



## Mid-Pliocene North Atlantic palaeoceanography based on palynology, planktonic foraminiferal Mg/Ca, and alkenones

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The mid-Pliocene was an episode of prolonged global warmth and strong North Atlantic thermohaline circulation, interrupted briefly at ca. 3.30 Ma by a global cooling event corresponding to Marine Isotope Stage (MIS) M2. We have combined Mg/Ca ratios and  $\delta^{18}\text{O}$  from *Globigerina bulloides* with dinoflagellate cyst assemblage data from three IODP/DSDP sites to reconstruct the palaeoceanography of the eastern North Atlantic between ca. 3.4 and 3.2 Ma.

Sea-surface temperature reconstructions indicate warm waters at IODP Site 1308 and DSDP Site 610 before and after MIS M2, but a cooling of ca. 2–3°C during MIS M2. A dinoflagellate cyst assemblage overturn, characterized by a significant decline in *Operculodinium centrocarpum* at those sites, points to a reduced northward heat transport and weakened influence of the NAC. The reduced northward heat transport at the northerly sites occurs about 23–35 ka in advance of the maximum global ice volume of MIS M2. Hence, it has been suggested that changes in North Atlantic circulation led to the expansion of the Greenland ice-sheet and initiated the global cooling event at MIS M2. Preliminary results from the more southerly IODP Site U1313 do not record the marked changes of the northerly site. Our foraminiferal Mg/Ca data and the dinoflagellate cyst assemblages shows only minor variability and no expressed cooling around MIS M2, suggesting that only the higher latitudes experienced significant cooling. In contrast, cooling is reflected around that time in an alkenone based sea surface temperature record from the same site.

Our multiproxy approach allows a first attempt at unravelling the ecological preferences of extant and extinct Pliocene dinoflagellate cysts. For at least one species, *Impagidinium pallidum*, a contradiction is apparent between its present and Pliocene spatial and temporal distributions, which could be explained by changes in seasonality, transport paths, or ecological preference.