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Reconstructing Holocene sea surface salinity changes in the Northern Aegean Sea: evidence from morphological variations of Emiliania huxleyi-coccoliths

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The Aegean Sea is a key area for our understanding of the impact of changes in the hydrological cycle on ocean circulation in the Mediterranean Sea. The Aegean Sea appears to be very sensitive to climate changes in Europe because of its small volume and the position between high- and low-latitude climate regimes. Therefore, it is assumed to record environmental change, especially changes in sea surface water salinity (SSS) without a significant time lag with respect to the forcing process (Rohling et al., 2002). However, up to date, SSS cannot be easily reconstructed from geological archives because several assumptions need to be made that lead to a significant error of the salinity estimates (e.g. Rohling, 2000).

Here, we present the first high resolution SSS reconstruction from a Holocene sediment core based on a recently developed transfer function using the morphological variation of Emiliania huxleyi coccoliths (Bollmann & Herrle 2007, Bollmann et al., 2009). The core is located in the northern Aegean Sea (eastern Mediterranean Basin) and covers the time period 3 –11ka ago.

Sea surface water salinity in the Aegean Sea has varied in concert with temperature oscillations as recorded in Greenland ice cores (iGISP2 ice core δ18O record) with a periodicity of about 900 years (Schulz & Paull, 2002). Four major SSS events can be identified at about 3.9, 4.7, 6.4, 7.4, and 8.2 ka in the northern Aegean Sea that correlate with increases in GISP2 δ18O (Schulz & Paull, 2002) as well as decreasing percentages of tree pollen studied at the same core expect for 3.9 ka (Kotthoff et al., 2008). The most prominent salinity increase occurred during the short-lived 8.2 kyr cold event (e.g., Rohling & Pälike, 2005), which was most likely triggered by a melt-water related perturbation of the Atlantic Meridional Overturning and associated decrease of ocean heat transport to the North Atlantic.

We suggest that the salinity fluctuations in the northern Aegean Sea are related to large-scale changes in the Northern Hemisphere climate system with effects similar to the decadal North Atlantic Oscillation. During times of a negative NAO the amount of precipitation and river runoff increases in the northern Aegean Sea (more fresh water input -> low salinity) whereas the amount of precipitation and river runoff decreases during a positive NAO (less fresh water input -> low salinity) (e.g., Tsimplis & Baker, 2000). The NAO-like SSS fluctuations may also have caused changes in the deep water formation in the northern Aegean Sea and thus affect the oxygenation of bottom water and the evolution of Holocene benthic ecosystem.

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