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Can leaf wax n-alkane δ^2H and GDGTs be used conjointly to reconstruct past environmental changes along altitudinal transects in East Africa?

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Leaf wax n-alkanes (C27-C31) and branched glycerol dialkyl glycerol tetraethers (br GDGTs) are increasingly being used as molecular proxies to investigate past environmental conditions. Indices were previously developed to relate the br GDGT distribution to temperature and pH in soils. Furthermore, the δ^2Hwax of leaf wax n-alkanes in soils was shown to track the ‘altitude effect’, suggesting it could be used to reconstruct paleoelevation. Combination of these two proxies could bring information on both past uplift elevation and past temperature changes, as illustrated by the pioneer paleostudy of Hren et al. (2010) in the Sierra Nevada. In the present study, δ^2Hwax and br GDGTs were analysed in ca. 60 surface soils collected along Mt. Rungwe (Southwest Tanzania) and Mt. Kenya (Central Kenya). A weak link was identified between δ^2Hwax and altitude (R^2 = 0.33) along Mt. Kenya, whereas no trend was observed along Mt. Rungwe, as also previously shown by Peterse et al. (2009) for Mt. Kilimanjaro. This shows that the strength of the relationship between soil δ^2Hwax and elevation depends on which mountain is considered in East Africa and can be overprinted by numerous poorly understood environmental and/or physiological parameters. In contrast, br GDGT-derived mean annual air temperature (MAAT) and temperature lapse rate (5 °C/1000 m) were in agreement with values recorded along both Mt. Rungwe and Mt. Kenya, highlighting the robustness of this proxy for paleotemperature reconstruction in East Africa. Moreover, the combination of these br GDGT data with previous results obtained from East African surface soils (along Mts. Kilimanjaro (Tanzania), Sinninghe Damsté et al., 2008; Rwenzori (Uganda), Loomis et al., 2011; Rungwe (Tanzania), Coffinet et al., 2014), allowed the establishment of a regional soil calibration between br GDGT distribution and MAAT. This new East African calibration, based on 105 samples, leads to a substantial improvement of both the R2 (0.75) and RMSE (2.4 °C) of brGDGT-derived MAAT with respect to the global soil calibration by Peterse et al. (2012; R2 0.61 and RMSE 5° C).

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