BASIN-WIDE ISOCHRONOUS SELECTIVE FORMATION AND PRESERVATION OF EASTERN MEDITERRANEAN SAPROPEL S1

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Abstract

Initial deposition and preservation of the most recent sapropel S1 took place basin-wide and iso-chronous. Our basin-wide approach further elucidates that the watercolumn below ~ 1.8 km must have remained predominantly anoxic during sapropel S1 deposition. A marked Mn-rich sediment bed formed during the onset of reventilation at the end of sapropel S1. Its postdepositional preservation is dependent on organic matter and sulphide content and subsequent sedimentation rates.

Keywords: Sediments, Paleoceanography, Deep Sea Processes

Mediterranean marine deposits found on land and at the seafloor, all demonstrate a clear cyclic pattern in their composition that appears related to Milankovitch astronomical variations [1-2]. The clear expression of these climate cycles in Mediterranean deposits in particular is partly related to restricted circulation in this semi-enclosed ocean basin.This restricted circulation results not only in a delicate oxygen balance, but also in a bottomwater formation and residence time that is very sensitive to Global climatic variations in past, present, and future. Variations in riverine fluxes concording with humidity-related climate cycles not only lead to variations in bottom water conditions but also in nutrient fluxes [3]. These variations have resulted in alternating organic-rich (sapropels) and organic-lean (marls) sediment intervals. This astronomical cyclicity serves as a perfect time-marker for Mediterranean Miocene to recent sediments, which permits an unprecedented comparison of samples in identical time-slices but from different locations. Some of these organic-rich units have a high degree of lamination [e.g. 4], thus permitting high-resolution studies, whereas the sedimentary expression of precessional cycles, volcanic ash layers and other time markers permit a high degree of age control. Potentially basin-scale reconstructions are possible for such time-slices, in particular for the most recent S1 period [5]. Such reconstruction may not only involve the oceanographic aspects of this model-ocean, but also the various land-ocean interactions, such as riverine and eolian inputs from various surrounding landmasses [6].

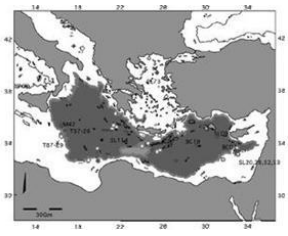

Fig. 1. In dark grey: deep water, thought to have been (nearly) permanently anoxic during sapropel S1 formation (5.7-9.8 ka ^{14}C BP); Analysed core sites are indicated.

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 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. As a consequence of the increased fresh water (monsoon) input between 10.4 – 5.0 14C ky BP, sapropel S1 formed basin-wide synchronously between 9.8 and 5.7 14C ky BP at all water depths greater than a few hundred metres [5]. Another effect of the increased precipitation over evaporation is water-column stratification, and the resulting restricted deep-water ventilation. This has caused predominantly anoxic water column conditions and as a consequence preferential preservation of organic matter has occurred below 1.8 km during 4,000 years of S1 formation (Fig. 1). Several diagenetic features are associated to sapropels, during their formation and during subsequent more oxic environmental conditions [7]. During sapropel formation the downward export of excess sulphide has resulted in an interval of reduced sediment immediately below S1 [8], whereas the post-depositional excess oxygen content has resulted in the downward removal of the topmost S1 interval [e.g. 9]. In addition, the deep-water reventilation thus re-oxygenation event has resulted in a marked MnO2 bed (previously referred to as Marker Bed; [10]). Using the S1 as a case study similar features can be recognized in older sapropel units.

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