Supplementary Files for

Repeated cooling and productivity pulses restructured surface ocean ecosystems during the Mid-Cenomanian Event

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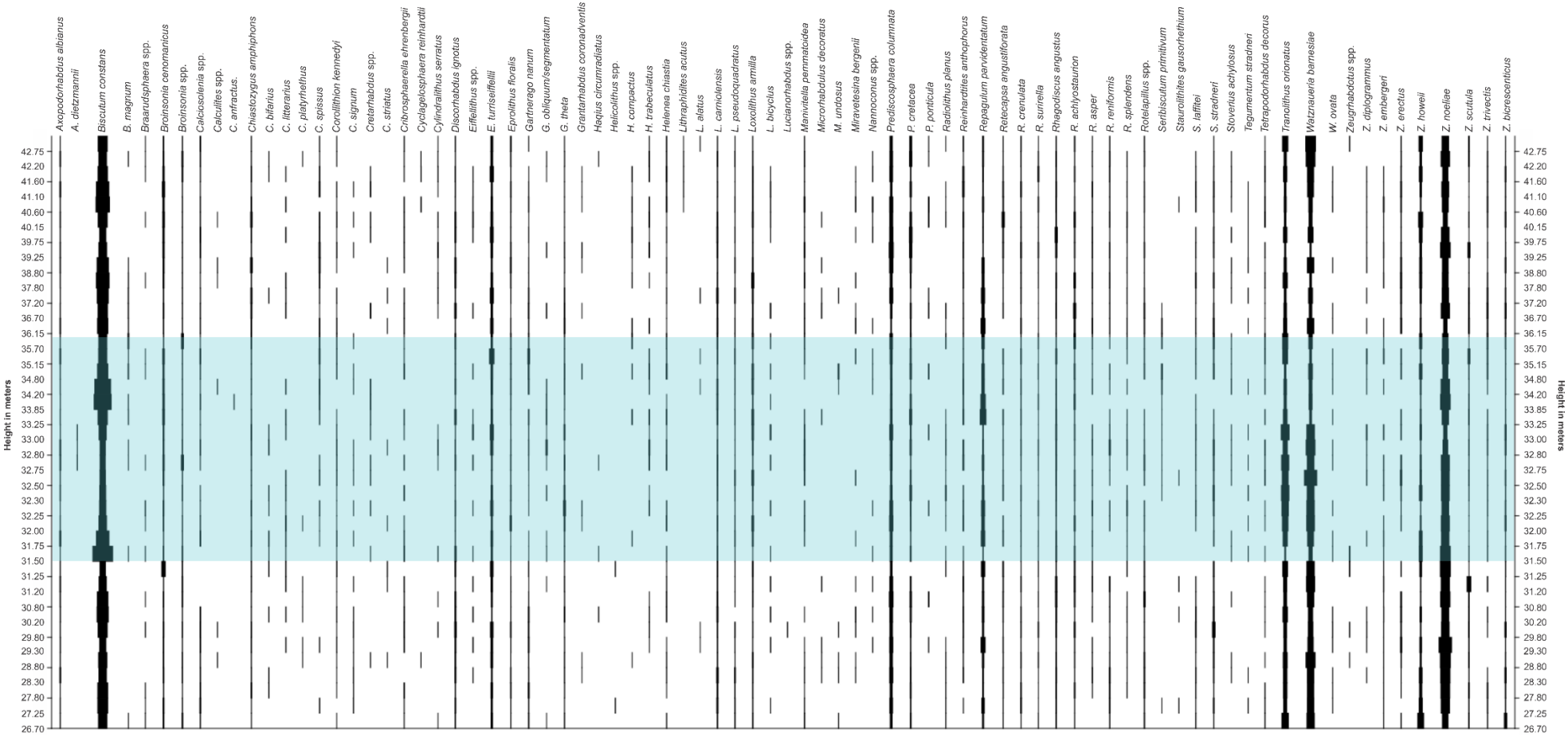
FIGURES

Supplementary Figure 1: Occurrences of calcareous nannofossil species from the Lydden Spout section, Folkestone, southeast England, UK.

