The Δ_{47} composition of coccoliths: From the laboratory to the natural environment

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The clumped isotope composition (Δ_{47}) of sedimentary carbonate has, in theory, the potential to alleviate limitations related to the use of the oxygen isotope compositions to reconstruct oceanic temperatures. Two main characteristics of the Δ_{47} systematics place this proxy as an ideal palaeothermometer: *i*/ measured Δ_{47} values do not depend on the isotopic composition of seawater, and *ii*/ overall, except for some biocarbonates [e.g. 1], there is no vital effect imprinting their Δ_{47} composition (conversely to $\delta^{18}O$ values). Although numerous experimental Δ_{47}–T calibrations have been established over the last decade, the establishment of a single coherent calibration was mainly hampered by differences in sample processing and Δ_{47} data treatment, as discussed in [2-4]. Such a consistent inter-laboratory calibration has recently emerged [2], allowing the advent of a standardised and robust Δ_{47}–$1/T^2$ equation for generating temperature estimates from the Δ_{47} values of fossil calcites.

In this contribution we investigate the potential of the Δ_{47} composition of calcite biominerals produced by the coccolithophores, the coccoliths, to faithfully retrace sea surface temperatures. To this aim, we have conducted a comprehensive culture of three geologically-relevant species and compared the Δ_{47}-T relationships of their counterparts retrieved from core top sediments. For laboratory-grown coccoliths, we found that the Δ_{47} compositions of the three investigated coccolith species were indistinguishable from inorganic values, indicating the lack of Δ_{47} vital effect in these biominerals [5], despite coeval large oxygen and carbon vital effects. In contrast, we found that the temperature dependence of Δ_{47} values of near-monotaxic subfossil coccoliths is more complex with overall higher Δ_{47} values than expected from culture and inorganic values. We discuss these discrepancies in terms of possible expression of a vital effect in naturally calcifying algae, preservation of Δ_{47} signal, coccolithophore biogeochemistry, and more broadly the extent to which laboratory data can be used in palaeoceanography.

[1] Thaler et al. (2017), this conference. [2] Bonifacie et al. (2017) *GCA*, **200**, 255-279. [3] Kelson et al. (2017) *GCA*, **197**, 104-131. [4] 6th International Clumped Isotope Workshop (2017), 9-12 August, IPGP, Paris, http://www.ipgp.fr/en/iciw. [5] Katz et al. (2017) *GCA*, **in press**.