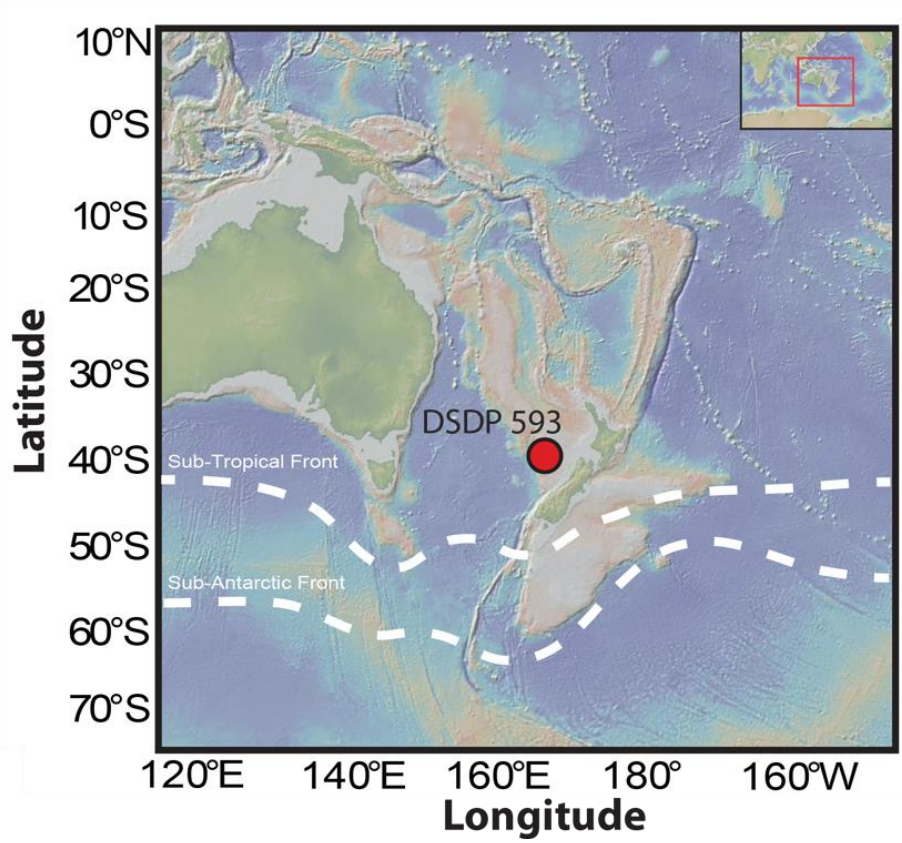
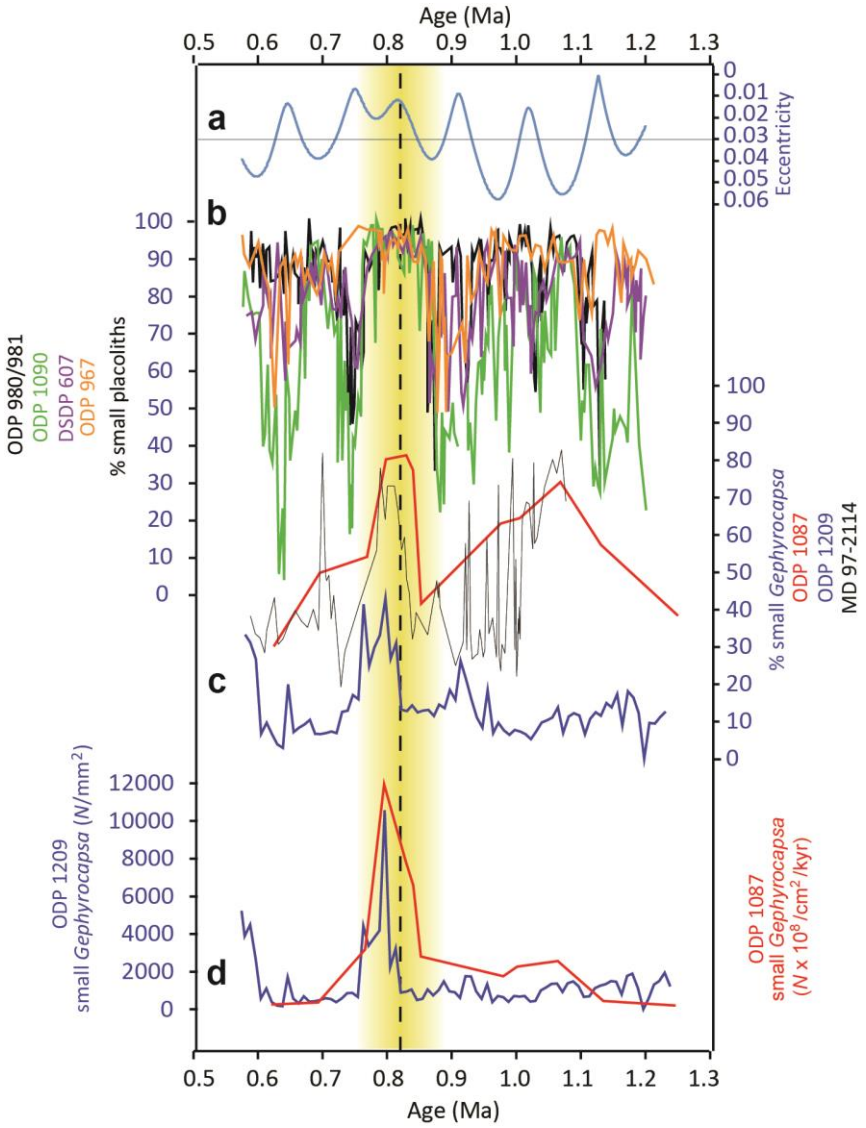
