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Upper Campanian-Maastrichtian stable isotopes and calcareous nannofossil palaeoecology in the Boreal Realm (Stevns-1 well, Danish Basin Chalks) : implications for climate change

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The Stevns-1 borehole, drilled in eastern Denmark close to the famous K-Pg boundary section of Stevns Klint, recovered 456 m of upper Campanian to basal Danian chalks with ∼100% recovery. A nearly complete nannofossil biozonation was documented for this core (Sheldon, 2008). Stevns-1 represents the first complete section throughout the uppermost Cretaceous chalk of NW Europe and the most expanded Maastrichtian section worldwide. Because these chalks lack extensive burial diagenetic overprinting and are composed of more of 70% of calcareous nannofossils in volume, they likely reflect conditions of past sea-surface waters, thus making this site highly suitable for the study of past environments and climates of the Boreal realm in the uppermost Cretaceous. Here, we present the results obtained on the long-term evolution of calcareous nannofossil assemblages and bulk carbon- and oxygen-stable isotopes on this site. In the nannofossil assemblage, the main significant changes are observed within the distribution of Watznaueria barnesiae (considered in the Boreal realm as a warm-water index), of the cool-water taxa and of the fertility indices. The neat opposition between the relative abundance of the sum of cool-water taxa and that of Watznaueria barnesiae allowed us to build a nannofossil temperature index (NTI). The NTI and the bulk δ^{18}O show the same evolution and have a high coefficient of correlation (R^2=0.73), thus suggesting that oxygen stable isotopes could be used here to estimate past variations of sea-surface temperatures (SST) in the Boreal realm. These two proxies suggest the following climate evolution : SST were quite stable and warm in the upper Campanian, and are estimated at around 19°C. A 4°C cooling is recorded between the uppermost Campanian and the lowermost Maastrichtian. An expanded mid-Maastrichtian warming episode of 1.5°C is recorded and followed by a second cooling event of 1.5°C in the upper Maastrichtian. The end of the Maastrichtian is characterized by the well-documented Deccan warming which is here expressed by a 2.2°C rise. This climate evolution is similar to that shown in the tropical South Atlantic, Pacific and Indian oceans (Barrera and Savin, 1999). As already suggested by these authors, the two cooling events seem to match well two third-order regressions of the sea-level as nicely expressed in the recently updated sea-level curve of Miller (detailed in Kominz et al., 2008), indicative of a possible glacio-eustatic control. Moreover, we show that changes in the abundances of nannofossil fertility index taxa occured at the time of remarkable shifts in the δ^{13}C curve. This suggests a competition for trophic resources through time among nannofossil taxa, indicative of surface-water fertility changes which are associated with the distinct climatic modes, with more fertile and/or more stable environmental conditions during the Campanian and the mid-Maastrichtian warming modes. The evolution of species richness and the record of first appearance and last appearance datums also suggest significant changes in the stability of the nannofossil community, with more severe environmental conditions coincident with minimum or sharply decreasing δ^{13}C values during the two cooling events of the Campanian-Maastrichtian interval.

References

Barrera, E. and Savin, S.M. In: Barrera, E., and Johnson, C.C., Eds., Evolution of the Cretaceous Ocean-Climate System: Boulder, Colorado, Geological Society of America Special Paper 332, 1999, pp. 245–282.

Kominz, M.A., Browning, J.V., Miller, K.G., Sugarman, P.J., Mizintseva, S., Scotese, C.R., 2008. Basin Research 20: 211-226.

Sheldon, E., 2008. Upper Campanian – Maastrichtian calcareous nannofossil biostratigraphy of the Stevns-1 borehole, Denmark. Journal of Nannoplankton Research 30(1): 39-49.