Paleoceanography

Supporting Information for

Interhemispheric controls on deep ocean circulation and carbon chemistry during the last two glacial cycles

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Introduction

This data set contains Nd isotope measurements made on acid-reductive sediment leachates, uncleaned planktonic foraminifera and fish teeth from core SK129-CR2 in the Central Indian Ocean spanning approximately 0-250 ka BP. It also includes benthic $\delta^{13}C$ and $\delta^{18}O$ data measured on the benthic foraminifera *Cibicidoides wuellerstorfi* in that core and age model information.

The Nd isotope data were collected on a Nu Plasma MC-ICP-MS at the University of Cambridge. The benthic $\delta^{13}C$ and $\delta^{18}O$ data were collected on a VG SIRA or a VG PRISM mass spectrometer at the University of Cambridge. Full details are provided in the main manuscript text and table footnotes.

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Table S1: Radiocarbon data for SK129-CR2.

Depth (cm)	**Sample identification**	**Species**	**^{14}C age** (yrs)	**error**	**^{14}C age res. corr. (yrs)**	**Calendar age (yrs BP)**	**error**
2.5	SUERC-13140	*sacculifer*	3727	35	3377	3616	43
12	SUERC-13141	*sacculifer*	6039	35	5689	6462	39
18	SUERC-13142	*sacculifer*	9170	35	8820	9876	107
22	SUERC-13143	*sacculifer*	9038	35	8688	9618	50
26	SUERC-13144	*sacculifer*	11896	38	11546	13411	59
30	SUERC-13147	*sacculifer*	13048	39	12698	14796	88
36	SUERC-13148	*sacculifer*	14341	43	13991	16320	126
40	SUERC-13149	*sacculifer*	14117	42	13767	16026	118
44	SUERC-13150	*sacculifer*	14909	44	14559	17249	171
52	SUERC-13665	*sacculifer*	17841	61	17491	20677	102
58	ANU-5020*	*menardii*	21580	80	21230	25421	129
64	SUERC-13669	*sacculifer*	22409	94	22059	26536	147
78	SUERC-13671	*ruber*	28849	189	28499	33888	248

Notes:

Radiocarbon analysis of planktonic foraminifera at the Scottish Universities Environmental Research Centre (SUERC) AMS Facility (5MV NEC AMS), except for sample at 58cm (denoted by *) which was picked by Luke Skinner and run by Stewart Fallon at the Australian National University AMS Lab. SUERC analyses were funded by grant allocation 1198.1006. Samples were hydrolysed to CO_2 using 85% orthophosphoric acid at 25°C. The gas was converted to graphite by Fe/Zn reduction. The errors are reported as 1σ. Conversion applied a uniform 350 y reservoir correction [*Butzin et al.*, 2005; *Cao et al.*, 2007] and was converted to calendar years using the *Fairbanks et al.* [2005] calibration curve 01.07 (see http://radiocarbon.LDEO.columbia.edu). This data corrects that presented in *Piotrowski et al.* [2009] which had an error in how the reservoir correction was applied.

Table S2: Age model tie points for SK129-CR2.

Depth (cm)	**Calendar age (ka BP)**	**Sed rate below (cm/ka)**	**Method**	**Notes**
2.5	3.616	3.34	^{14}C	
12	6.462	2.44	^{14}C	
20	9.747	1.64	^{14}C ave	average of two closely spaced ^{14}C measurements
26	13.411	2.89	^{14}C	
30	14.796	5.81	^{14}C	
38	16.173	5.58	^{14}C ave	average of two closely spaced ^{14}C measurements
44	17.249	2.33	^{14}C	
52	20.677	1.26	^{14}C	
58	25.421	5.38	^{14}C	
64	26.536	1.90	^{14}C	
78	33.888	1.99	^{14}C	
156	73	2.00	MIS 4/5	
160	75	1.72	YTT	first appearance of Youngest Toba Tuff
258	132	2.41	MIS 5/6	
400	191	1.41	MIS 6/7	
438	218	2.80	MIS 7.3/7.4	
480	233	1.67	MIS 7.4/7.5	
500	245	2.80	MIS 7/8	sedimentation rate below MIS 7-8 boundary is unconstrained and based on sedimentation rate in the subsequent glacial period MIS 7.4

Notes:

The age model is constrained by radiocarbon dates for 0-34 ka, and thereafter graphical correlation of benthic δ^{18}O to the LR04 benthic δ^{18}O stack [*Lisiecki and Raymo*, 2005]. The first appearance of the Youngest Toba Tuff [*Banakar*, 2005; *Mark et al.*, 2014] also provides an independent age estimate that is consistent with the LR04 based age model.

