

## **An acme of the dinoflagellate cyst *Palynodinium grallator*, Gocht, 1970; a marker for the late Maastrichtian warming event at Northern mid-latitudes?**

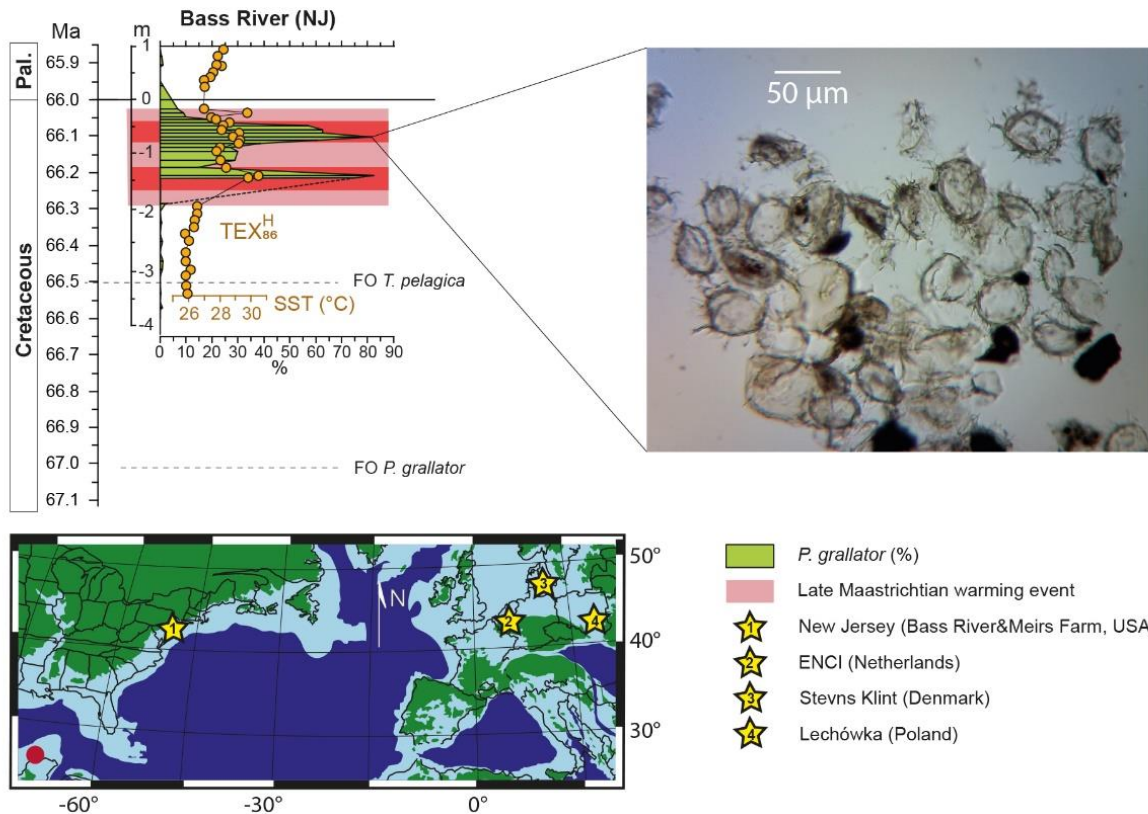
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The Late Maastrichtian Climatic Optimum (LMCO; 66.4-66.1 Ma), likely related to a large volcanic outpouring phase of the Deccan Traps large igneous province (Ravizza & Peucker-Ehrenbrink, 2003), was characterized by a 3-7 degrees warming of sea-surface temperatures in the last ~350 kyrs of the Cretaceous (Schoene et al., 2015; Barnett et al., 2018; Woelders et al., 2018). Our dinoflagellate cyst (dinocyst) records suggest that in the North Atlantic and European mid-latitudes, dinoflagellate communities responded strongly to this warming event (Fig. 1). Stable, normal marine dinocyst assemblages generally characterize the interval before the LMCO. The onset of the warming is marked by a transition to assemblages that are alternately dominated by one or two specific dinocyst taxa. At widespread sites such as the New Jersey paleoshelf, the North Sea Basin, Denmark and Poland, an acme of the dinocyst taxon *Palynodinium grallator* occurs within the LMCO. At its peak abundance, *P. grallator* typically represents >50% of the assemblages, in some samples even >80% of the assemblage. This acme is characterized by a 2 to 10 fold increase in concentration of dinocysts in cysts/gram. This increase in concentration of dinocysts is caused by the additional input of *P. grallator*, as the concentrations of other dinocysts taxa (in cysts/gram) remain relatively stable, ruling out condensation as the mechanism causing the observed high concentrations of dinocysts. Instead, the peak abundances of *P. grallator* reflect massive production of dinoflagellate cysts. The palynological records from the New Jersey paleoshelf illustrate that the *P. grallator* acme occurs during peak warmth, as recorded by  $\delta^{18}\text{O}$ , Mg/Ca and TEX<sub>86</sub> paleotemperature records (Vellekoop et al., 2016; Woelders et al., 2018; Fig. 1). Accordingly, assemblages characterized by a dominance of *P. grallator* appear to be a marker for the end-Cretaceous warming event throughout the Northern mid-latitudes. This dinoflagellate response to the LMCO was likely triggered by the combination of higher sea-water temperatures and more thermally-stratified seas, which may have resulted in higher growth rates and longer-lasting annual bloom windows.



**Figure 1.** *Palynodinium grillator* acme at Bass River.

## References

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