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The origin of leaf wax n-alkanes in fluvial sedimentary archives – a conceptional study using 14C-dating

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Leaf waxes such as long-chain n-alkanes (C25-C35) are preserved over millennial timescales in sedimentary archives, and are thus increasingly used to reconstruct past environmental conditions. Their homologue patterns reflect on past changes in vegetation, whereas their hydrogen isotopic composition is thought to reflect the isotopic signal of precipitation and can thus be used to reconstruct paleohydrological conditions (e.g. Zech et al., 2013). However, in dynamic and discontinuous sedimentary archives such as fluvial sediment sequences leaf wax formation does not necessarily correspond with sediment deposition. This can result in large age offsets between leaf wax formation and their final embedding into fluvial sediments. Moreover, the origin of leaf waxes (local vs. catchment-derived) in those archives is only poorly understood so far, and thus a major constrain when applying this method for paleoenvironmental reconstructions.

During the last years, direct radiocarbon dating of leaf waxes has been made possible with the development of the mini carbon dating system (MICADAS) that enables gas measurements of small samples (<50 μg). Up to now, direct dating of leaf waxes already proved its potential to establish independent age chronologies in lake sediments and loess-paleosol sequences (e.g. Gierga et al., 2016; Haas et al., 2017). However, this method was not applied to fluvial sedi-mentary archives so far.

Here we present a conceptual study of potentials and limitations of direct radiocarbon dating of leaf wax n-alkanes in fluvial sediment archives using the example of a fluvial sediment-paleosol sequence along the upper Alazani River in SE-Georgia. Generally, n-alkane records from fluvial sediment archives must be divided into (i) a catchment signal that is stored in fluvial sediment layers, and (ii) a local in-situ signal that is stored in intercalated paleosols. Catchment-derived organic carbon (OC), including leaf wax n-alkanes, is a mixture of recent biogenic, pre-aged and petrogenic sources. Recent biogenic OC was produced by terrestrial biomass shortly before sediment deposition, while pre-aged and petrogenic OC represent aged and diagenetically altered carbon originating from long-lasting soil formation on the slopes and weathered sedimentary rocks. OC from paleosols is dominated by recent input of the local vegetation but can be biased by the inherited signal from the fluvial sediments in which they developed. Accordingly, radiocarbon ages of OC from both fluvial sediment layers and paleosols are generally biased by the mixture of material with different ages, but direct radiocarbon dating of the n-alkanes can be a method to at least partly overcome this problem.

References:

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