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Foraminifera as Paleoceanographic and Paleoclimatologic Proxies

Chaired by Wolkfgang Kuhnt and Holger Gebhardt

Foraminiferal studies provide a fundamental contribution to our understanding of past and future ocean and climate systems. Most reconstructions of paleotemperature, paleosalinity, carbon dioxide content of atmosphere and oceans, sea-level fluctuations, paleoproductivity and carbon export flux rates rely entirely on analyses of foraminiferal test geochemistry and assemblage composition. In this session, we want to focus on innovative applications of foraminifera as proxy indicators in paleoceanography and paleoclimatology. This may include (but is not restricted to) stable isotope and geochemical analyses of foraminiferal tests, transfer functions for planktic and benthic assemblage counts, biometric and other quantitative approaches to reconstruct physical, chemical and biological oceanographic processes. The session is not restricted to more recent periods of Earth's history and extends to the entire Phanerozoic. Contributions which try to overcome the lack of modern analogues for pre-Pleistocene times were particularly encouraged.

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Reconstructing changes in upper water habitats during the late Maastrichtian global warm event based on stable isotopes

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Oxygen and carbon stable isotope measurements of individual species of planktic foraminifera are a valuable tool for reconstructing habitats pattern, water mass stratification paleofertility, and for tracing special vital effects (e.g., photosymbiosis). This study presents a stable oxygen and carbon isotope database for several Maastrichtian species that provides insight into changes in upper water habitats and vital activities during the global greenhouse warming near the end of the Maastrichtian.

The South Atlantic DSDP Site 525A was chosen for this study because it provide the most detailed record of this warm event. Previous studies indicate that the warming occurred between 65.45 and 65.11 Ma, raised deep-water masses temperatures by about 3-4°C, was associated with significant decrease in planktic foraminiferal diversity and the appearance of dwarfed morphologies (Li & Keller, 1998; Abramovich & Keller, 2003).

Eleven sample intervals were selected from the uppermost Maastrichtian sediments of Hole 525A representing the climatic periods that predated (65.7, 65.67, 65.6 Ma), coincided with (65.32, 65.3, 65.28, 65.26, 65.15 Ma), and followed the warm event (65.1, 65.04 Ma). Stable isotope measurements were taken from 20-30 adult specimens of each species from the > 250 µm size fraction from each sample interval. In addition, ~50 specimens of dwarfed forms from the < 150 µm size fraction were measured to assess possible ecological divergence in this group in the warm intervals.

In the intervals that predate warming, $\delta^{18}O$ values of the surface dweller *Pseudoguembelina hariaensis* averaged -0.98‰ and the deep dweller *Abathomphalus mayaroensis* averaged -0.58‰ indicating temperatures of 16°C and 14.2°C, respectively. Peak warming was at 65.32 and 65.3, where $\delta^{18}O$ values of *P. hariaensis* averaged -1.1 ‰ (17.1°C) and $\delta^{18}O$ values of *Abathomphalus mayaroensis* averaged -0.96‰ (15.9°C) suggesting that maximum surface and sub-thermocline temperatures increased by about 1.1°C and 1.7°C, respectively. Thus, surface waters warmed at the same time as the deeper water masses, but not by the same amount. This warming event terminated at 65.15 Ma, with the return of average Late Maastrichtian paleotemperatures values.

Enriched $\delta^{13}C$ values in *Racemiguembelina fructicosa* are attributed to a strong photosymbiotic signal occurring during cool intervals pre- and postdating the warm event. Average $\delta^{13}C$ values of 3.1‰ for *R. fructicosa* are typically > 0.5‰ more enriched than other species from the same sample. However, during the 65.32-65.3 Ma intervals $\delta^{13}C$ values of this species decrease to an average of 2.5‰, which is similar to the $\delta^{13}C$ signal of non-symbiotic species. This change suggests that photosymbiotic activity was significantly reduced during the warmest intervals.

Oxygen and carbon signals of dwarfed specimens to date do not show any significant deviation from the signals of coeval normal-sized adult forms, which suggest that they lived in the same temperatures and in similar habitats. Unless better sampling of peak warming and cooling intervals modify these results, a different explanation for the dwarfing feature, such as reproductive strategy, must be invoked.

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