Potential of GDGTs and δ^2H of soil *n*-alkanes as paleoaltitude proxies in East Africa

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Résumé:

Mountain formation and erosion can influence climate variability by, for instance, introducing atmospheric circulation disturbance. However, the evolution of one of the major orographic features on Earth, such as the East African rift system (EARS), is still not well constrained because few tools are available to reconstruct paleoaltimetry at high resolution. Recently, $^2H/^1H$ composition of long chain n-alkanes (δ^2H_{wax}) together with distribution in branched glycerol dialkyl glycerol tetraethers (br GDGTs) were proposed to track past evolution of Earth elevation (e.g. Peterse et al., 2009). These two proxies can indirectly track elevation changes through changes in the $^2H/^1H$ composition of precipitation and adiabatic variation of temperature, respectively. In this study, 41 surface soils were sampled along two altitudinal transects, from 500 to 2800 m in Mt. Rungwe (South western Tanzania) and from 1897 to 3268 m in Mt. Kenya (Central Kenya) and analysed for their δ^2H_{wax} and br GDGT distributions. A linear correlation between br GDGT-derived temperatures and the altitude (R^2=0.83) was obtained by combining results of these two transects. The reconstructed temperature lapse rate (0.5 °C/100 m) was consistent with the one determined from temperature measurements at six altitudes along these two mountains. These results were combined with all the other br GDGT-derived temperatures made in altitudinal gradients in East Africa so far (Sinninghe Damsté et al., 2008; Loomis et al., 2011). This correlation (R^2=0.65) then gives a regional calibration of the br GDGTs and shows that it is a suitable and robust temperature and altitudinal proxy in East Africa. A correlation between δ^2H_{wax} and altitude was observed along Mt. Kenya (R^2=0.51) but not along Mt. Rungwe - similarly to Mt. Kilimanjaro (Peterse et al., 2009). This contrast between Mt. Kenya on one hand and Mts. Rungwe and Kilimanjaro on the other hand, may potentially be explained by differences in topography or/and in evapotranspiration mechanisms. These results highlight the complexity of the signal recorded by δ^2H, particularly soil δ^2H_{wax}, and the importance of a regional calibration before using this parameter as a paleoaltitude proxy.

Loomis et al., 2011, Organic Geochemistry 42
Peterse et al., 2009, Biogeosciences 6
Sinninghe Damsté et al., 2008, Organic Geochemistry 39