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Refining chronologies by dating pollen concentrates – new approach of separating pollen using flow cytometry

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Radiocarbon dating of terrestrial plant-remains is a traditional method for precise age estimations of lake sediments. The absence of sufficient large plant macrofossils required for AMS dating in continental records, especially large lakes, demands for a satisfactory alternative, such as carbon-containing microfossils. Due to their ubiquitous presence in sedimentary archives pollen grains may be considered for dating. Nevertheless, the isolation and enrichment of pollen without a significant carbon contamination is still challenging. Even though commonly applied separation techniques can be used to remove the predominant portions of foreign particles, the undesirable transfer of these particles into the pollen concentrate cannot be excluded, yet. However, flow cytometry, as a highly promising alternative, offers the possibility to sort huge quantities of particles in a short period of time and to generate pure pollen concentrates from heterogeneous samples suitable for AMS radiocarbon dating.

In this study we present the approach to sort limnic sediment samples using flow cytometry. We are able to unequivocally identify pollen populations in the heterogeneous composition of the sediments and isolate them. The sediments analyzed were taken from the continental record of Lake Van (Eastern Anatolia). Annually laminated layers from the Holocene section of the sediment cores allow a precise temporal classification and validation of generated radiocarbon ages derived from fossil pollen. Although it is now possible to produce pollen concentrates without the contamination of foreign particles, the isolation of a sufficient quantity of pollen grains to generate reliable radiocarbon ages is still difficult. An increase pollen yield is required. Due to the limitation of the initial material, it is therefore especially necessary to improve the efficiency during the cytometric analysis.

Our results show the importance to steadily optimize the processing steps during chemical pretreatment, cytometric analysis as well as the radiocarbon dating itself. This facilitates the handling of the ultra-small samples and ensures precise age estimations of the pollen concentrates. Furthermore improving the laboratory routine for the enrichment of pollen will allow the analysis of vast amounts of samples in a short period of time. In consequence, dating pollen concentrates generated by flow cytometry can be used as a robust contribution and independent time control for existing chronologies in continental climate records.