A new high resolution stable isotope record from the North Atlantic Ocean: a detailed insight into the mid-Maastrichtian event

Alexa Fischer[1,*], Oliver Friedrich[1], André Bahr[1], Silke Voigt[2]

1 Institute of Earth Sciences, Heidelberg University, Heidelberg, Germany
2 Institute of Geosciences, Goethe University, Frankfurt, Germany
*Contact: alexa.fischer@geow.uni-heidelberg.de

GEOW INSTITUT FÜR GEOWISSENSCHAFTEN

UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386

1. Introduction

The long-term global cooling trend during the latest Cretaceous was interrupted by an intense global warming episode at ~69 Ma known as the mid-Maastrichtian event (MME)[1,2 3]. The MME is characterized by two positive $\delta^{13}C$ excursions with an overall magnitude of 0.6‰ to 1.5‰ separated by a negative inflection[3]. The $\delta^{13}C$ excursions are accompanied by the extinction of inoceramid bivalves[4] and an abrupt increase in deep-sea and sea-surface temperatures[5,3]. Changes in ocean circulation, particularly a change in thermohaloine circulation patterns, have been proposed to be one of the main drivers of the MME[6]. Nevertheless, the driving mechanisms, timing, character, and consequences of the circulation change are still up for debate.

2. Aims

- To understand the climatic patterns causing the MME
- To unravel the drivers of the potential circulation change during the MME
- To further asses the biotic and climatic effects of the MME

3. Material and Methods

- IODP Core U1403 in the North Atlantic (J-Anomaly Ridge) (Fig. 3)
- 2 Myr-long time interval of the mid to late Maastrichtian has been analyzed at a ~2.5 to 5 kyr-resolution
- XRF core scanning
- wt% $CaCO_3$ analyses
- Stable oxygen and carbon isotope measurements of benthic foraminifera (*Nuttallides truempyi*)
- Bottom-water temperature reconstruction through Mg/Ca measurements of the same foraminiferal tests (*Nuttallides truempyi*)

4. Results

- MME lasted ~600 kyr
- Bottom-water temperature increase up to 4 °C (Fig. 2)
- Several $CaCO_3$ dissolution events (Fig. 2)
- High percentage of infaunal benthic foraminifera species → oxygen-poor bottom waters during the MME (Fig. 1)

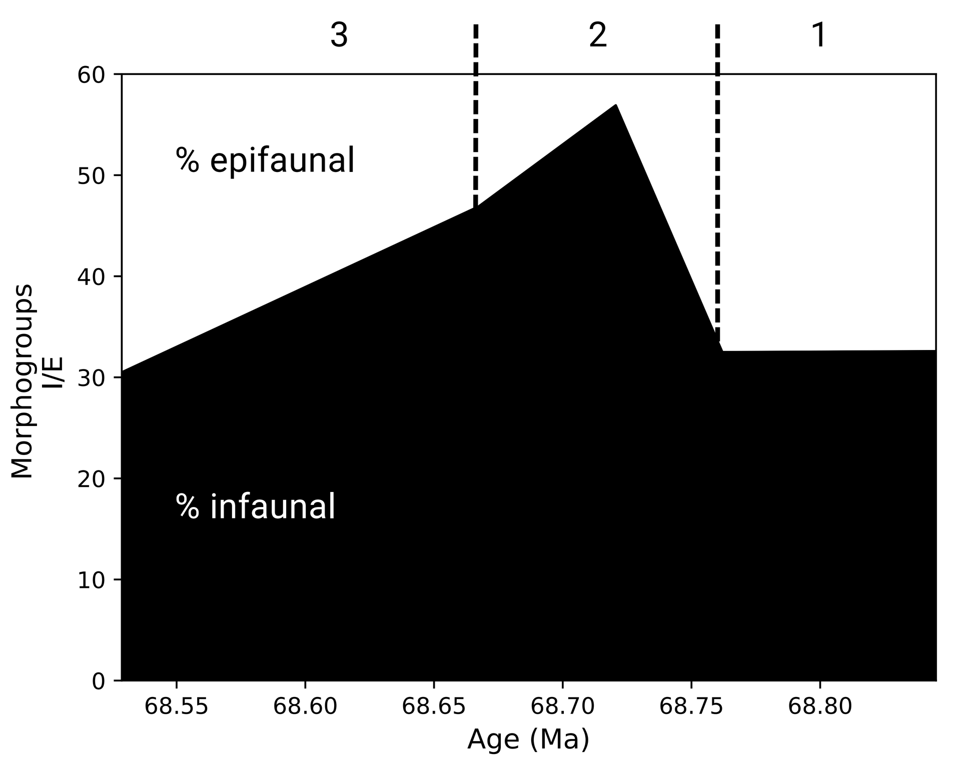

Fig. 1: Preliminary benthic foraminiferal infaunal-epifaunal ratios across the MME. Numbers indicate MME Peaks 1-3.

