Calcareous nannofossil paleoceanography across Oceanic Anoxic Event 3: From local to global perturbations

Elisabetta Erba
University of Milan, Department of Earth Science, 20133 Milan, Italy; elisabetta.erba@unimi.it

Francesco Miniati
Institute of Geosciences and Earth Resources (IGG), National Research Council of Italy (CNR), 50121 Firenze, Italy; francesco.miniati@igg.cnr.it

Cinzia Bottini
University of Milan, Department of Earth Science, 20133 Milan, Italy; cinzia.bottini@unimi.it

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The Late Cretaceous was punctuated by several periods of global perturbations in the climate–ocean system that led to widespread deposition of organic carbon-rich marine black shales known as oceanic anoxic events (OAEs). The OAE3, which represents the youngest Cretaceous episode of anoxia and is in the Coniacian–Santonian, was confined to the equatorial Atlantic Ocean and adjacent basins rather than being global in scale. We focused on nannofossil paleoceanography of the late Turonian to early Campanian time interval and applied quantitative analyses to assess the response of calcareous nannoplankton to paleoenvironmental changes across OAE3. The study was conducted on sites from the Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP) situated in the equatorial and southern Atlantic Ocean and the Indian Ocean, as well as land sections from the Anglo-Paris Basin. A detailed, revised, and high-resolution nannofossil biostratigraphy of the selected sites enabled correlations at a supra-regional scale.

Quantitative analyses allowed us to characterize paleotemperature and nutrient changes before, during, and after OAE3. Nannofossil-based paleotemperatures varied depending upon the cool-water taxa considered. However, warm conditions that were interrupted by brief cooling episodes in the Coniacian–early Santonian interval were followed by a generalized and longer term cooling that began in the middle Santonian. Regarding paleofertility, the nannofossil assemblages exhibit very different patterns at the various sites, suggesting that OAE3 was not characterized by a global fertilization episode.

We identified relatively large fluctuations in abundance of the genera *Micula* and *Marthasterites*, which correlate with coeval peaks described in the literature, albeit with different abundance values at various sites and sections. Discrete *Marthasterites* (*M. furcatus*) and *Micula* (*M. staurophora*) "acmes" were identified across OAE3. The paleoecological affinities of *Micula* and *Marthasterites* remain elusive, but their distinctive fluctuations indicate that there were profound paleoceanographic changes at specific times. The onset of OAE3 coincides with a major increase in abundance (and local dominance) of *M. furcatus*, suggesting the rapid establishment of new and peculiar paleoceanographic conditions at a widespread to global scale. The most altered paleoceanographic conditions occurred during the core of OAE3 as characterized by the synchronous maximum abundance (climax) of *M. staurophora* on a global scale. In addition to their value for paleoenvironmental reconstructions, the *Micula* and *Marthasterites* "acmes" are useful for the biostratigraphic characterization of the Turonian/Coniacian, Coniacian/Santonian, and Santonian/Campanian boundaries. These "acmes" might be introduced as additional events in future nannofossil zonations for the Late Cretaceous.