Table S3: Stable oxygen and carbon isotope data from SK129-CR2.

Depth (cm)	**Age (ka BP)**	**$\delta^{18}O_{Cib}$ EPSL**	**$\delta^{13}C_{Cib}$ EPSL**	**$\delta^{18}O_{Cib}$ this study**	**$\delta^{13}C_{Cib}$ this study**	**$\delta^{18}O_{Cib}$ combined**	**$\delta^{13}C_{Cib}$ combined**
0	2.28	2.88	0.53			**2.88**	**0.53**
8	5.26	2.55	0.47			**2.55**	**0.47**
14	7.28	2.72	0.44			**2.72**	**0.44**
16	8.10	3.31	-0.06			**3.31**	**-0.06**
18	8.93	3.41	0.23			**3.41**	**0.23**
22	10.97	3.84	0.12			**3.84**	**0.12**
24	12.19	4.01	0.00			**4.01**	**0.00**
26	13.41	4.16	0.00			**4.16**	**0.00**
30	14.80	4.14	0.03			**4.14**	**0.03**
32	15.14	4.04	-0.07			**4.04**	**-0.07**
36	15.83	4.53	-0.09			**4.53**	**-0.09**
40	16.53	4.15	-0.24			**4.15**	**-0.24**
44	17.25	4.16	-0.18			**4.16**	**-0.18**
48	18.96	4.22	-0.10			**4.22**	**-0.10**
52	20.68	4.13	-0.14			**4.13**	**-0.14**
56	23.84	4.20	-0.11			**4.20**	**-0.11**
58	25.42	4.12	-0.15			**4.12**	**-0.15**
60	25.79	3.96	-0.06			**3.96**	**-0.06**
62	26.16	4.10	-0.09			**4.10**	**-0.09**
64	26.54	4.01	-0.21			**4.01**	**-0.21**
66	27.59	4.22	-0.08			**4.22**	**-0.08**
68	28.64	4.24	-0.01			**4.24**	**-0.01**
70	29.69	3.62	0.10			**3.62**	**0.10**
72	30.74	3.79	-0.10			**3.79**	**-0.10**
74	31.79	3.77	0.11			**3.77**	**0.11**
76	32.84	3.88	0.04			**3.88**	**0.04**
78	33.89	3.76	0.05			**3.76**	**0.05**
80	34.89	3.78	0.13			**3.78**	**0.13**
82	35.89	3.77	0.04			**3.77**	**0.04**
84	36.90	3.81	0.02			**3.81**	**0.02**
86	37.90	3.93	0.04			**3.93**	**0.04**
88	38.90	3.90	0.05			**3.90**	**0.05**
90	39.91	3.81	0.08			**3.81**	**0.08**
92	40.91	3.93	0.15			**3.93**	**0.15**
94	41.91	3.84	0.13			**3.84**	**0.13**
96	42.91	3.89	-0.12			**3.89**	**-0.12**
98	43.92	3.53	0.20			**3.53**	**0.20**
100	44.92	3.65	0.07			**3.65**	**0.07**
102	45.92	3.69	0.03			**3.69**	**0.03**
104	46.93	3.67	0.06			**3.67**	**0.06**
106	47.93	3.59	-0.05			**3.59**	**-0.05**
108	48.93	3.68	0.09			**3.68**	**0.09**
110	49.93	3.76	0.02			**3.76**	**0.02**
112	50.94	3.73	0.01			**3.73**	**0.01**
114	51.94	3.66	-0.08			**3.66**	**-0.08**
116	52.94	3.80	0.13			**3.80**	**0.13**
118	53.95	3.60	0.02			**3.60**	**0.02**
120	54.95	3.63	-0.02			**3.63**	**-0.02**

