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The impact of climate instability on marine ecosystems: planktonic foraminiferal biological response to the latest Albian Oceanic Anoxic Event 1d and to the Paleocene-Eocene Thermal Maximum

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Interactions between biosphere and geosphere and, in particular, between biodiversity and global change are archived in sedimentary successions that can be deciphered by geoscientists to separate abiotic and biotic causes of biota evolution. The last 120 million years time interval was marked by radical changes in the protistans, and, among them, planktonic foraminifera became fundamental parts of marine food chains. Besides the long-term (millions of years) evolutionary changes, planktonic foraminifera were also transformed by environmental perturbations that took place over short time scales (thousands of years).

For the understanding of relationships between environmental change and ecosystem functioning a detailed study of the planktonic foraminiferal assemblages was performed across the latest Albian Oceanic Anoxic Event 1d (about 100 Ma) and at the Paleocene/Eocene boundary (about 55.5 Ma) in sediments recovered during Ocean Drilling Program (ODP) Leg 198 on Shatsky Rise (NW Pacific Ocean), and 171B on Blake Nose (WN Atlantic Ocean).

The OAE 1d and the event at the Paleocene/Eocene boundary known as Paleocene/Eocene Thermal Maximum (PETM) are both characterized by global warming coupled with dramatic changes in the nature of global carbon cycling. The planktonic foraminiferal assemblages across the two time-intervals were compared to doc-

ument the population dynamics, to shed light on the tempo and mode of planktonic foraminiferal evolution and to investigate the biosphere capability to react and adapt to environmental changes. Rates of diversification, extinction and turnover in surface- and deep-dweller planktonics reveal more complex relationships between biotic evolution and climate.

Results document a turnover occurred across the OAE1d in the latest Albian with the progressive disappearance of several taxa and the appearance of a new fauna. On the contrary, the response of planktonic foraminifera to PETM environmental changes was mainly associated with an increase in absolute abundance of surface-dwelling taxa, and with a rapid diversification that gave rise to a number of novel morphotype stratigraphically restricted to the carbon isotope excursion interval. Short-lived taxa close to the carbon isotope anomaly were also observed across the OAE1d. Data reveal that the morphological evolution of these taxa occurred at rates previously unknown among planktonic foraminifera.

The observed timing between abiotic factors (environmental changes) and biota evolution during the studied transient intervals of perturbation in the ocean-climate system may indicate that climate instability promotes highest rates of diversification in surface and subsurface dwellers whereas deeper taxa experienced lowest diversification.