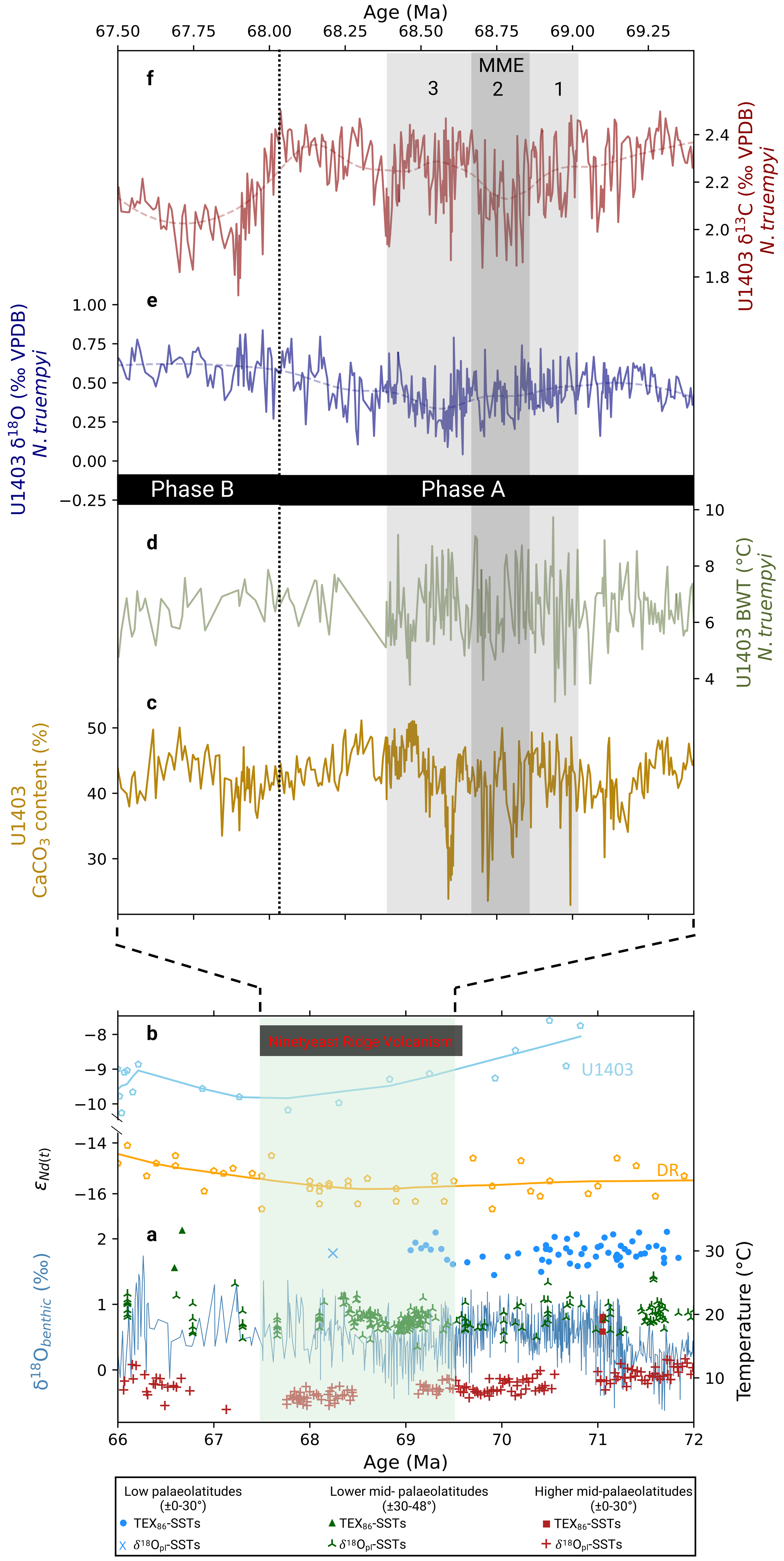

Fig. 2: High-resolution records across the latest Cretaceous of U1403. Light green shaded box, study interval for this work. **a**, Deep sea benthic foraminifer composite $\delta^{18}O$ data for the Maastrichtian from multiple sites[7] and compiled TEX_{86}^{H} and $\delta^{18}O_{pl}$ SST[8]. **b**, Nd-Isotope data, in yellow: Demera Rise (DR)[9] and in blue: U1403[10]. **c**, $CaCO_3$ wt(%) content. **d**, Mg/Ca-based bottom-water temperatures. **e**, Benthic foraminifera (*N. truempyi*) $\delta^{18}O$ (‰, VPDB). **f**, Benthic foraminifera (*N. truempyi*) $\delta^{13}C$ (‰, VPDB). Ninetyeast hotspot volcanism adapted from [12]. MME: mid-Maastrichtian event.