124	56.95	3.59	-0.10			**3.59**	**-0.10**
132	60.97	3.71	-0.21			**3.71**	**-0.21**
140	64.98	3.94	-0.16			**3.94**	**-0.16**
142	65.98	4.09	0.04			**4.09**	**0.04**
144	66.98	4.36	-0.05			**4.36**	**-0.05**
146	67.99	3.98	-0.17			**3.98**	**-0.17**
148	68.99	4.18	-0.05			**4.18**	**-0.05**
150	69.99	3.77	-0.10			**3.77**	**-0.10**
152	70.99	3.87	-0.01			**3.87**	**-0.01**
154	72.00	3.85	0.02			**3.85**	**0.02**
156	73.00	3.57	0.11			**3.57**	**0.11**
160	75.00	3.38	0.13			**3.38**	**0.13**
162	76.16	4.07	0.44			**4.07**	**0.44**
164	77.33	3.53	0.23			**3.53**	**0.23**
166	78.49	3.28	0.09			**3.28**	**0.09**
168	79.65	3.21	0.18			**3.21**	**0.18**
170	80.82	3.21	0.19			**3.21**	**0.19**
172	81.98	3.41	0.32			**3.41**	**0.32**
174	83.14	3.32	0.41			**3.32**	**0.41**
178	85.47			3.33	0.31	**3.33**	**0.31**
186	90.12	3.42	0.07			**3.42**	**0.07**
194	94.78	3.12	0.13			**3.12**	**0.13**
198	97.10			3.21	0.03	**3.21**	**0.03**
210	104.08	3.15	0.11			**3.15**	**0.11**
214	106.41	3.31	0.07			**3.31**	**0.07**
218	108.73	3.29	0.07			**3.29**	**0.07**
222	111.06	3.45	0.30			**3.45**	**0.30**
224	112.22	3.33	0.03			**3.33**	**0.03**
228	114.55	2.85	-0.08			**2.85**	**-0.08**
232	116.88	3.08	-0.12			**3.08**	**-0.12**
236	119.20	3.18	0.06			**3.18**	**0.06**
240	121.53	2.88	-0.04			**2.88**	**-0.04**
242	122.69	2.71	0.13			**2.71**	**0.13**
244	123.86	2.88	0.00			**2.88**	**0.00**
248	126.18	3.34	0.19			**3.34**	**0.19**
250	127.35	2.70	0.07			**2.70**	**0.07**
252	128.51	2.86	0.20			**2.86**	**0.20**
254	129.67	2.21	-0.21			**2.21**	**-0.21**
256	130.84	3.44	0.03			**3.44**	**0.03**
258	132.00	2.44	-0.18			**2.44**	**-0.18**
260	132.83	3.89	-0.32			**3.89**	**-0.32**
262	133.66	4.21	-0.31			**4.21**	**-0.31**
264	134.49	4.01	-0.24			**4.01**	**-0.24**
266	135.32	4.18	-0.39			**4.18**	**-0.39**
270	136.99	4.13	-0.32			**4.13**	**-0.32**
274	138.65	4.40	-0.46			**4.40**	**-0.46**
278	140.31	4.27	-0.37			**4.27**	**-0.37**
282	141.97	4.14	-0.42			**4.14**	**-0.42**
286	143.63	4.30	-0.40			**4.30**	**-0.40**
290	145.30	4.19	-0.39			**4.19**	**-0.39**
294	146.96	4.11	-0.31			**4.11**	**-0.31**
298	148.62	4.15	-0.41			**4.15**	**-0.41**