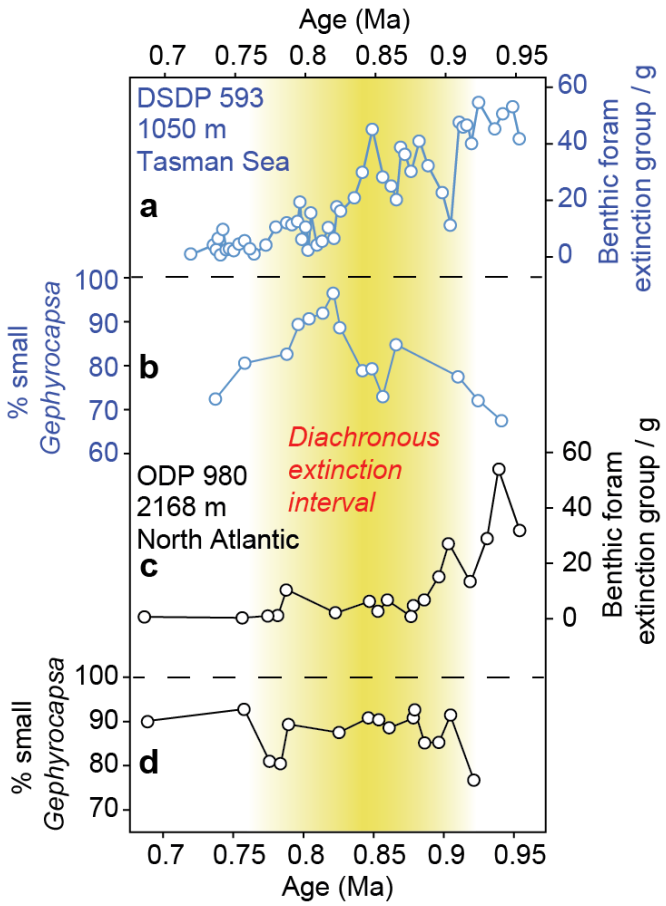
SUPPLEMENTARY INFORMATION



