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Strategies for radiocarbon analysis of ultra-small macrofossils from lake sediments

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Macrofossils of terrestrial plants, such as seeds, twigs, wood or leaf fragments are ideal candidates for establishing radiocarbon (^{14}C) -based chronologies of lake sediments (1, 2). They are quickly transported from land to sediment and unlike the bulk organic carbon reflect atmospheric ^{14}C concentrations. For accurate and precise ^{14}C analysis samples are typically converted into graphite and measured by accelerator mass spectrometry (AMS). In many cases, the terrestrial plant debris preserved in the lake sediments contain far less than 1 mg carbon (C) and are consequently unsuited for robust ^{14}C dating by conventional means. At the MICADAS AMS system at ETH Zurich, Switzerland, the ^{14}C analyses of combustible samples ranging from 100 μg C down to 10 μg C, are performed on a routine basis using an elemental analyzer (EA) for sample introduction. Such small samples are extremely sensitive to extraneous C, which is inevitably introduced during sample preparation (acid-base-acid cleaning). Furthermore, the vessels carrying the sample material during EA-combustion are an additional source for extraneous carbon. These different contamination sources will bias the results; hence, a minimum number of pretreatment steps and a suitable data correction strategy are necessary in order to obtain accurate ^{14}C dates (3). Processing standards that closely match the matrix of the sample material are required to precisely determine the contamination parameters, namely the mass and its ^{14}C contribution. Optimized ^{14}C gas measurement procedures and the subsequent data correction will be presented for EA-AMS analyses of macrofossils.

[1] Hajdas, I. et al. (1995), QSR 14, 137. [2] Haas, M. et al. (2019) EPSL 505, 110. [3] Welte, C. et al. (2018) NIM B 437, 66.