300	149.45	4.17	-0.40			**4.17**	**-0.40**
306	151.94	4.33	-0.16			**4.33**	**-0.16**
320	157.76			4.13	-0.43	**4.13**	**-0.43**
326	160.25			4.09	-0.27	**4.09**	**-0.27**
334	163.58			3.75	-0.38	**3.75**	**-0.38**
342	166.90			4.11	-0.32	**4.11**	**-0.32**
344	167.73			3.78	-0.28	**3.78**	**-0.28**
344	167.73			3.95	-0.42	**3.95**	**-0.42**
346	168.56			3.80	-0.22	**3.80**	**-0.22**
350	170.23			3.77	-0.22	**3.77**	**-0.22**
352	171.06			3.79	-0.20	**3.79**	**-0.20**
356	172.72			3.78	-0.25	**3.78**	**-0.25**
358	173.55			3.84	-0.49	**3.84**	**-0.49**
364	176.04			3.89	-0.10	**3.89**	**-0.10**
366	176.87			3.89	-0.32	**3.89**	**-0.32**
374	180.20			3.97	-0.20	**3.97**	**-0.20**
378	181.86			3.82	-0.31	**3.82**	**-0.31**
380	182.69			3.63	-0.39	**3.63**	**-0.39**
382	183.52			3.97	-0.45	**3.97**	**-0.45**
384	184.35			3.86	-0.42	**3.86**	**-0.42**
386	185.18			3.91	-0.59	**3.91**	**-0.59**
390	186.85			3.91	-0.62	**3.91**	**-0.62**
392	187.68			3.71	-0.35	**3.71**	**-0.35**
394	188.51			3.84	-0.43	**3.84**	**-0.43**
396	189.34			3.44	-0.20	**3.44**	**-0.20**
400	191.00			3.55	-0.34	**3.55**	**-0.34**
402	192.42			3.21	-0.16	**3.21**	**-0.16**
402	192.42			3.31	-0.45	**3.31**	**-0.45**
404	193.84			3.42	-0.09	**3.42**	**-0.09**
408	196.68			3.28	-0.04	**3.28**	**-0.04**
410	198.11			3.60	-0.23	**3.60**	**-0.23**
412	199.53			3.20	0.17	**3.20**	**0.17**
414	200.95			3.18	0.21	**3.18**	**0.21**
416	202.37			3.10	0.15	**3.10**	**0.15**
418	203.79			3.00	0.12	**3.00**	**0.12**
420	205.21			3.06	0.15	**3.06**	**0.15**
422	206.63			3.33	0.16	**3.33**	**0.16**
424	208.05			3.31	-0.01	**3.31**	**-0.01**
426	209.47			3.17	0.12	**3.17**	**0.12**
426	209.47			3.49	0.22	**3.49**	**0.22**
428	210.89			3.21	0.10	**3.21**	**0.10**
432	213.74			2.97	0.09	**2.97**	**0.09**
438	218.00			3.18	0.29	**3.18**	**0.29**
444	220.14			3.67	-0.15	**3.67**	**-0.15**
446	220.86			2.93	-0.07	**2.93**	**-0.07**
450	222.29			3.61	-0.26	**3.61**	**-0.26**
456	224.43			3.57	-0.07	**3.57**	**-0.07**
462	226.57			3.48	0.03	**3.48**	**0.03**
468	228.71			3.62	-0.20	**3.62**	**-0.20**
474	230.86			3.61	-0.24	**3.61**	**-0.24**
480	233.00			3.40	-0.03	**3.40**	**-0.03**
484	235.40			3.38	0.37	**3.38**	**0.37**

488	237.80			3.11	0.12	**3.11**	**0.12**
490	239.00			3.20	0.04	**3.20**	**0.04**
490	239.00			3.28	0.20	**3.28**	**0.20**
494	241.40			2.78	0.18	**2.78**	**0.18**
498	243.80			3.06	0.09	**3.06**	**0.09**
500	245.00			3.70	-0.32	**3.70**	**-0.32**
504	246.43			3.90	-0.25	**3.90**	**-0.25**
508	247.86			3.88	-0.14	**3.88**	**-0.14**
512	249.29			3.88	-0.32	**3.88**	**-0.32**
518	251.43			3.88	-0.31	**3.88**	**-0.31**

Notes:
Data from *Piotrowski et al.* [2009] (referred to as 'EPSL') and this study. All data from *C. wuellerstorfi*.

Table S4: Neodymium isotope data from sediment leachates in SK129-CR2.

