PALEOCLIMATE RECONSTRUCTION FROM LAKE VAN SEDIMENTS DURING DANSGAARD-OESCHGER EVENTS AND LAST GLACIAL TERMINATION

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A 220-m long sedimentary sequence from Lake Van (Turkey), covering 600,000 yrs of decadal to orbital-scale climate variability, has been investigated to provide insights into the mechanisms of climate changes in the continental interior. The excellent quality, age control and sensitivity of this sedimentary archive together with the wide range of classical proxy records available makes this site ideal to reconstruct past environmental changes in the Near East. Our studies using biomarkers of Lake Van sediments for paleoenvironmental reconstructions gave first insights into long-term changes (Randlett et al., 2014).

First insights into long-term changes have been revealed by application of a suite of proxies e.g., sediment color, TOC, pollen, elemental concentrations, and bulk stable isotopes, which show that variations in lake productivity, lake level, water mixing, chemistry and shoreline distance, as well as vegetation type change in concert with millennial-scale hydroclimate variability during the glacials and terminations (Stockhecke et al., 2014). Furthermore, the pollen record documents a paleovegetation dominated by oak and pine during interstadials/interglacials, and a *Artemisia* steppe vegetation during stadials/glacial periods (Litt et al., 2014). The Lake Van color record indicates lake-level rises for all Dansgaard-Oeschger (DO) interstadials synchronous to the NGRIP $\delta^{18}O$ record of Greenland ice reflecting temperature increases. Comparison with the results from LOVECLIM model simulations supports the notion that the lake-level increases during the warm interstadials is caused by precipitation increases due to atmospheric changes as consequence of an enhanced Atlantic Meridional Overturning Circulation (AMOC) (Stockhecke et al., 2016).

Here, we reconstructed relative temperature and hydroclimate changes during several DO events from MIS 3 and over the last glacial termination using a multi-proxy lipid biomarker approach. Mean air temperatures (MAT) is reflected by down-core distributional changes in branched glycerol dialkyl glycerol tetraethers (brGDGTs). Since their exact source in lake sediments is not yet fully constrained, the obtained record can only be interpreted as relative temperature change. BrGDGTs in Lake Van sediments reflect the expected temperature variability during glacial/interglacial cycles, with cooler glacials and warmer interglacials, and furthermore indicate that the amplitude of temperature change during stadial/interstadial transitions is smaller than for glacial/interglacial transitions.

Analysis of the leaf wax hydrogen isotopic composition (δDwax) results in a reconstruction of changes in the water available for the plants due to variable precipitation/ evaporation ratio. Isotopically 10‰ (20‰) lighter δD-values of leaf-wax *n*-alkane C_{29} argues for a significantly increased humidity during the interstadials (interglacials) compared to the stadials (glacials). The magnitude of precipitation changes is estimated based on (i) the relation of δD of grass-derived *n*-C_{29} with precipitation on the Great Plains (USA), which suggest a 10‰ decrease in δD of n-C_{29} per 100 mm increase in annual precipitation, and (ii) the temperature-δD correlation of precipitation in Erzurum, located close to the Lake Van area. This implies that the amount of annual precipitation was about 200 mm higher during DO interstadials and 300-350 mm higher during interstadials.

The effect of evapotranspiration on these estimates is evaluated by analyzing short- (n-$C_{18:0}$) and long-chain (n-$C_{28:0}$) saturated fatty acids, produced by phytoplankton in the lake and higher plants around the lake, respectively. The δD of n-$C_{28:0}$ fatty acid varies synchronously with δD of the n-C_{29} alkane, showing isotopically heavier values during stadials and glacials. However, offsets in δD between n-$C_{18:0}$ and n-$C_{28:0}$ fatty acids are larger during cooler intervals, and are primarily driven by the hydrogen isotopic composition of land-plant derived lipids, indicating intensified evapotranspiration..

References

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