Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17884

Improved calibration of the GDGT paleothermometer in lake sediments and reconstruction of warm season temperatures in Europe during the past 60,000 years

PAUL D. ZANDER[1], DANIEL BÖHL[1], FRANK SIROCKO[2], GERALD H. HAUG[1,3] AND ALFREDO MARTINEZ-GARCIA[1]

[1]Max Planck Institute for Chemistry
[2]Johannes Gutenberg-University
[3]ETH Zurich

Presenting Author: paul.zander@mpic.de

Glycerol dialkyl glycerol tetraethers (GDGTs) are uniquely valuable for past temperature reconstructions from terrestrial settings because the distribution of these organic molecules is strongly influenced by (warm season) temperatures[1,2]. However, GDGT distributions can be influenced by other environmental factors or changing sources of GDGTs. In this study, we hypothesize that a novel branched GDGT isomer (IIIa''), which is only found in suboxic to anoxic hypolimnions of lakes[3], can be used to correct and improve temperature estimates from GDGT distributions in lake sediments. We measured GDGT concentrations in modern soil and lake surface sediments, as well as lake sediment cores, from the Eifel volcanic field, Germany. GDGT-inferred temperatures from several calibration models were compared with modern (1901-2016) temperatures, and we find that the IIIa'' GDGT isomer is significantly correlated with the offset between instrumental temperature and GDGT-inferred temperatures. Concentrations of GDGT IIIa'' are highest in samples from the deepest portion of the lakes, and it is absent or scarce in soils. When this isomer is abundant, temperature estimates are cold biased, likely due to greater production of GDGTs within the cooler hypolimnion. Based on this relationship, we apply a correction to a published lake GDGT calibration model and use this corrected calibration to reconstruct warm-season temperatures at centennial resolution during the past 60,000 years. The temperature reconstruction broadly agrees with independent temperature reconstructions, and the new correction based on the IIIa'' isomer improves the reconstruction (as evidenced by stronger correlations with ice core isotope records from Greenland and Antarctica). Our work suggests that GDGT temperature reconstructions can be improved by including compounds beyond the standard set of GDGTs. Future work should test the method we have used to improve GDGT temperature calibrations from lake sediments on broader scales

[1] Raberg, J. H., *et al*. (2022), *Science Advances* **8**, 7625.

[2] Martínez-Sosa, P., *et al. (2021), Geochimica et Cosmochimica Acta* **305**, 87–105.

[3] Weber, Y. *et al. (2018), Proceedings of the National Academy of Sciences* **115**, 10926–10931.