Depth (cm)	**Age (ka BP)**	**Notes**	**ε_{Nd} decarbonated leachate**	**2σ**	**Ref**	**Size (g)**	**Number of acetic acid leaches**	**ε_{Nd} corrected**	**2σ**	**Correction magnitude**	**Correction method**	**ε_{Nd} non-decarbonated leachate**	**2σ**	**Size (g)**	**Number of acetic acid leaches**	**ε_{Nd} combined leachates**	**2σ**
2.5	3.62		-9.60	0.20	EPSL			-9.90	0.36	-0.30	constant					**-9.90**	**0.36**
6	4.66		-9.90	0.32	EPSL			-10.20	0.44	-0.30	constant					**-10.20**	**0.44**
10	5.86		-9.28	0.24	EPSL			-9.58	0.38	-0.30	constant					**-9.58**	**0.38**
14	7.28		-8.82	0.20	EPSL			-9.12	0.36	-0.30	constant					**-9.12**	**0.36**
18	8.93		-8.51	0.36	EPSL			-8.81	0.47	-0.30	constant					**-8.81**	**0.47**
18	8.93		-8.45	0.24	EPSL			-8.75	0.38	-0.30	constant					**-8.75**	**0.38**
22	10.97		-8.52	0.20	EPSL			-8.82	0.36	-0.30	constant					**-8.82**	**0.36**
26	13.41		-7.41	0.24	EPSL			-7.71	0.38	-0.30	constant					**-7.71**	**0.38**
30	14.80		-7.39	0.19	EPSL			-7.69	0.36	-0.30	constant					**-7.69**	**0.36**
38	16.17		-6.85	0.19	EPSL			-7.15	0.36	-0.30	constant					**-7.15**	**0.36**
44	17.25		-6.76	0.21	EPSL			-7.06	0.37	-0.30	constant					**-7.06**	**0.37**
44	17.25		-6.66	0.24	EPSL			-6.96	0.38	-0.30	constant					**-6.96**	**0.38**
52	20.68		-6.31	0.24	EPSL			-6.61	0.38	-0.30	constant					**-6.61**	**0.38**
52	20.68		-6.31	0.24	EPSL			-6.61	0.38	-0.30	constant					**-6.61**	**0.38**
56	23.84		-6.93	0.21	EPSL			-7.23	0.37	-0.30	constant					**-7.23**	**0.37**
58	25.42		-6.38	0.25	EPSL			-6.68	0.39	-0.30	constant					**-6.68**	**0.39**
60	25.79		-6.52	0.24	EPSL			-6.82	0.38	-0.30	constant					**-6.82**	**0.38**
62	26.16		-6.92	0.25	EPSL			-7.22	0.39	-0.30	constant					**-7.22**	**0.39**
64	26.54		-7.48	0.20	EPSL			-7.78	0.36	-0.30	constant					**-7.78**	**0.36**
66	27.59		-6.63	0.25	EPSL			-6.93	0.39	-0.30	constant					**-6.93**	**0.39**
68	28.64		-6.66	0.25	EPSL			-6.96	0.39	-0.30	constant					**-6.96**	**0.39**
70	29.69		-7.75	0.22	EPSL			-8.05	0.37	-0.30	constant					**-8.05**	**0.37**
74	31.79		-7.46	0.20	EPSL			-7.76	0.36	-0.30	constant					**-7.76**	**0.36**
76	32.84		-6.96	0.25	EPSL			-7.26	0.39	-0.30	constant					**-7.26**	**0.39**
78	33.89		-7.24	0.25	EPSL			-7.54	0.39	-0.30	constant					**-7.54**	**0.39**