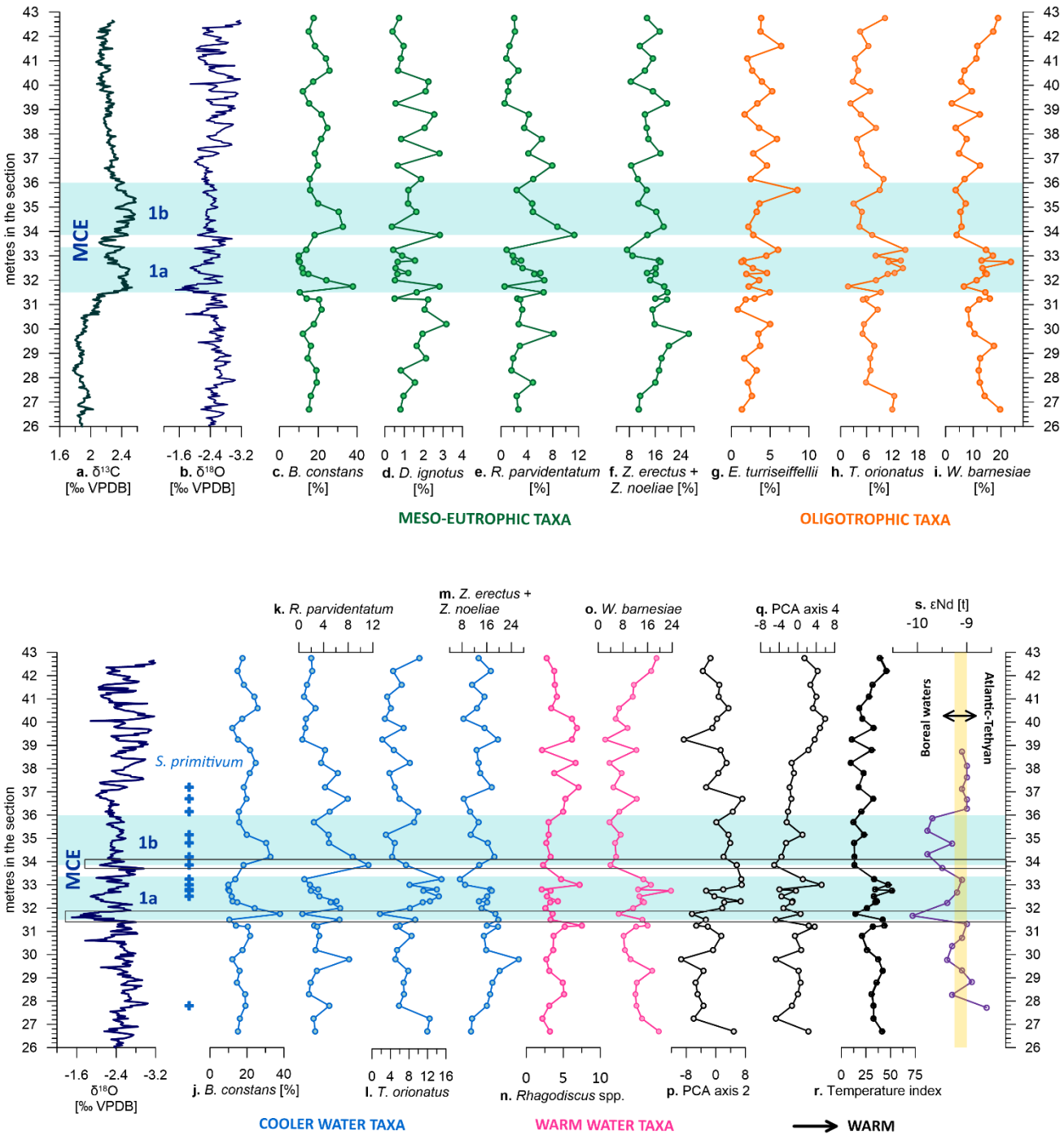
Supplementary Figure 2: Variability and species-specific responses across the Mid-Cenomanian Event (MCE) at the Lydden Spout section, Folkestone, southeast England, UK.

