Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20014

Clumped isotopes applied to coccolith calcite: a new way of reconstructing temperatures from euphotic oceans

LUZ MARIA MEJIA RAMIREZ[1,2], HEATHER STOLL[3], STEFANO M. BERNASCONI[3], ALVARO FERNANDEZ[4], HONGRUI ZHANG[3], JOSÉ GUITIÁN[5], HENRIK SADATZKI[6], IVÁN HERNÁNDEZ-ALMEIDA[3] AND HEIKO PÄLIKE[7]

[1]ETH Zurich
[2]MARUM Bremen University
[3]ETH Zürich
[4]CSIC Granada
[5]Universidad de Vigo
[6]Alfred-Wegener Insititute for Polar and Marine Research
[7]MARUM

Presenting Author: lmejia@marum.de

Accurate reconstruction of Earth Climate Sensitivity requires reliable estimations of ocean temperatures. Widely-used temperature proxies have different limitations, such as an incomplete understanding of their controlling mechanisms (e.g. TEX_{86} and $U^{k'}_{37}$), or relying on assumptions of seawater chemistry (e.g. foraminifera Mg/Ca and $\delta^{18}O$), which could result in inaccurate reconstructed magnitudes and/or trends. On the other hand, the application of clumped isotopes (Δ_{47}) to calcite produced by coccolithophores, photosynthetic organisms geographically and temporally ubiquitously distributed in the paleo record, has the potential to improve current reconstructions.

We estimated calcification temperatures from Δ_{47} of a monospecific sediment trap of *Coccolithus pelagicus* in the Iceland Sea, which agree well with SSTs during the bloom period. This result support all previous studies on coccolith Δ_{47} that suggest that if present, vital effects are below the limit of detection of the method.

Calcification temperatures estimated from coccolith Δ_{47} of world-wide distributed Holocene sediments are lower than SSTs in tropical Sites, and lower than temperatures derived from $U^{k'}_{37}$ measured in the same samples, suggesting that coccolithophores biomineralize deeper in the water column and not at the surface. For high latitude Sites, Δ_{47} calcification temperatures are likely indicating mixed layer temperatures. If as coccoliths, alkenones were also being produced at depth, it would imply the need to reevaluate the calibrations traditionally applied to $U^{k'}_{37}$, and would explain SSTs overestimates by the $U^{k'}_{37}$ proxy in our Holocene records.

Coccolith Δ_{47} calcification temperatures from pure size fractions in the North Atlantic (ODP Site 982) during the last 16 Ma were found to be in average ~10°C colder than those estimated using $U^{k'}_{37}$. A 10 °C colder North Atlantic suggests that polar amplification may have been modest, rather than extreme, during warm intervals, a result which agrees much better with climate models, and indicate a lower sensitivity of the North Atlantic to greenhouse forcing. An extension of the record further back in time, from both high and low latitudes is currently being conducted, which we hope will show the potential of the application of Δ_{47} to coccolith calcite as a new tool to reconstruct temperatures of euphotic oceans.