78	33.89		-6.30	0.25	EPSL			-6.60	0.39	-0.30	constant					**-6.60**	**0.39**
80	34.89		-7.09	0.25	EPSL			-7.39	0.39	-0.30	constant					**-7.39**	**0.39**
82	35.89		-7.05	0.24	EPSL			-7.35	0.38	-0.30	constant					**-7.35**	**0.38**
86	37.90		-7.76	0.20	EPSL			-8.06	0.36	-0.30	constant					**-8.06**	**0.36**
90	39.91		-7.37	0.21	EPSL			-7.67	0.37	-0.30	constant					**-7.67**	**0.37**
92	40.91		-7.00	0.25	EPSL			-7.30	0.39	-0.30	constant					**-7.30**	**0.39**
94	41.91		-7.13	0.25	EPSL			-7.43	0.39	-0.30	constant					**-7.43**	**0.39**
96	42.91		-7.29	0.20	EPSL			-7.59	0.36	-0.30	constant					**-7.59**	**0.36**
98	43.92		-6.98	0.25	EPSL			-7.28	0.39	-0.30	constant					**-7.28**	**0.39**
100	44.92		-6.76	0.25	EPSL			-7.06	0.39	-0.30	constant					**-7.06**	**0.39**
102	45.92		-7.06	0.24	EPSL			-7.36	0.38	-0.30	constant					**-7.36**	**0.38**
104	46.93		-7.32	0.25	EPSL			-7.62	0.39	-0.30	constant					**-7.62**	**0.39**
106	47.93		-7.79	0.20	EPSL			-8.09	0.36	-0.30	constant					**-8.09**	**0.36**
108	48.93		-7.80	0.25	EPSL			-8.10	0.39	-0.30	constant					**-8.10**	**0.39**
110	49.93		-8.22	0.23	EPSL			-8.52	0.38	-0.30	constant					**-8.52**	**0.38**
112	50.94		-7.57	0.25	EPSL			-7.87	0.39	-0.30	constant					**-7.87**	**0.39**
114	51.94		-8.00	0.20	EPSL			-8.30	0.36	-0.30	constant					**-8.30**	**0.36**
116	52.94		-6.90	0.36	EPSL			-7.20	0.47	-0.30	constant					**-7.20**	**0.47**
118	53.95		-7.36	0.25	EPSL			-7.66	0.39	-0.30	constant					**-7.66**	**0.39**
124	56.95		-7.37	0.24	EPSL			-7.67	0.38	-0.30	constant					**-7.67**	**0.38**
132	60.97		-7.59	0.21	EPSL			-7.89	0.37	-0.30	constant					**-7.89**	**0.37**
140	64.98		-7.62	0.18	EPSL			-7.92	0.35	-0.30	constant					**-7.92**	**0.35**
148	68.99		-7.28	0.24	EPSL			-7.58	0.38	-0.30	constant					**-7.58**	**0.38**
152	70.99		-8.36	0.18	EPSL			-8.66	0.35	-0.30	constant					**-8.66**	**0.35**
158	74.00		-8.20	0.22	EPSL			-8.50	0.37	-0.30	constant					**-8.50**	**0.37**
162	76.16		-9.02	0.18	EPSL			-9.32	0.35	-0.30	constant					**-9.32**	**0.35**
174	83.14		-9.09	0.18	EPSL			-9.39	0.35	-0.30	constant					**-9.39**	**0.35**
186	90.12		-8.96	0.20	EPSL			-9.26	0.36	-0.30	constant					**-9.26**	**0.36**
194	94.78		-9.05	0.20	EPSL			-9.35	0.36	-0.30	constant					**-9.35**	**0.36**
210	104.08		-9.21	0.24	EPSL			-9.51	0.38	-0.30	constant					**-9.51**	**0.38**

