

## High-resolution calcareous nannofossil biostratigraphy and chemostratigraphy of the Cenomanian-Turonian boundary in the Vocontian Basin, south-east France

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The Cenomanian-Turonian boundary (CTB) Oceanic Anoxic Event 2 (OAE2) is considered the type example of the Mesozoic OAEs, associated with a large and abrupt perturbation in atmospheric  $p\text{CO}_2$ , changes/turnover in the marine macro- and microfauna, changes in ocean water chemistry, and a pronounced positive excursion in the  $\delta^{13}\text{C}$  record of the marine carbonate and marine and terrestrial organic matter. The positive shift in the  $\delta^{13}\text{C}$  curve is believed to be related to the widespread burial of isotopically light organic matter, in response to enhanced oceanic productivity during a period of large igneous province (LIP) formation (*i.e.*, Caribbean Plateau) and increased submarine volcanism, ocean crust production and hydrothermal activity, as substantiated by available strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) isotope and trace metal distribution data.

The Thomel Level of the Lambruisse section in the Vocontian Basin in south-east France accumulated during the CTB OAE2, and is marked by intercalations of black shale and organic-rich marl. Biostratigraphic analysis of the section revealed a total of 6 nannofossil zones, corresponding to the UC2-UC9 zones (Lower Cenomanian-Middle Turonian). The result correlates well with the previously established planktonic foraminiferal biostratigraphy in the section. Biostratigraphically important taxa observed in the section include *Cretarhabdus striatus*, *Axopodorhabdus albianus*, *Lithrathidites acutus*, *Corollithion kennedyi*, *Heleneia chiastia*, *Quadrum gartneri*, *Q. intermedium*, *Eiffellithus eximius*, *Eprolithus octopetalus* and *E. eptapetalus*. *Heleneia chiastia* and *Q. gartneri*, the two nannofossil taxa commonly used in the delineation of the C-T boundary (*e.g.*, Sissingh, 1977; Perch-Nielsen, 1985; Bralower, 1988; Bralower *et al.*, 1995; Burnett, 1998; Luciani & Cobianchi, 1999; Paul *et al.*, 1999; Tsikos *et al.*, 2004), occur less than 2m apart in the studied section, within the UC6 and the *Whiteinella archaeocretacea* zones. Detailed litho- and chemostratigraphic analyses indicate that the  $\delta^{13}\text{C}$  profile of the section corresponds well with changes in lithofacies and fluctuations in the total organic carbon (TOC) and calcium carbonate content of the section. Initial increase in the  $\delta^{13}\text{C}$  values occurs within the UC3-UC4a composite zone, coinciding with the onset of the deposition of the organic-rich sediments of the Thomel Level and drastic decline in the  $\text{CaCO}_3$  values. The plateau of high  $\delta^{13}\text{C}$  values, on the other hand, occurs within the UC5 zone, between the LO of *C. kennedyi* and the LO of *H. chiastia*. This interval of high  $\delta^{13}\text{C}$  values also corresponds to the interval of high TOC and low  $\text{CaCO}_3$  values.

During the biostratigraphic investigation of the Lambruisse section, the common occurrence of large specimens (>8  $\mu\text{m}$ ) of *Assipetra terebrodentarius* (*i.e.*, *A. terebroden-*

*tarius youngii*) was observed in the black shales of the Thomel Level, within the UC3-UC5 nannofossil zones. The increase in abundance and size of this nannolith is well-documented in the Early Aptian OAE1a (*e.g.*, Erba, 1994, 2004; Tremolada & Erba, 2002), but these trends have never been documented in younger OAEs, particularly OAE2. Although the paleoecology of *Assipetra* is still poorly understood, the taxon's presence in OAE1a and OAE2 (both considered as high productivity events or P-OAEs; Erbacher *et al.*, 1996) suggests possible affinity for higher fertility of surface waters and, therefore, supports its potential as a high-productivity indicator-taxon, as suggested by earlier studies (*e.g.*, Tremolada & Erba, 2002). One new holococcolith taxon, a species of *Owenia*, is described in this study.

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