TABLE

Supplementary Table 1: Key ecological traits of calcareous nannofossil taxa



Supplementary Figure 1: Occurrences of calcareous nannofossil species from the Lydden Spout section at Folkestone, southeast England, UK: spindles represent the relative abundances from quantitative counts, with presence-only data obtained from scanning additional fields of view. Blue band indicates the Middle Cenomanian Event interval.



Supplementary Fig. 2: Variability and species-specific responses across the Mid-Cenomanian Event (MCE) at the Lydden Spout section, Folkestone, southeast England, UK: **a)** bulk carbonate $\delta^{13}C$ and **b)** $\delta^{18}O$ records[1]; **c to f**) relative abundances of meso-eutrophic taxa (*Biscutum constans*, *Discorhabdus ignotus*, *Repagulum parvidentatum*, and *Zeugrhabdotus erectus* + *Z. noeliae*); **g to i)** relative abundances of oligotrophic taxa (*Eiffellithus turriseiffelii*, *Tranolithus orionatus*, and *Watznaueria barnesiae*); **j to n)** relative abundances of temperature-sensitive taxa, including cooler-water taxa (*Biscutum constans*, *Repagulum parvidentatum*, *Tranolithus orionatus*) and warm-water taxa (*Rhagodiscus* spp. and *Watznaueria barnesiae*), together with PCA axes **(p, q)** and temperature index **(r).** Also shown is the neodymium isotope (εNd) record of the studied section[2], suggesting episodic influence of Boreal seawater in the epicontinental seas during MCE. Horizontal bars indicate horizons yielding Boreal-affiliated macrofauna. The blue shaded band marks the MCE, with sub-events MCE 1a and 1b indicated.

Supplementary Table 1: Key ecological traits of calcareous nannofossil taxa (1= This study; 2 = Bottini and Erba [3]; 3 = Hardas, et al. [4]; 4 = Linnert, et al. [5].

SPECIES	Cold	Warm	Eutrophic (Mixed)	Mesotrophic	Oligotrophic (Stratified)
Biscutum constans	1, 2, 4		1, 2, 3	3	
Biscutum ellipticum	4				
Broinsonia spp.					3
Discorhabdus ignotus			1, 2		
Eiffellithus turriseffellii					3
Eprolithus floralis	2				3
Gartnerago segmentatum					3
Helicolithus spp.			3	3	
Prediscosphaera cretacea/columnata					3
Prediscosphaera spinosa					3
Repagulum parvidentatum	1, 2				
Rhagodiscus asper		2	3	3	
Rhagodiscus spp.		1, 2			
Seribiscutum gaultensis					3
Staurolithites crux			3	3	
Staurolithites stradneri	2				
Tranolithus orionatus	1, 2				3
Watznaueria barnesiae		1, 2			1, 2, 3, 4
Zeugrhabdotus diplogrammus		2			
Zeugrhabdotus erectus	1		1, 2	1, 3	
Zeugrhabdotus noeliae	1		1	1	
Zeugrhabdotus spp.			2	4	

References

1 Petrizzo, M. R. & Gale, A. S. Planktonic foraminifera document palaeoceanographic changes across the middle Cenomanian carbon-isotope excursion MCE 1: new evidence from the UK chalk. *Geological Magazine* **160**, 372-392 (2023).

2 Zheng, X.-Y., Jenkyns, H. C., Gale, A. S., Ward, D. J. & Henderson, G. M. A climatic control on reorganization of ocean circulation during the mid-Cenomanian event and Cenomanian-Turonian oceanic anoxic event (OAE 2): Nd isotope evidence. *Geology* **44**, 151-154 (2016).

3 Bottini, C. & Erba, E. Mid-Cretaceous paleoenvironmental changes in the western Tethys. *Climate of the Past* **14**, 1147-1163 (2018).

4 Hardas, P., Mutterlose, J., Friedrich, O. & Erbacher, J. The Middle Cenomanian Event in the equatorial Atlantic: the calcareous nannofossil and benthic foraminiferal response. *Marine Micropaleontology* **96**, 66-74 (2012).

5 Linnert, C., Mutterlose, J. & Mortimore, R. Calcareous nannofossils from Eastbourne (southeastern England) and the paleoceanography of the Cenomanian–Turonian boundary interval. *Palaios* **26**, 298-313 (2011).