210	104.08		-9.13	0.22	EPSL			-9.43	0.37	-0.30	constant					**-9.43**	**0.37**
214	106.41		-9.30	0.20	EPSL			-9.60	0.36	-0.30	constant					**-9.60**	**0.36**
218	108.73		-9.04	0.25	EPSL			-9.34	0.39	-0.30	constant					**-9.34**	**0.39**
222	111.06		-8.72	0.24	EPSL			-9.02	0.38	-0.30	constant					**-9.02**	**0.38**
228	114.55		-8.56	0.24	EPSL			-8.86	0.38	-0.30	constant					**-8.86**	**0.38**
232	116.88		-8.38	0.20	EPSL			-8.68	0.36	-0.30	constant					**-8.68**	**0.36**
236	119.20		-8.51	0.24	EPSL			-8.81	0.38	-0.30	constant					**-8.81**	**0.38**
240	121.53		-9.24	0.20	EPSL			-9.54	0.36	-0.30	constant					**-9.54**	**0.36**
240	121.53		-8.86	0.23	EPSL			-9.16	0.38	-0.30	constant					**-9.16**	**0.38**
244	123.86		-8.73	0.22	EPSL			-9.03	0.37	-0.30	constant					**-9.03**	**0.37**
244	123.86		-8.61	0.20	EPSL			-8.91	0.36	-0.30	constant					**-8.91**	**0.36**
246	125.02		-8.38	0.22	EPSL			-8.68	0.37	-0.30	constant					**-8.68**	**0.37**
250	127.35		-8.55	0.20	EPSL			-8.85	0.36	-0.30	constant					**-8.85**	**0.36**
252	128.51		-8.67	0.25	EPSL			-8.97	0.39	-0.30	constant					**-8.97**	**0.39**
254	129.67		-7.49	0.20	EPSL			-7.79	0.36	-0.30	constant					**-7.79**	**0.36**
256	130.84		-6.92	0.25	EPSL			-7.22	0.39	-0.30	constant					**-7.22**	**0.39**
258	132.00		-7.36	0.22	EPSL			-7.66	0.37	-0.30	constant					**-7.66**	**0.37**
260	132.83		-6.09	0.22	EPSL			-6.39	0.37	-0.30	constant					**-6.39**	**0.37**
264	134.49		-7.32	0.24	EPSL			-7.62	0.38	-0.30	constant					**-7.62**	**0.38**
266	135.32		-7.03	0.25	EPSL			-7.33	0.39	-0.30	constant					**-7.33**	**0.39**
278	140.31		-6.44	0.20	EPSL			-6.74	0.36	-0.30	constant					**-6.74**	**0.36**
282	141.97		-7.33	0.22	EPSL			-7.63	0.37	-0.30	constant					**-7.63**	**0.37**
286	143.63		-6.76	0.20	EPSL			-7.06	0.36	-0.30	constant					**-7.06**	**0.36**
290	145.30		-7.39	0.22	EPSL			-7.69	0.37	-0.30	constant					**-7.69**	**0.37**
296	147.79											-7.83	0.23	1.99	3	**-7.83**	**0.23**
304	151.11											-8.15	0.19	2.08	3	**-8.15**	**0.19**
306	151.94		-6.34	0.25	EPSL			-6.64	0.39	-0.30	constant					**-6.64**	**0.39**
310	153.61											-6.83	0.25	2.84	3	**-6.83**	**0.25**
320	157.76		-6.57	0.29	this	3.80	9	-7.29	0.47	-0.72	size					**-7.29**	**0.47**
326	160.25		-6.66	0.23	this	3.60	10	-7.44	0.43	-0.78	size					**-7.44**	**0.43**

