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Testing a new temperature proxy using the late-glacial and early Holocene chironomid record of Rotsee, Switzerland

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High concentrations of chironomid head capsules in late-glacial and early Holocene sediments from Rotsee, a lake in Central Switzerland, provide an excellent opportunity to study past climatic change and its effects on biota. Chironomids (non-biting midges) have been widely used as palaeoecological indicators of environmental change. In this study, we are testing the potential of these chitinous microfossils as a proxy to produce d18O records.

Background information on the Rotsee record is provided by high-resolution records of organic matter and carbonate content. Periods of rapid climatic change are reflected by variations in stable oxygen isotope concentrations analyzed on bulk carbonates. For this record a high-resolution age model is based on wiggle-match dating using over 60 AMS radiocarbon dates on terrestrial plant macrofossils. In addition, changes in bulk carbonate d18O are correlated to similar variations observed in the Greenland ice core records to obtain an independent age control, which is additionally supported by pollen analysis and tephrochronology.

Shifts in taxonomic composition of chironomid assemblages are apparent throughout the record. They coincide with changes in bulk carbonate d18O and are, therefore, thought to be related to climatic changes. Carbonate particles adhering to chironomid head capsules caused a noisy d18O record. After adequate carbonate removal a reliable d18O record based on chironomid head capsules was produced, which agrees well with the bulk carbonate record. The close agreement between variations in d18O of bulk carbonates and d18O in chironomid head capsules indicates that chironomid d18O can provide reliable reconstructions of past changes in lake water d18O, and indirectly climate, also in lakes where carbonates are absent. In future studies analyses of fossil chironomids can therefore produce reconstructions based on past assemblage changes and chironomid-temperature transfer functions, while at the same time providing independent paleoclimate records based on changes in d18O of the head capsules.