Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Age and origin of leaf wax n-alkanes in fluvial sediment-paleosol sequences, and implications for paleoenvironmental reconstructions" *by* Marcel Bliedtner et al.

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Marcel Bliedtner and collaborators investigate a paleosol sequence of the upper Alazani river valley in Eastern Georgia with molecular-level radiocarbon records of long-chain leaf waxes. The aim of this study is to differentiate between sources of n-alkanes in sedimentary deposits via radiocarbon isotope mass balance calculations of two sources: petrogenic (shale) and pre-aged (catchment).

The authors employ compound-class 14C measurements of long-chain leaf waxes (C

$\geq$ 25) after removing the shorter chain lengths (C < 25) during the laboratory analyses to reduce the impact of petrogenic C (and reduce uncertainties from microbial reworking). However, even long chain leaf waxes contain a fraction of petrogenic carbon for which the authors introduce a factor and correct their 14C values to then discuss the pre-aging. Further, they translate their extracted 14C values to obtain calendar years yet hardly discuss the additional sensitivities introduced during "calibrating" with the 14C reference Intcal13. Or do the authors speak about 14C years? The former can be tricky because the paleo-fluvial sedimentary sequence seems to have features of recent biological activity and contemporary carbon that can complicate any attempt of absolute age dating.

The excellent combination of molecular-level geochemical tools to trace the fate of carbon in past fluvial deposits is of great interest to earth scientists from various disciplines and, to my understanding, well suited for publication in HESS. The manuscript is scientific sound, entails adequate illustrations and details. However, the current version could benefit from (i) improve clarity in several sections (sentence length and perhaps language); (ii) some clear statement on catchment-wide molecular-level 14C data that consists of an age distribution of 14C rather than a single value; (iii) a statement on the informative value on ACL vs isotopes (13C and 14C); (iv) discussion of data in the light of contemporary and pre-aged carbon; (v) some more informative details on potentials and limits on the geochemical constraints of molecular environmental 14C data compared to conventional 14C dating (in archeology). Probably some of my comments may already be included in the manuscript and might become clear after some careful checking/shortening of sentences and the addition of some clear statements. Overall a great study.

Some specific comments: 1,17: is 'direct' the correct term since you clean your fractions prior to 14C analyses?

1,19-20: 'in-situ signal from local biomass': do you mean contemporary or on-site from litter fall?

1, 30: 'were estimated': how do you determine the petrogenic C contributions? If only estimated, you may need to add some more details on the rationale and the precision of your approach

2, 3: how you know about the 'local dominance of grasses/herbs throughout the Holocene'. Alkane distribution patterns or isotopes?

2, 10: 'valuable biomarkers' - for whom? A clear statement on the power of immortal molecules and the informative value could certainly improve the readability. Please check your manuscript throughout.

2, 12: 'increasingly used' – there a several groundbreaking studies that have already changed our understanding of the environment. Also, are there other biomarkers that can be used to trace primary productivity?

3, 1: what about ultra-small graphitization lines. Same same but different, other labs use conventional sample treatment at similar precision (« 10 μg C)

3, 2: how does MICADAS enable direct 14C dating of specific OC compounds? Do you mean online EA-AMS?

3, 20: 'this petrogenic contribution should lead to increased...'. In 14C, petrogenic is 14C depleted and thus it must be a matter of fraction size. Can you write this more clearly?

3, 22: what about microbial processing and impact, is it solely petrogenic?

9, 1-16: In my opinion, you miss the opportunity to inform the general audience about the principle of your measurement: you always measure a mean/median age of your individual or compound-class 14C n-alkanes because of the variable spatial origin and trajectories. This is central to understand that you integrate on spatial and temporal scale. Along these lines, is it correct to use these values for calibration absolute dating with IntCal14 (atmospheric 14C concentration) or better use 14C years only? Given you can, is your 14C age distribution a bell curve and how do you propagate the ana-

lytical uncertainties with the correction for petrogenic and the age dating?

9, 21: here you assume that your factor remains constant over the entire sequence while you source contributions likely are variable. Please add a statement.

10, 5-6: is it only erosion? What about sub-surface flow and export in addition to erosion of soil mineral horizon? Depending on the level of water saturation, would this impact your trajectories?

10, 27: are you sure your leaf wax n-alkanes are in-situ rather than originate from litter fall from vegetation on-site or transported by wind and water?

11, 5ff: Any thoughts on the role and extent of overprint by contemporary biological activity?

Your results point towards some spatial and time integrated value that is characteristic for a catchment. But how well does the sequence (depth profile) record the catchment changes in the past versus the soil development by contemporary vegetation?

11, 22: do you mean reworking?

11, 24: 'indicate high grass/herb percentages'. Please be specific. If you know the percentages, share it with the reader.

11, 25: 'not biased by pre-aging and reworking effects' – what do you mean? Please consider rephrasing

12, 3: 'this is caused' seems a quite strong statement. Please adjust

12, 4: 'this is further...' Please check that sentence carefully, it reads bulky.

12, 13: by anthropogenic activity: how? By any disturbance events, eg. deforestation?

12, 15: no older ages were determined? ÂňÂňÂňSo, this is the oldest?

12, 26: 'deposition than before'? please check

13, 7: only shale or also microbial?

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