Evidence for an evolving sub-oxic zone in the Eastern Mediterranean during sapropel S1 partly controlled by the increased Nile flood; a sensitive record of regional paleoclimatic change.

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Understanding the nature and evolution of past Oxygen Minimum Zones (OMZ) are of great interest since they shed light on expanding OMZ's in the modern ocean. Furthermore, as we alter the nutrient fluxes emitted from modern major rivers there are known to be major, often undesirable, consequence to the oxygen status in the marine basin both proximal and distal to the river discharge (e.g. Mississippi and Ganges-Brahmaputra). Recent GCM modeling of the nature and development of S-1 sapropel in the Eastern Mediterranean (EMS) have suggested a four layer system with a well-ventilated surface water (0-200 m) and intermediate water (200-500 m), a partially ventilated sapropel intermediate water (SIW, 500-1800 m) and long-term stagnant deep water below 1800 m. Our conceptual model is of the partially ventilated SIW flowing from Adriatic/Aegean towards the east and becoming depleted in oxygen as it is increasingly influenced by descending labile organic matter derived directly or indirectly from the greatly increased Nile flood during this period
Most studies of sapropels in the EMS have concentrated on the sample locations in deep water below 1800 m water depths, which have been shown to be anoxic during S-1. Only a limited number of samples having been taken from the SIW layer. The redox poised nature of this layer makes it a sensitive record of paleoclimatic changes in the catchment and basin. In this review, we focus on the several stations sampled between 500-1800 m and particularly on stations in the Eastern Aegean and Levantine basins. Data has been obtained from sediment cores (9509, 9501, SL112, PS009PC, SL123, 562MC) in which either benthic foraminifera fauna or redox sensitive trace metals (RSTM) data have been measured. The Shannon-Weaver diversity index and the Oxygen Index have been calculated on the benthic foraminifera fauna.
These cores reveal a distinct pattern in onset and offset of sapropel S1 and in the interruption of the sapropel at 8.2 ka BP different from deeper water cores. The onset of S1 was earlier in the shallower water depths consistent with greater respiration rates from progressively less labile organic matter dropping from the photic zone. There was a clear spatial trend in intensity of the OMZ with benthic foraminifera surviving in SIW throughout S1 offshore Libya (562MC) and close to Crete (SL123) nearer the source of SIW. By contrast the diversity is reduced and in case of 562MC the Oxygen Index reached zero close to the Israeli coast and under the direct influence of the Nile. There was an observed correlation between the V/Al ratio (PS009PC), a redox sensitive trace metal used as an indicator for sub-oxic conditions in the water column and the calculated Oxygen Index as well as diversity on benthic foraminifera (SL112). Our study also shows that the intensity of S1 sapropel was greater in this region between its onset and the 8.2 interruption, than in the period from 8.2 to the end of S1. Indeed, close to Cyprus (9501) sapropel S1 ends at 8.2 ka BP and doesn't have a second sapropelic part. These changes are likely to be directly related to the nature and intensity of paleoclimatic changes in humidity in the Mediterranean basin and Nile catchment.