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NOVEL PROXIES FOR CONTINENTAL PALAEO TEMPERATURE AND SOIL PH BASED ON TETRAETHER MEMBRANE LIPIDS OF SOIL BACTERIA

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Several proxies based on organic compounds exist of which the $U^{K'}_{37}$ and the TEX_{86} are now well established quantitative temperature proxies applied in the marine realm. For the terrestrial realm biomarker proxies exist based on for example $\delta^{13}C$ and δD values of plant wax *n*-alkanes, however, these are mainly qualitative. Here we introduce two new proxies based on terrestrial derived branched glycerol dialkyl glycerol tetraether (GDGT) membrane lipids to quantitatively estimate continental palaeo temperatures and palaeo soil pH.

Branched GDGTs, which are ubiquitous in soils and peat bogs (Weijers et al., 2006a), possess variable amounts of methyl groups and cyclopentyl moieties in their carbon chains and their distribution in soils is strongly related to soil pH and annual mean air temperature (MAT) (Weijers et al., 2006b). As these branched GDGTs are fluvially transported to the oceans and become part of the marine sedimentary archive, it might be possible to use these relations for reconstructing past continental temperatures and soil pH by analysing marine sediment cores in front of large river outflows. As an advantage over current terrestrial temperature proxies, this approach yields continuous long-term high resolution records of river basin integrated continental temperatures and soil pH. In this study, for the first time, we applied these potential proxies in several sediment cores. Application in a sediment core (GeoB 6518) in front of the Congo River outflow, spanning the last deglaciation, shows that the reconstructed annual MAT gradually increased by 4°C, from 21 to 25°C starting around 17 ka BP, in equatorial central Africa. The record of palaeo soil pH co-varies with humidity records, which is explained by stronger and weaker soil leaching processes with higher and lower precipitation intensity, respectively. Additionally, this approach also allows for direct comparison of palaeo land and seawater temperatures. The record of land-sea temperature differences over the last deglaciation for central Africa shows variability which co-varies with humidity records (Schefuß et al., 2005), indicating that this difference exerts strong control on central African hydrology.

Another application of this new temperature proxy involves a record for the Palaeocene-Eocene thermal maximum in the Arctic. The reconstructed annual MAT increased by ~8°C yielding subtropical temperatures of ca. 25°C for the Arctic continent during this time interval. These temperatures are comparable with Arctic Ocean sea surface temperatures reconstructed previously with the TEX_{86}' proxy (Sluijs et al., 2006) (Fig. 1). Moreover, we have detected branched GDGTs in all soils analysed so far and also in an Eemian palaeo soil, in an immature lignite of Late-Palaeocene age and in marine sedimentary records up to 95 Ma ago. This shows that these new biomarker based proxies can be applied in both marine and ancient terrestrial sequences up to the mid-Cretaceous, making these proxies an excellent and very promising tool for continental palaeoclimate research.

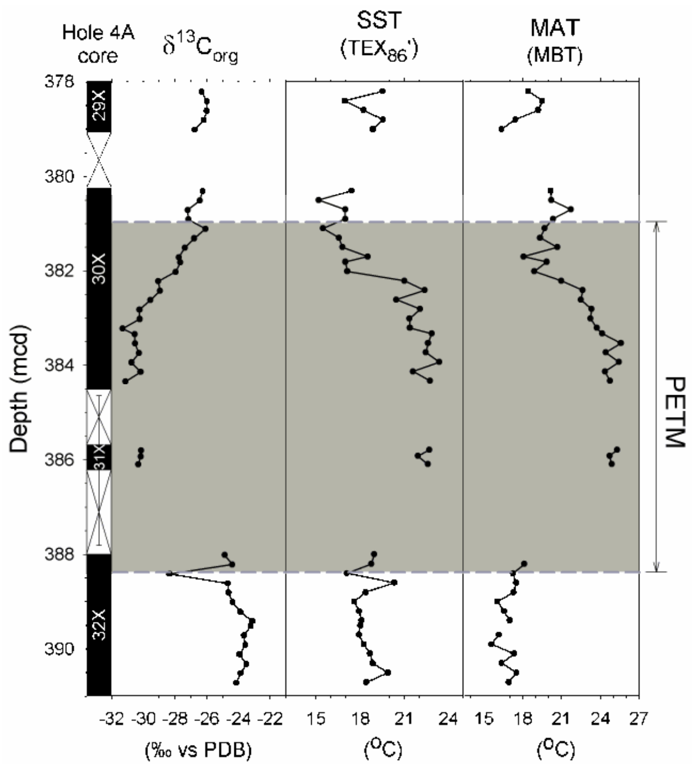

Figure 1. The record of terrestrial annual MAT for the Palaeocene-Eocene thermal maximum in the Arctic region compares well with the reconstructed Arctic Ocean SST

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