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The dinoflagellate cyst record of the Cenomanian-Turonian boundary (OAE 2): data from a newly cored black shale succession, Wunstorf, northern Germany

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Global oceanic anoxic events (OAEs) represent major perturbations in the global carbon cycle and are identified by evidence of the widespread deposition of organic carbon-rich sediments in pelagic sedimentary successions. The latest Cenomanian – earliest Turonian oceanic anoxic event (OAE 2) is the most important of the Cretaceous OAEs and is one of only two truly global OAEs (with late Early Aptian OAE 1a). OAE 2 is characterised by the extensive burial of organic carbon in marine black shales, and a large positive δ^{13}C excursion in both marine carbonate and organic matter. A unique and expanded OAE 2 succession was cored at Wunstorf, Germany in February 2006, in order to develop a high-resolution chemo- and biostratigraphy for the Cenomanian / Turonian (C/T) boundary interval which will serve as an international standard. The Wunstorf section includes one of the world's most expanded (25 m thick), accessible C/T sections with thick black shales. The long-term response of organic-walled phytoplankton to OAE 2 has been examined based on the analysis of dinoflagellate cyst (dinocyst) assemblages and abundances in samples collected at metre intervals through 65 m of the Wunstorf core.

Two distinct dinocyst assemblages are recognised within the C/T boundary succession at Wunstorf. These are separated by a barren interval in the Upper Cenomanian, below the interval containing the δ^{13}C excursion. The first assemblage occurs in the *C. guerangeri* ammonite Zone and is dominated by *Spiniferites ramosus ramosus* and

Palaeohystrichophora infusorioides, which are indicative of relatively stable ocean conditions. The absolute abundance of dinocysts within the *C. guerangeri* Zone decreases to a barren interval in the "poor *rhotomagense* limestones", below the base of the *M. geslinianum* Zone. The steady decline in dinocyst abundance suggests that the barren interval is result of decreasing ocean fertility, but decreasing preservation of organic matter is indicated by decreasing numbers of spores and pollen and foraminiferal test linings.

Dinocyst numbers recover sharply in the lower *M. geslinianum* Zone and this is associated with the appearance of black shales in the succession which mark the onset of OAE 2. Immediately above this, a temporary disappearance of black shales at the level of the incoming of *Praeactinocamax plenus* coincides with the bottom of a second interval barren of dinocysts. This lies below the main package of largely Turonian black shales and limestones that yield abundant palynomorphs. These beds yield a different dinocyst assemblage characterised by the presence of *Cyclonephelium membraniphorum,* which reflects more environmentally stressed conditions. Dinocyst abundances in this interval are greater in black shale horizons than in the intercalated limestones, while abundances overall are more than double those in the Upper Cenomanian. This indicates a likely increase in both production and preservation. Dinocyst abundances decline again in association with the disappearance of black shales towards the top of the core. This is probably a result of preservational factors, since it is associated with the appearance of reddened chalks (Rotpläner facies) and the general disappearance of palynomorphs in the succession. Our dinocyst assemblage and abundance data suggest that a combination of production and preservation controlled the deposition of organic matter across the C/T boundary interval and the development of the associated global carbon stable-isotope excursion..