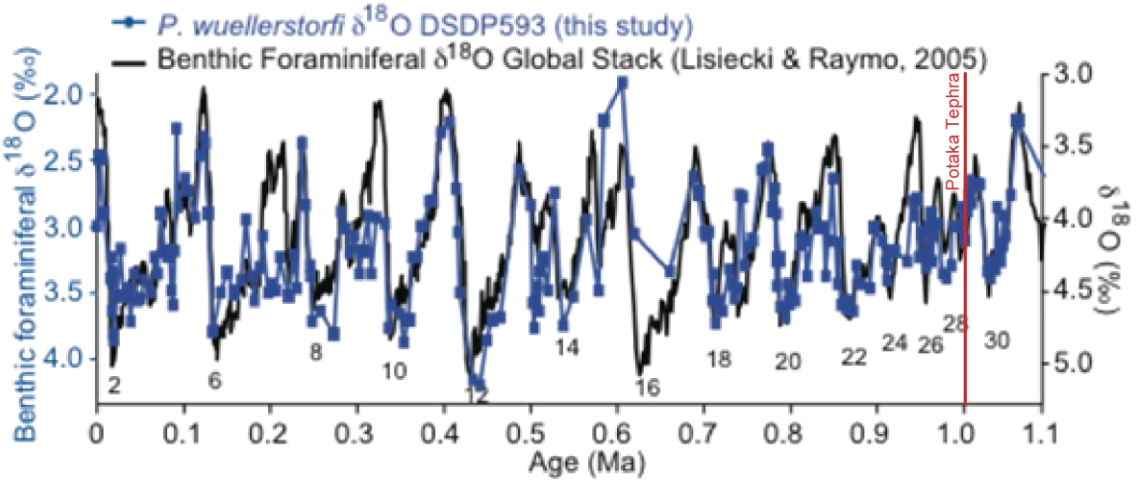
Supplementary Figure 1. Location bathymetry map of DSDP Site 593 (this study) in the Tasman Sea, and other localities discussed in the text. Position of important frontal regions is also shown. Antarctic Intermediate Water, that currently bathes Site 593, forms between the two fronts. Map adapted from Elmore et al. (ref. 1).



