Dissolution and calcification patterns in calcareous nannofossils during the middle Eocene C21r-H6 hyperthermal event (~47.4Ma) at the Gorrondatxe section (Bay of Biscay, western Pyrenees)

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The carbonate content of calcareous nannofossils is directly affected by seawater chemistry (Riebesell *et al*., 2004). One of the factors that affects seawater chemistry and coccolithophore calcification is global warming, as can be seen in present day oceans (Langer *et al*., 2006). Dissolution on the seabed and burn down are also characteristics of abyssal settings, which partially or completely remove coccoliths from deep-sea deposits (Colosimo *et al*., 2006). Similar processes and results have also been deduced for Eocene hyperthermal events, such as the PETM and ETM2 (Zachos *et al*., 2005). This study reports changes in coccolith carbonate mass from a hemipelagic setting (Gorrondatxe at 1500m paleodepth) during a minor Eocene hyperthermal event, namely the C21r-H6 event (47.44–47.32Ma). Image analysis techniques (Fuertes *et al*., 2014), which were used to decipher changes in the carbonate mass of selected calcareous nannofossil taxa, showed species-specific results. *Chiasmolithus solitus* lost 50% of its $CaCO_3$ mass during the C21r-H6 event, and many specimens also lost their crossed central bars. *Reticulofenestra* spp. (3–5μm) showed a similar pattern, but the amount of mass lost during the event was not as high as in *Chiasmolithus solitus*. *Toweius pertusus*, which was interpreted as reworked, mirrored *Chiasmolithus solitus*, showing that the $CaCO_3$ mass loss occurred on the seabed rather than in the water column. Previous to the hyperthermal event, all taxa show higher mass peaks. It can be concluded that the lysocline rose to a 1500m paleobathymetry in the Bay of Biscay during the C21r-H6 event. Formation of corrosive bottom water in the North Atlantic Ocean is regarded as responsible for the rise of the lysocline (Nunes & Norris, 2006).

References

Colosimo, A.B., Bralower, T.J. & Zachos, J.C. 2006. Evidence for lysocline shoaling at the Paleocene/Eocene Thermal Maximum on Shatsky Rise, Northwest Pacific. *Proceedings of Ocean Drilling Program, Scientific Results*, **198**: 1–36.

