

Carbonate clumped isotope thermometry in coccoliths: New proxy for SST reconstruction

A. KATZ¹, M. BONIFACIE¹ AND M. HERMOSO²

¹IPGP, Sorbonne Paris Cité, Univ Paris Diderot, UMR7154 CNRS, F-75005 Paris, France (katz@ipgp.fr)

²University of Oxford, Dept. Earth Sciences, Oxford, UK

Various geochemical proxies are applied to constrain past sea surface temperatures (SSTs), a critical parameter to reconstruct paleoclimates. To this aim, the carbonate clumped isotope thermometer (Δ_{47}) shows high promises, as it may complement other proxies (or circumvent some limitations thereof) [1]. Coccoliths are calcitic biominerals formed intracellularly by unicellular photosynthetic algae. They represent more than 50% of the carbonated archive in the pelagic realm and are continuously present since the Jurassic [2]. Because coccoliths only calcify in the sunlit oceanic waters (which is not always the case for foraminifera) they are ideally placed to be used as SST markers. Another prominent advantage of the coccoliths is their overall better preservation state compared to foraminifera, especially during high temperature settings.

Here we calibrate the Δ_{47} thermometer for coccolith calcite with a view to augment our paleoceanographic toolbox, and more specifically to overcome current limitations in the use of $\delta^{18}\text{O}$, Mg/Ca and U^{k}_{37} . We cultured three geological-relevant coccolith species (*Emiliana huxleyi*, *Coccolithus pelagicus* and *Calcidiscus leptoporus*) showing a $> 3\text{‰}$ range in $\delta^{18}\text{O}$ variations for a given growth temperature – an interspecific offset imparted to the vital effect. On the 7 to 25°C temperature range, we observe that: 1/ for a given temperature, the three studied species show identical Δ_{47} values suggesting that there is no species-specific Δ_{47} vital effect in coccoliths. 2/ When the three species are taken together, the Δ_{47} -T dependence reported here for the coccoliths is indistinguishable from previously published Δ_{47} calibrations for inorganic and biogenic calcites that were generated with similar procedures used for Δ_{47} measurements [3-5]. We conclude that coccolith Δ_{47} composition reflects absolute temperatures without vital effect, with typical uncertainty of $\pm 3^\circ\text{C}$.

Altogether, the results show that the emerging Δ_{47} thermometry has the potential to provide valuable refinement on past sea surface temperature throughout the Meso-Cenozoic Eras with unsubstantial effect from changes in the nannofloral assemblage.

[1] Eiler (2011), *QSR* **30**, 3575-3588; [2] Bown and Copper (1998), *BMSPS*, 34-85; [3] Henkes et al. (2013), *GCA* **106**, 307-325; [4] Tang et al. (2014), *GCA* **134**, 120-136; [5] Wacker et al. (2014) *GCA* **141**, 127-144