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Changes in coccolith sizes through Oceanic Anoxic Event 2: a proxy of ocean acidification?

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The latest Cenomanian was a time of global paleoenvironmental changes: the normal pelagic sedimentation was abruptly interrupted by an episode of ocean-wide anoxia, named Oceanic Anoxic Event 2 (OAE2). The associated C isotopic positive excursion, documented in marine carbonate and organic matter as well as in terrestrial records, is caused by a major perturbation of the carbon budget, generally related to enhanced productivity and burial of organic matter. OAE2 was perhaps triggered by the extensive submarine volcanism during the formation of the Caribbean Plateau that acted as a natural source of CO_2. The environmental perturbation recorded during OAE2 can be synthesized as follows:
1. The onset of OAE2 correlates with a major volcanic episode, causing global warming, a rise in CO_2 and an increase in metals.
2. A weathering spike is followed by a cooling episode and CO_2 drop in the interval of C isotopic peak A, under persisting volcanic emissions.
3. At C isotopic peak B, a major volcanic peak is associated with an increase in.
4. The end of OAE2 is marked by the decrease of C isotopic values after peak C with a return to normal metal concentrations, although temperatures remain relative warm.
Here we present morphometric data of four nannofossil species in the OAE2 interval from different areas. The major result is a change to tiny-dwarf coccoliths, although of different amplitude, at the OAE2 onset. The inferred warmer conditions, higher fertility and excess CO_2 suggest a potential role on nannoplankton calcification. Coccolith sizes return close to normal values around the C isotopic peak A, where minimum pCO_2 and a cooling phase are reconstructed. A major reduction in size is recorded around C isotopic peak B, and coeval to an increase in volcanogenic CO_2 based on metal spikes. The end of the C isotopic excursion doesn't correlate with a return to coccolith normal sizes, suggesting a protraction of anomalous conditions immediately after OAE2 termination.
Our results were compared to the morphometric data collected through OAE1a. During OAE1a dwarfism and malformation are restricted to the C isotopic negative shift and most profound paleoenvironmental perturbations. In the OAE2 interval dwarfism is most pronounced in the last part of the C isotopic anomaly, and coccolith malformation is negligible. Based on available data, climatic and fertility changes per se appear to be of marginal relevance to coccolith morphologies. In particular, the nannofossil record of paleo-fertility during OAE2 is not straightforward, since increases or decreases in abundance were documented in different settings.
Similarly to OAE1a, we speculate that during OAE2, excess CO_2 played a fundamental role in nannoplankton calcification, and that coccolith dwarfism might be a proxy of ocean acidification. In the analyzed sections, during OAE2, dwarf coccoliths occur at levels with metal peaks, perhaps also-alternatively recording a species-specific intolerance to metal toxicity.