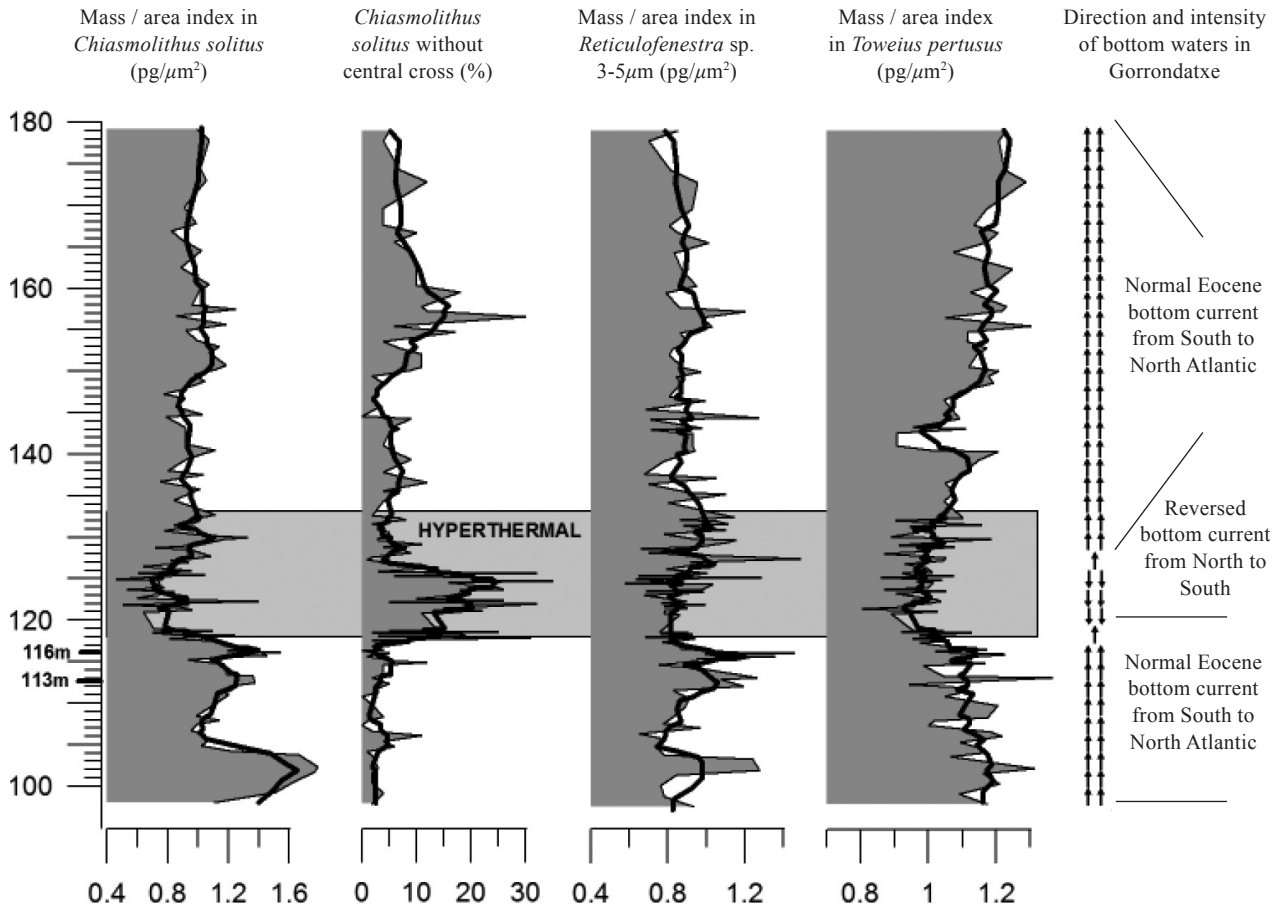
Fuertes, M.A., Flores, J.A. & Sierro, F.J. 2014. The use of circularly polarized light for biometry, identification and estimation of mass of coccoliths. *Marine Micropaleontology*, **113**: 44–55.

Langer, G., Geisen, M., Baumann, K.H., Klas, J., Riebesell, U., Thoms, S. & Young, J.R. 2006. Species-specific responses of calcifying algae to changing seawater carbonate chemistry. *Geochemistry, Geophysics, Geosystems*, **7**: 1227–1238.

Nunes, F. & Norris, R.D. 2006. Abrupt reversal in ocean overturning during the Palaeocene/Eocene warm period. *Nature*, **439**: 60–63.

Riebesell, U. 2004. Effects of CO_2 enrichment on marine phytoplankton. *Journal of Oceanography*, **60**: 719–729.

Zachos, J.C., Röhl, U., Schellenberg, S.A., Sluijs, A., Hodell, D.A., Kelly, D.C., Thomas, E., Nicolo, M., Raffi, I., Lourens, L.J., McCarren, H. & Kroon, D. 2005. Rapid acidification of the ocean during the Paleocene-Eocene Thermal Maximum. *Science*, **308**: 1611–1615.


Mass / area index in *Chiasmolithus solitus* (pg/μm^2)
Chiasmolithus solitus without central cross (%)
Mass / area index in *Reticulofenestra* sp. 3-5μm (pg/μm^2)
Mass / area index in *Toweius pertusus* (pg/μm^2)
Direction and intensity of bottom waters in Gorrondatxe
180
160
140
120
116m
113m
100
HYPERTHERMAL
0.4 0.8 1.2 1.6
0 10 20 30
0.4 0.8 1.2
0.8 1 1.2
Normal Eocene bottom current from South to North Atlantic
Reversed bottom current from North to South
Normal Eocene bottom current from South to North Atlantic