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Changes in erosional input and environmental conditions at Lake Gerzensee, Switzerland, during Termination 1

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The lateglacial record from Lake Gerzensee became an iconic figure since the early days of correlating terrestrial records with the results of polar ice core studies as initiated by Siegenthaler, Eicher, Oeschger and Dansgaard in 1984. Recently, the stable isotope record of Gerzensee was refined using a new sediment core retrieved in autumn 2008 in unprecedented resolution of 0.5cm (= 8-14 years). Depending on the sedimentation rate, the inferred temporal sample resolution of this new stable isotope record is between 8 and 14 years. A robust chronology was established through wiggle matching of the δ18O records from Gerzensee and NGRIP. Primary tie points between the two records were the prominent δ18O-shifts at the beginning and end of the Bølling/Allerød (B/A) and the Younger Dryas (YD). Then, three minor oscillations (Gerzensee, GI-1c2, and Aegelsee Oscillation) clearly visible in both, the NGRIP and Gerzensee δ18O record, were correlated.

XRF core scanning was then applied to the sediments of Lake Gerzensee to establish high-resolution elemental records with a spatial resolution of 2mm. These elemental concentrations allow studying the influence of the lateglacial climate pattern on the environment and the lake system in great detail. It can be observed that environmental thresholds such as vegetation density play a mayor role on the erosive input into a lake system.

Detrital elements (like Al, K, Zr, Rb, and Ti) reflect the erosional influx, which strongly decreases during the Bølling/Allerød reaching lowest concentration at the onset of the GI-1c2 oscillation. This coincides precisely with the full development of a stable pine forest in the vicinity of Lake Gerzensee demonstrating the strong coupling between vegetation and erosion. A comparable study (Lauterbach et al., 2011) at Mondsee, Austria allows to compare the same linkages between erosive input and pine forest development and to elaborate regional differences in this coupling.

Initiated by technical developments, the transition in and out of the Younger Dryas received lately much attention in order to determine rates of change for the different proxies. Similar patterns and timing are observed between the Gerzensee elemental record and the sub-annually resolved NGRIP ice core record (Steffensen et al., 2008). For example, the detrial input at Gerzensee during the onset of the YD mimics in great detail the Ca2+ curve in Greenland pointing towards a fast change in the atmospheric circulation at this time.

Beside the large lateglacial transitions, the short-term oscillation during the Bølling/Allerød reveal unique patterns in the lake record. The strongest expressed cold swing in the elemental records of Lake Gerzensee is the Aegelsee Oscillation (GI-1d). Interestingly, the detrital input increases approximately 50 years earlier then the sharp decrease in the oxygen isotope at the onset of this oscillation. In order to evaluate if these patterns are site-specific or of larger spatial extent, more highly resolved records are needed from terrestrial archives, as well as from the ice sheets.

References:

Lauterbach, S. et al., 2011. Environmental responses to Lateglacial climatic fluctuations recorded in the sediments of pre-Alpine Lake Mondsee (northeastern Alps). Journal of Quaternary Science, 26(3): 253-267.

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