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OAE2 from Tethys to the Boreal Sea: linking marine productivity and climate change

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The Cenomanian–Turonian boundary (CTB) interval, around 93.6 Ma, is characterized globally by a large positive excursion of δ13C in marine carbonates, and both marine and terrestrial organic matter. Increased primary production, and increased preservation of organic matter accompanying oxygen depletion in oceanic water columns, led to widespread black shale deposition in ocean basins and one of very few truly global oceanic anoxic events, OAE2.

Organic-walled dinoflagellate cyst (dinocyst) and geochemical records across the Cenomanian–Turonian boundary (CTB) are compared between Boreal Chalk Anglo-Paris Basin sections in southern England, black shale-bearing successions in the Lower Saxony Basin of northern Germany and the central North Sea Basin, and north Tethyan hemipelagic black shale-bearing successions in the Vocontian Basin, SE France. High-resolution correlation between the sections has been achieved using carbon-isotope chemostratigraphy integrated with planktonic foraminifera, calcareous nannofossil and dinocyst biostratigraphy, and elemental chemostratigraphy. The sections show remarkably similar stratigraphic trends despite representing different palaeolatitudes and different biotic provinces (Boreal to Tethyan), and contrasting lithofacies associations (pelagic chalks, marls, organic-rich shales and limestones).

Dinocyst fertility indexes indicate that local upwelling-driven productivity pulse accompanied a eustatic sea-level fall that preceded the rise in δ13C values that marks the onset of OAE2. A marine productivity collapse during the latest Cenomanian is indicated by the falling absolute and relative abundance of peridinioid dinocysts, believed to be the product of heterotrophic dinoflagellates. This biotic change accompanied transgression and sharply rising sea-surface temperatures, following an Atlantic-wide episode of short-lived cooling. Differences between the magnitudes of changes in the organic-carbon and carbonate-carbon stable isotope (Δ13C) records provide evidence of episodes of falling atmospheric pCO2 driven by organic-matter burial in oceanic areas. CTB biotic turnover in epicontinental and marginal seas was driven largely by watermass changes rather than oxygen depletion.