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n-Alkane lipid biomarkers in loess: post-sedimentary or syn-sedimentary?

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There is an ongoing discussion whether n-alkane biomarkers – and organic matter (OM) from loess in general – reflect a syn-sedimentary paleoenvironmental and paleoclimate signal or whether they are significantly a post-sedimentary feature contaminated by root-derived OM (Zech et al., 2012, 2013; Wiesenberg and Gocke, 2013). We present first radiocarbon data for the n-alkane fraction of lipid extracts and for the first time luminescence ages for the Middle to Late Weichselian loess-paleosol sequence of Gleina in Saxony, Germany. Comparison of these biomarker ages with sedimentation ages as assessed by optically stimulated luminescence (OSL) dating shows that one n-alkane sample features a syn-sedimentary age (14C: 29.2 $\pm$ 1.4 kyr calBP versus OSL: 27.3 $\pm$ 3.0 kyr). By contrast, the 14C ages derived from the other n-alkane samples are clearly younger (20.3 $\pm$ 0.7 kyr calBP, 22.1 $\pm$ 0.7 kyr calBP and 29.8 $\pm$ 1.4 kyr calBP) than the corresponding OSL ages (26.6 $\pm$ 3.1 kyr, 32.0 $\pm$ 3.5 kyr and 45.6 $\pm$ 5.3 kyr). This finding suggests that a post-sedimentary n-alkane contamination presumably by roots has occurred.
In order to estimate the post-sedimentary n-alkane contamination more quantitatively, we applied a 14C mass balance calculation based on the measured pMC (percent modern carbon) values, the calculated syn-sedimentary pMC values and pMC values suspected to reflect likely time points of post-sedimentary contamination (modern, last decades, 3 kyr, 6 kyr and 9 kyr). Accordingly, modern and last decadal root-contamination would account for up to 7%, a 3 kyr old root-contamination for up to 10%, and an Early and Middle Holocene root-contamination for up to 20% of the total sedimentary n-alkane pool.
We acknowledge and encourage that these first radiocarbon results need further confirmation both from other loess-paleosol sequences and for different biomarkers, e.g. carboxylic acids or alcohols as further lipid biomarkers.

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Zech, M., Rass, S., Buggle, B., Löscher, M. and Zöller, L.. 2013. Response to the comment of G. Wiesenberg and M. Gocke on “Reconstruction of the late Quaternary paleoenvironments of the Nussloch loess paleosol sequence, Germany, using n-alkane biomarkers”. Quaternary Research, in press.