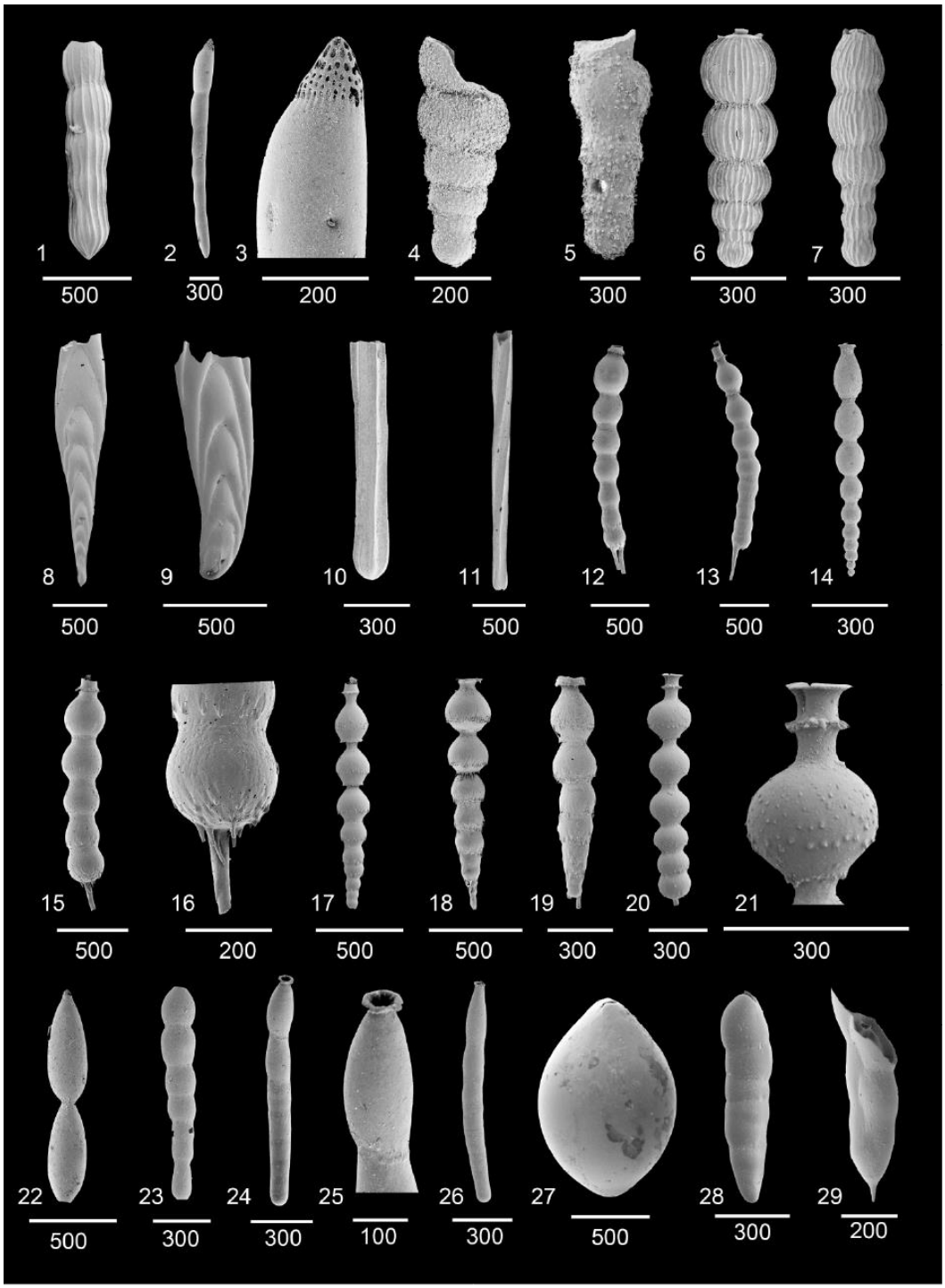
Supplementary Figure 2. Summary of previously-published Mid Pleistocene nannoplankton records. a, Orbital eccentricity[2], showing prolonged insolation minima at ~0.8 Ma due to minimum tilt. **b**, assemblage % small placoliths (which includes small *Gephyrocapsa*, along with other small species) from various sites[3,4,5]. **c**, % of small *Gephyrocapsa* from Sites 1087 (South Atlantic[6]), MD 97-2114 (SW Pacific[7]) and 1209 (North Pacific[8]). Yellow bar indicates the approximate position of the diachronous global benthic foraminiferal extinction.



