Eastern Mediterranean Sapropel 1 (S1) dynamics from coccolith chemistry

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The eastern Mediterranean Sea is an area where occasionally sapropel (organic-rich layer deposited under seafloor anoxic conditions) formation took place. The occurrence of these layers corresponds with the summer insolation maxima of the Northern Hemisphere, which increases the seasonal thermal gradient between ocean and continental regions and thus enhancing the African monsoonal circulation system. The driving mechanism of sapropel deposition is still debatable however, the combination of both anoxia of the bottom-water and enhanced marine productivity, as a response to the climate forcing (Emeis *et al*., 2000) could explain it.

Coccolithophores are a dominant phytoplankton group in the Mediterranean Sea and an important indicator of past conditions in the fossil record. In the eastern Mediterranean, the significant increase of *Florisphaera profunda* during S1 was correlated with a nutrient-rich lower photic zone and stratification of the upper water-column.

To reconstruct the dynamics of S1 formation, we analyzed species-specific coccolith stable isotopes on four deep-sea sediment cores spanning S1 from the eastern Mediterranean, and one from the western Mediterranean. The oxygen isotopes of species-specific coccolith carbonate may infer the oxygen isotope composition of the seawater, which is affected by temperature, evaporation, and precipitation. The $\delta^{13}C$ of the dissolved inorganic carbon (DIC) in seawater is influenced by the production and respiration of organic matter. We also present results on Sr/Ca ratios as a proxy of productivity from two cores.

The fine fraction (<20 μm) record showed a shift of about ~ 0.5 to 2 ‰ in $\delta^{18}O$ and ~1 ‰ in $\delta^{13}C$. The fine fraction carbonate in the Mediterranean Sea is made up of not only several coccolith species (vital effects in $\delta^{18}O$ and $\delta^{13}C$) but possibly also reworked coccolith species and fragments of other unidentified biogenic carbonate. *Emiliania huxleyi* enriched fraction (3-5 μm) showed a negative shift of about ~ 1 ‰ in $\delta^{18}O$ and $\delta^{13}C$. The $\delta^{18}O$ results combined with alkenone temperature reconstructions from the same samples confirmed a large freshwater discharge before sapropel formation. An increase of freshwater input will establish a low-salinity surface layer, thus modifying the thermohaline circulation of the eastern Mediterranean by weakening the Eastern Mediterranean Deep Water formation and promoting a termination of deep water ventilation. This condition might lead to the oxygen depleted zone which caused accumulation and preservation of the organic-carbon-rich sediments. Furthermore, an increase of continental influence may fertilize the basin and lead to relatively high productivity.

A parallel trend of negative shifts in the $\delta^{18}O$ and $\delta^{13}C$ of both fractions mirrored the Sr/Ca ratios which showed an increase of ~ 1.5 mmol/mol for fine fraction and ~ 0.75 mmol/mol for *E. huxleyi* enriched fraction. These results clearly suggested an increase in productivity during S1 in the eastern Mediterranean. Nevertheless, the record in the western basin showed no response to such climate change during S1 time interval.

Reference

Emeis, K.C., Sakamoto, T., Wehausen, R. & Brumsack, H-J. 2000. The sapropel record of the eastern Mediterranean Sea - results of Ocean Drilling Program Leg 160. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **158**: 371-395.