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Incorrect when uncorrected: Reconstructing vegetation history using n-alkane biomarkers in loess-paleosol sequences – a case study from the Saxonian loess region, Germany

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With our study (Zech et al., Quaternary International, accepted) we aim at contributing to the reconstruction of the paleoenvironment of the Saxonian loess region by investigating sedimentary n-alkanes as plant leafwax derived biomarkers in two loess-paleosol sequences (LPSs), namely the Gleina and the Rottewitz LPSs.
The Weichselian paleosols are characterised by n-alkane concentration maxima when compared to the loess layers. When this coincides with high odd-over-even predominances (OEPs), this points not only to increased n-alkane input and/or production but also to increased n-alkane preservation in the soils, namely in gleysols with water-logged edaphic conditions. By contrast, the buried cambisols reveal low OEPs, indicating accelerated degradation under aerobic edaphic conditions. The n-alkane concentrations in the truncated Eemian Interglacial paleosol are very low. This reflects the removal of the formerly n-alkane-enriched Eemian topsoil, low n-alkane input into the Bt-Sd-horizon (subsoil horizon of the Eemian luvisol) and/or strong soil organic matter mineralization. Four investigated n-alkane ratios show distinct variations during the Weichselian tempting to infer vegetation changes in terms of varying contributions of tree/shrub-derived (dominated by nC27 or nC29) versus grass-derived (dominated by nC31 or nC33) n-alkanes. However, using the OEP as a proxy for degradation and considering that n-alkane ratios are prone to degradation effects, we highlight that the above interpretation is very likely incorrect. Indeed, degradation can be accounted for most variability of the n-alkane ratios.
Applying an endmember model based on a modern n-alkane reference dataset allows estimating the contribution of tree/shrub- versus grass-derived n-alkanes semi-quantitatively. These modelling results suggest that both the Gleina and the Rottewitz LPSs were formed under prevailing grassland. Minor contributions of trees/shrubs are only likely for the Gleinaer Soil Complex in Rottewitz LPS, for the top of a Brown Gleysol in Gleina LPS and the Holocene soil. The Weichselian vegetation changes as inferred from the uncorrected n-alkane ratios are not confirmed. Overall, the n-alkane results support the idea that the Gleinaer Soil Complex in Gleina and Rottewitz LPS, respectively, are not identical but rather chronostratigraphic equivalents. More favourable regional climatic conditions presumably occurred in the southwesterly exposed Rottewitz locality and allowed tree/shrub vegetation to grow during favourable periods of the Weichselian. A major shortcoming of the n-alkane biomarker method is that only vegetation changes of deciduous woodland to grassland and vice versa can be reconstructed, because coniferous trees exhibit by two to three orders of magnitude lower n-alkane concentrations