Supplementary Figure 3. Nannoplankton and extinct benthic foraminiferal assemblages compared at the same sites. a-b, DSDP Site 593 (this study). **c**, ODP Site 980 (ref. 9). **d**, ODP Site 980 (this study). Note how dominance of small *Gephyrocapsa* within nannoplankton is coincident with low abundance of the benthic foraminifera extinction group in both ocean basins in distal locations.



Supplementary Figure 4. Age model for DSDP593. Plots show the correspondence between $\delta^{18}O_{P.\ wuellerstorfi}$ from DSDP593 (blue; left axis) with the LR04[10] benthic foraminiferal $\delta^{18}O$ stack (black; right axis). Average analytical reproducibility for $\delta^{18}O$ of the calcite standard is < 0.1‰.



Supplementary Figure 5. Scanning electron microscope photographs of selected abundant taxa from the elongate uniserial extinction group. 1. *Chrysalogonium deceptorum* (593Z, 3H, 2W, 130-132 cm); **2-3.** *Cribroconica stimulate* (593Z, 3H, 4W, 100-102 cm); **4.** *Chrysalogonium rudis* (593Z, 3H, 6W, 40-42 cm); **5.** *Chrysalogonium rudis*

(593Z, 3H, 6W, 40-42 cm); **6.** *Orthomorphina perversa* (593Z, 3H, 4W, 100-102 cm); **7.** *Orthomorphina perversa* (593Z, 3H, 2W, 130-132 cm); **8.** *Mucronina compressa* (593Z, 3H, 2W, 130-132 cm); **9.** *Mucronina compressa* (593Z, 3H, 2W, 130-132 cm); **10.** *Staffia tostata* (593Z, 3H, 6W, 40-42 cm); **11.** *Staffia tostata* (593Z, 3H, 6W, 40-42 cm); **12.** *Siphonodosaria pomuligera* (593Z, 3H, 4W, 100-102 cm); **13.** *Siphonodosaria pomuligera* (593Z, 3H, 4W, 100-102 cm); **14.** *Strictocostella matanzana* (593Z, 3H, 6W, 40-42 cm); **15-16.** *Siphonodosaria jacksonensis* (593Z, 3H, 4W, 100-102 cm); **17.** *Siphonodosaria lepidula* (593Z, 3H, 2W, 130-132 cm); **18.** *Siphonodosaria lepidula* (593Z, 3H, 4W, 100-102 cm); **19.** *Siphonodosaria lepidula* (593Z, 3H, 6W, 40-42 cm); **20-21.** *Siphonodosaria lepidula* (593Z, 3H, 2W, 130-132 cm); **22.** *Stilostomella fistuca* (593Z, 3H, 4W, 100-102 cm); **23.** *Stilostomella parexilis* (593Z, 3H, 6W, 40-42 cm); **24-25.** *Strictocostella scharbergana* (593Z, 3H, 4W, 100-102 cm); **26.** *Strictocostella scharbergana* (593Z, 3H, 6W, 40-42 cm); **27.** *Ellipsoglandulina labiate* (593Z, 3H, 4W, 100-102 cm); **28.** *Pleurostomella alternans* (593Z, 3H, 2W, 130-132 cm); **29.** *Pleurostomella alternans* (593Z, 3H, 2W, 130-132 cm). Scale bars in μm.

Supplementary Table 1. *Planulina wuellerstorfi* oxygen isotope data between 0.4 and 1.1 Ma for DSDP Site 593.

Core Depth (m)	Age (Ma)	Reference
0.00	0	Ref. 1
0.31	0.0159	AMS-^{14}C (refs. 11,12)
0.81	0.088	Ref. 1
1.80	0.123	Ref. 1
2.31	0.138	Ref. 1
3.18	0.186	Ref. 1
3.86	0.237	Ref. 1
4.89	0.252	Ref. 1
5.28	0.295	Ref. 1

5.60	0.332	Ref. 1
5.80	0.341	Ref. 1
7.61	0.370	Ref. 1
8.07	0.421	Ref. 1
9.81	0.491	*This study*
10.31	0.513	*This study*
10.51	0.530	*This study*
11.01	0.584	*This study*
11.12	0.600	*This study*
12.00	0.650	*This study*
12.26	0.695	*This study*
12.81	0.706	*This study*
14.90	0.718	*This study*
15.10	0.735	*This study*
15.67	0.766	*This study*
15.88	0.790	*This study*
16.80	0.809	*This study*
17.17	0.831	*This study*
17.70	0.858	*This study*
18.10	0.874	*This study*
18.35	0.907	*This study*
18.56	0.92	*This study*
19.59	0.954	*This study*
21.20	0.987	*This study*
21.50	1.000	Potaka Tephra *(This study)*
23.50	1.070	Base of Jaramillo (ref. 13)
25.22	1.128	*This study*

Supplementary References

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