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Evidence for an evolving oxygen minimum zone in the Eastern Mediterranean during sapropel S1 controlled partly by the increased outflow from the Nile flood

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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 major, often undesirable, consequence to the oxygen status in the marine basin both proximal and distal to the river discharge (e.g. Mississippi). Recent Global Climate Model (GCM) 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 Nile flood. Most studies of sapropels in the EMS concentrate on the deep water below 1800 m water depths with only a limited number of samples having been taken from the SIW layer.
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. 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.