HYDROXYLATED GDGT INDICES FOR TEMPERATURE RECONSTRUCTIONS IN POLAR WATERS: APPLICATION TO THE SOUTHERN OCEAN

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Reconstructing past seawater temperature in the Southern Ocean is essential in light of its role in global climatic changes. However, well established temperature proxies based on microfossils and alkenones have limitations in polar waters. Here we focus on the archaeal glycerol dialkyl glycerol tetraethers (GDGT). One of the recent advances in GDGT-paleothermometry is the proposal of the hydroxylated isoprenoid GDGTs as temperature indicator in the polar regions. Despite the widespread occurrence of hydroxylated isoprenoid GDGTs in marine surface sediments (Liu et al., 2012), they generally appear to occur in low abundance at low latitude or warm water masses and display higher abundance in high latitude or cold water (Huguet et al., 2013).

We analyzed both, non-hydroxylated ("traditional") and hydroxylated isoprenoid GDGT based indices and tested their fit with published temperature records over 500 kyr of glacial-interglacial cycles in a sediment core from the South Atlantic (PS2489-2, neighboring ODP Site 1090; c. 42°S). Glacial-interglacial temperature variability reconstructed using "traditional" TEX_{86} and TEX_{86}^{L} indices was inconsistent with published alkenones and foraminifera based records. The temporal variability in the percentage of hydroxylated GDGTs versus total isoprenoid GDGTs (non-hydroxylated plus hydroxylated), in contrast, was in good agreement. We thus explored the applicability of several indices that include the hydroxylated GDGTs. Two of them showed consistent temporal variability and may therefore potentially be used as a temperature proxy in the Southern Ocean and other cold areas where other proxies may not be applicable.

To improve the calibrations of the new indices, we combined the data from an existing global core-top study (Huguet et al., 2013) with new core-top data from the Pacific sector of the Southern Ocean. However, even using these new calibrations, the ranges of our newly developed hydroxylated GDGT based temperature estimates were much lower than the published temperatures based on alkenones and foraminifera. We will discuss potential explanations for the much colder hydroxylated GDGT derived paleo-temperatures.

References

Liu, X.-L., Lipp, J.S., Simpson, J.H., Lin, Y.-S., Summons, R.E., Hinrichs, K.-U., 2012. Mono and dihydroxyl glycerol dibiphytanyl glycerol tetraethers in marine sediments: identification of both core and intact polar lipid forms. Geochimica et Cosmochimica Acta 89, 102–115.
Huguet, C., Fietz, S., Rosell-Melé, A., 2013. Global distribution patterns of hydroxy glycerol dialkyl glycerol tetraethers. Organic Geochemistry 57, 107-118.