Unraveling the potential for sea surface temperature reconstructions using coccolith clumped isotopes

*L.M. MEJÍA[1], A. FERNÁNDEZ[1], JOSÉ GUITIÁN[1], H. ZHANG[1], S. M. BERNASCONI[1], H. STOLL[1]

[1]ETH Zürich, Sonneggstrasse 5, 8092 Zürich.
*correspondence: [luz.mejia@erdw.ethz.ch]

Coccolithophores are geographycally and chronologically ubiquitous climate regulators and key contributors to marine calcium carbonate export to the deep ocean. Despite their relevance to the carbon cycle, very few studies have focused on determining if reliable absolute sea surface temperatures (SST) can be obtained using clumped isotope thermometry in their calcite. Under the current anthropogenic warming, it is urgent to reach a consensus on Earth climate sensitivity, for which accurate SST recontructions during past periods of CO_2 similar to those projected for the future, are required. For this purpose, the application of clumped isotope thermometry to coccolith calcite is promising, as a surface signal is ensured, opposed to foraminieral calcite. However, it is still not clear whether there are vital effects in coccolith clumped isotopes, potentially related to similar mechanisms causing vital effects in carbon isotopes.

We will present preliminary clumped isotope SST reconstructions from ODP Site 982 (North Atlantic) from the last ~16 Ma based on different coccolith size fractions. Since cells of different sizes experience different degrees of carbon limitation, believed to cause vital effects in carbon isotopes, we expect vital effects in coccolith clumped isotopes to be evidenced in the analysis of well-separated discrete size fractions. The record will be compared to SSTs derived from alkenones, assuming no temperature-saturation of this proxy at this latitude and during this time interval.

To determine whether variability in clumped isotopes between size fractions or potential disagreement with alkenone SSTs records are due to carbon limitation, we combine clumped isotopes with data of carbon isotopic fractionation of coccolith calcite (ε_{cocco}) and fractionation during photosynthesis measured in alkenones (ε_p). The later will be used to reconstruct CO_2 trends in the studied site and evaluate the selective pressure of carbon limitation through time in different size fractions.

This study constitutes one of the first approaches to unravel the potential of this technique to reconstruct absolute SSTs in the deep past, when and where other widely-used temperature proxies are not reliable, providing new data to better understand climate sensitivity.