the last glacial temperature minimum when climates were more arid than today (van der Hammen et al., 1971; Fairbridge, 1972; Flohn, 1973) sea level stood very low, the Nile discharge was greatly reduced and the connection between the Mediterranean and the Black Sea, which is a major supplier of low salinity water was severed (ibid.). Following global warming and subsequent massive deglaciation, sea level rose. When the sea stand reached the Bosporus sill (~ 36 m) the connection between the Mediterranean and the Black Sea was reestablished and the low salinity Black Sea water spilled over into the Mediterranean. A significant increase in precipitation and river runoff is also recorded during transitional climatic periods (Kullenberg, 1952; Fairbridge, 1972). These compounded effects, namely warming of the surface water, together with the flooding of the Eastern Mediterranean by large volumes of fresh and low salinity water produced a low density surface water layer which restricted thermohaline convection (Kullenberg, 1952). The result was stagnation of the sub-surface water and subsequent deposition of sapropels (ibid.). Some of the sapropels including the most recent one deposited between 11,000 and 7,000 years BP (ibid.) were laid down during such intervals of pronounced density stratification. Surface water salinities dropped to low values during the deposition of sapropels as evidenced by oxygen isotope data (e.g. Vergnaud-Grazzini and Herman-Rosenberg, 1969). Twelve sapropels, documenting different degrees of stagnation, occur in sediments representing the last 0.5 Ma.

Today sub-surface water forms in the Mediterranean and it probably did so in the past. We estimate that sub-surface temperature during glacial temperature minima were ~ 3-4°C lower than today and salinities were ~ 1o/oo higher as compared to present day values.

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The study of interstitial water of a core sample from the Nile Cone, Southern Mediterranean

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The aim of this research was to establish the environmental conditions controlling the sedimentation pattern over the Egyptian margin during the Late Pleistocene and Holocene. A gravity core sample of 238cm. length and 2670m. depth was collected from the Nile Cone region and at a distance of 250Km. north of Alexandria (Lat. 33 28 2 N , Long. 30 0 9 E). The interstitial water of this core was analysed for salinity, alkalinity, Cl, SO4, Ca, Mg, Na+K, NH4 and Si. Chemical analysis for interstitial water showed that it retains the original composition of the sea water, and according to Valyashko (1955) it could be classified as oceanic type($MgSO_4$;Alk<Ca). The geochemical interpretation of the data revealed that the anaerobic conditions are highly associated with the excess of organic matter in the sediment succession. Sulphate redution, as well as the decrease of SO4/Cl, NH4 and Si in a downward direction in the interstitial water (Fig.A)and the increase of Alk, Alk/Cl and Alk/SO4 in the same direction confirmed this conclution (Manheim and Chan, 1974, Nasr, 1983, Gorsky et. al. 1986). From this study we could conclude that the factors controlling the diagensis of interstitial water of the Nile Cone area during the Late Pleistocene and Holocene time could be summerized in the following: 1) Sea level and climatic oscillations, 2) Rate of terrigenous sediment influx and fresh water discharge , 3) Diagensis of organic matter and clay minerals and 4) Infeltration of salts from the underlying Messinian evaporites.

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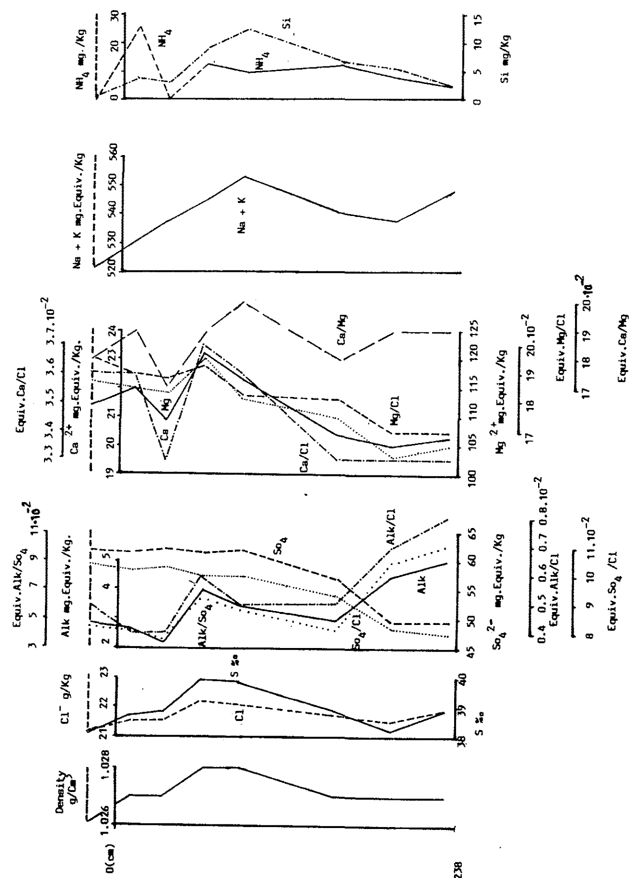

(Fig.A)- showing vertical distribution of some chemical parameters in the interstitial water of Nile Cone.