DIAGENETIC AND PALAEOCEANOGRAPHIC ASPECTS OF SAPROPEL FORMATION IN THE EASTERN MEDITERRANEAN

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Abstract

Organic-rich sediment units (sapropels) occur at an astronomically determined cyclicity. Their occurrence is related to relatively humid climatic periods, resulting in enhanced organic seafloor-arriving fluxes, whereas the intervening, arid periods are characterized by deposition dust fluxes (Ti/Al). The last "humid period", from 10-6 kyr ^{14}C, and was followed by a rapid increase in aridity (Ti/Al) coinciding with a peak of high Mn-oxide content. This peak occurs in response to an abrupt re-ventilation even which was followed by a progressively downward moving oxidation front. Proper recognition of initial versus secondary signals is vital in the interpretation of sedimentary proxies.

Keywords : Eastern Mediterranean, Sapropel, Atmospheric Input, Paleoceanography, Geochemical Cycles.

Eastern Mediterranean Sediments are known to be ideal recorders of Global paleoclimatic continental and marine signals. This is due to the highly favourable semi-enclosed nature of the basin and the various surrounding landmasses. As a consequence, climatic variations are accurately recorded not only by giving variations in typical 'marine' signals, but also in typical 'continental' signals. The 'Monsoonal index' is strongly associated with the paleoclimatic conditions in the area around the Eastern Mediterranean, i.e. Sahara/ Africa, Middle East, Southern Europe. This association is clearly present and visualized in its sediments, mainly in a ∼21 kyr precession-controled cycle: during 'humid' climatic periods organic-rich sediment (Sapropel) is deposited containing strong river and marine productivity signals, whereas during 'arid' climatic periods organic-lean sediment is deposited containing high dust input signals. The Eastern Mediterranean, therefore, is an ideal area to study land-sea interactions of Global paleoclimatic variations. In particular, as this area is influenced and preserves paleoclimatic signals from the mid to high latitude northern borderlands to the low latitude Monsoonal influeced southern borderlands.

The occurrence of sapropels is related to relatively humid climatic periods, whereas the intervening, arid periods are characterized by deposition of rather high dust fluxes indicated by Ti/Al (Fig.1) [1].

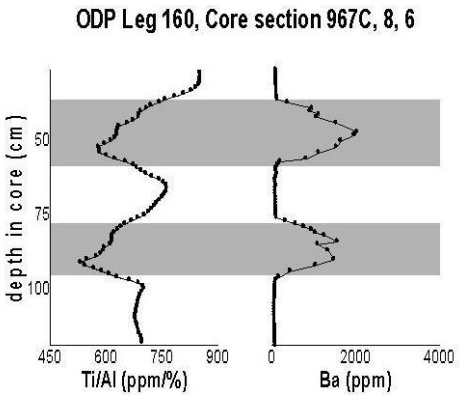

Fig. 1. The occurrence of sapropels is related to relatively humid climatic periods, whereas the intervening, arid periods are characterized by deposition of rather high dust fluxes indicated by Ti/Al.

The last of such 'humid periods' occurred from 10.4 to 5.7 kyr ago, simultaneous with the sustained wet period in the circum Mediterranean area. At the end of this humid period, the rapid increase in aridity coincides with a peak of high Mn-oxide content. This peak occurs in response to a relatively abrupt re-ventilation event occurring in all studied cores, and is confirmed by several other proxies such as micropaleontological and organic geochemical. From the comparison of organic C and Ba/Al it is clear, that in the sediments of all cores, the upper part of the youngest sapropel, S1, has been removed [2-3]. Following the ventilation event, at 5-6 kyr (^{14}C age), oxygen has continued to progressively move downward into the sediment oxidizing e.g. organic C. The visual evidence for varying depth intervals of the upper reaches of the S1 sapropel have been removed by this process. In line with these observations, microfossil occurrence indicates environmental changes occurring at or near the lower S1 boundary and at the upper boundary of the initial S1 sapropel [2-4]. Although siliceous microfossils have entirely disappeared, their organic geochemical 'signature' is still there (e.g. diatoms, represented by loliolide. Other marine biomarkers are dinosterol, which is predominantly derived from dinoflagelates and $U^{K'}_{37}$ which is the ratio of 2 ketones and thought to be predominantly related to planktonic nannofossil E. *Huxleyi*, whereas B-sitosterol is considered to be a terrestrial biomarker. Clearly, it is in particular the marine biomarkers that are enriched in the remaining organic-rich sapropel S1 interval, whereas these are completely removed upon oxidation. The occurrence of such a removal mechanism seriously affects the traditional interpretation based on palaeoproxies, and, therefore, is of vital importance for the interpretation of proxies and our understanding of palaeo conditions. Thus a more reliable reconstruction can be made of initial sediment composition, hence of initial palaeo-oceanographic, palaeo-climatic, and palaeo-environmental conditions of sapropel formation in the eastern Mediterranean, relative to diagenetic changes.

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