5. Conclusion

Ocean circulation phases

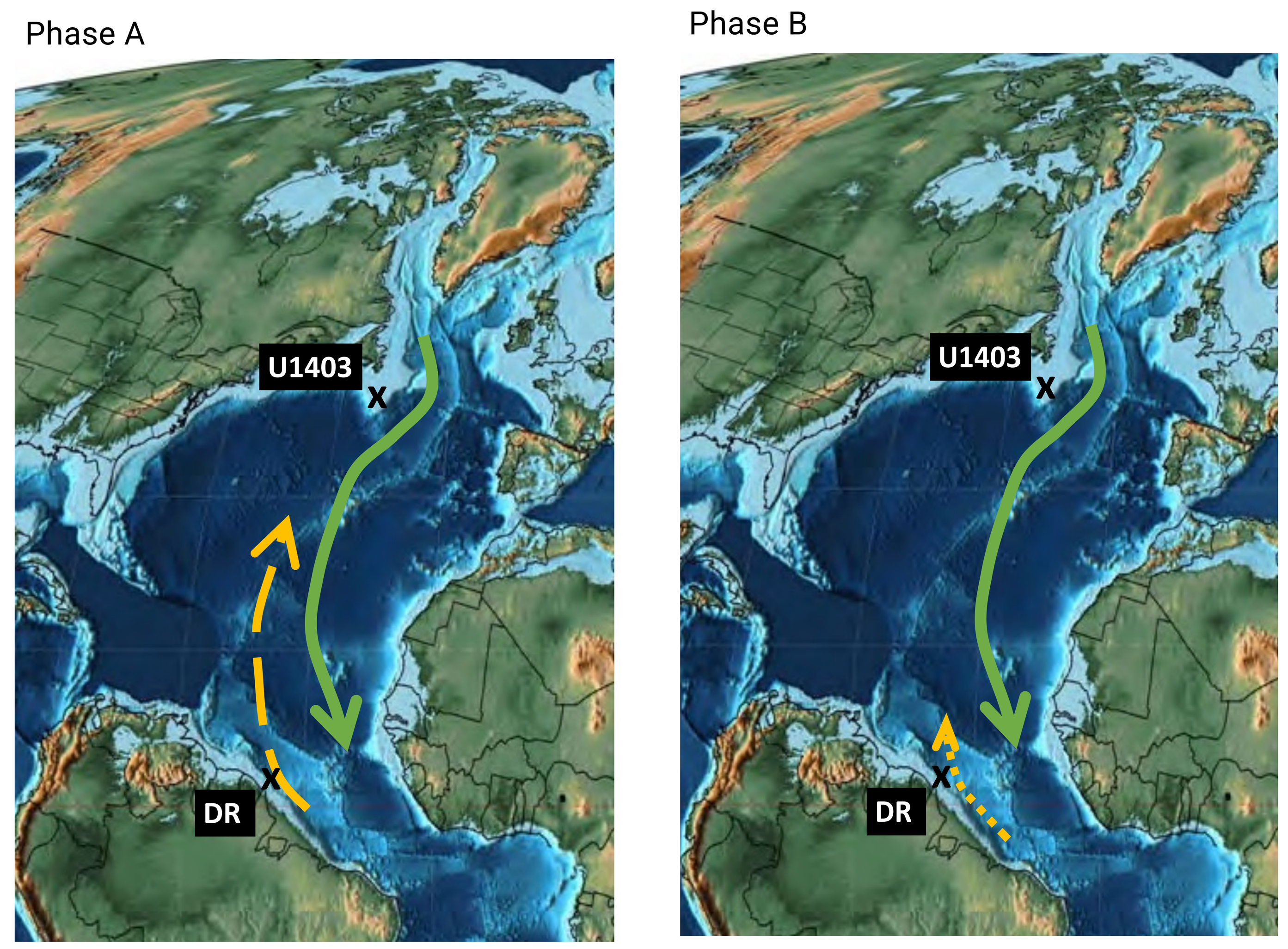

Fig. 3: Schematic representation of the proposed North Atlantic circulation patterns during the late Maastrichtian (68 Ma). Green arrow: waters from the high-latitudes. Yellow dashed arrow: waters from the low-latitudes DR: Demera Rise. Paleomap via [13].

- Interplay between waters from the high- and low-latitudes between 69.25 and 68 Ma (Fig. 2, Fig 3 Phase A)
  - Alternating warm and cold bottom-water temperatures
  - $\delta^{13}C$ fluctuations
  - $CaCO_3$ dissolution events
- Northern-sourced water mass as main deep-water source starting around ~68 Ma (Fig. 2, Fig. 3 Phase B)
  - Stable bottom-water temperatures
  - Stable and lighter $\delta^{13}C$ values
  - No $CaCO_3$ dissolution events

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