328	161.08	large	-7.02	0.26	this	4.61	10	-7.47	0.45	-0.46	size					**-7.47**	**0.45**
328	161.08	small	-5.87	0.26	this	1.87	10	-7.20	0.45	-1.33	size					**-7.20**	**0.45**
334	163.58		-6.98	0.29	this	3.40	9	-7.82	0.47	-0.85	size					**-7.82**	**0.47**
342	166.90		-7.22	0.23	this	2.30	10	-8.42	0.43	-1.20	size					**-8.42**	**0.43**
344	167.73		-7.81	0.26	this	2.99	10	-8.78	0.45	-0.98	size					**-8.78**	**0.45**
346	168.56		-7.57	0.18	this	2.70	9	-8.64	0.41	-1.07	size					**-8.64**	**0.41**
350	170.23		-7.87	0.26	this	2.67	10	-8.94	0.45	-1.07	size					**-8.94**	**0.45**
352	171.06		-8.04	0.24	this	2.60	9	-9.15	0.44	-1.11	size					**-9.15**	**0.44**
356	172.72		-7.79	0.18	this	2.40	9	-8.96	0.41	-1.17	size					**-8.96**	**0.41**
358	173.55		-8.07	0.26	this	3.24	10	-8.98	0.45	-0.91	size					**-8.98**	**0.45**
364	176.04		-7.47	0.24	this	1.60	9	-8.90	0.44	-1.43	size					**-8.90**	**0.44**
366	176.87		-8.62	0.29	this	2.70	9	-9.70	0.47	-1.07	size					**-9.70**	**0.47**
370	178.54		-8.71	0.23	this	2.10	10	-9.97	0.43	-1.27	size					**-9.97**	**0.43**
372	179.37											-9.41	0.43	6.70	4	**-9.41**	**0.43**
374	180.20		-8.20	0.24	this	1.10	9	-9.80	0.44	-1.59	size					**-9.80**	**0.44**
378	181.86		-8.20	0.29	this	6.00	9	-8.20	0.47	0.00	size					**-8.20**	**0.47**
382	183.52		-7.32	0.18	this	3.40	9	-8.17	0.41	-0.85	size					**-8.17**	**0.41**
386	185.18		-8.07	0.29	this	4.80	9	-8.46	0.47	-0.39	size					**-8.46**	**0.47**
394	188.51		-8.27	0.29	this	4.90	9	-8.63	0.47	-0.36	size					**-8.63**	**0.47**
400	191.00		-8.43	0.23	this	3.40	10	-9.27	0.43	-0.85	size					**-9.27**	**0.43**
404	193.84		-8.59	0.26	this	3.37	11	-9.44	0.45	-0.85	size					**-9.44**	**0.45**
408	196.68											-9.45	0.19	7.00	4	**-9.45**	**0.19**
410	198.11		-8.79	0.18	this	2.90	9	-9.80	0.41	-1.01	size					**-9.80**	**0.41**
414	200.95		-9.36	0.26	this	3.69	11	-10.10	0.45	-0.75	size					**-10.10**	**0.45**
420	205.21		-8.24	0.21	this	2.90	10	-9.24	0.43	-1.01	size					**-9.24**	**0.43**
422	206.63											-9.46	0.19	7.61	4	**-9.46**	**0.19**
424	208.05		-9.34	0.29	this	3.60	9	-10.12	0.47	-0.78	size					**-10.12**	**0.47**
426	209.47		-8.67	0.26	this	2.98	11	-9.64	0.45	-0.98	size					**-9.64**	**0.45**
428	210.89		-8.97	0.23	this	3.00	10	-9.95	0.43	-0.98	size					**-9.95**	**0.43**
434	215.16	large	-9.59	0.26	this	2.95	11	-10.56	0.45	-0.97	size					**-10.56**	**0.45**

434	215.16	small	-8.76	0.26	this	1.67	11	-10.16	0.45	-1.40	size					**-10.16**	**0.45**
438	218.00											-9.49	0.19	5.33	4	**-9.49**	**0.19**
444	220.14		-8.89	0.23	this	4.50	10	-9.38	0.43	-0.49	size					**-9.38**	**0.43**
446	220.86											-9.19	0.19	6.48	4	**-9.19**	**0.19**
450	222.29		-8.58	0.29	this	4.70	9	-9.00	0.47	-0.42	size					**-9.00**	**0.47**
456	224.43		-8.25	0.23	this	5.60	10	-8.38	0.43	-0.13	size					**-8.38**	**0.43**
462	226.57											-8.67	0.19	5.47	4	**-8.67**	**0.19**
468	228.71		-8.03	0.29	this	4.20	9	-8.61	0.47	-0.59	size					**-8.61**	**0.47**
474	230.86		-7.58	0.26	this	2.48	11	-8.72	0.45	-1.14	size					**-8.72**	**0.45**
480	233.00		-8.73	0.23	this	3.30	10	-9.61	0.43	-0.88	size					**-9.61**	**0.43**
484	235.40											-9.54	0.19	7.93	4	**-9.54**	**0.19**
488	237.80		-8.91	0.26	this	2.70	11	-9.99	0.45	-1.07	size					**-9.99**	**0.45**
494	241.40											-9.53	0.19	3.01	4	**-9.53**	**0.19**
498	243.80		-8.51	0.26	this	2.71	11	-9.58	0.45	-1.07	size					**-9.58**	**0.45**
500	245.00		-8.30	0.23	this	3.30	10	-9.18	0.43	-0.88	size					**-9.18**	**0.43**
504	246.43		-7.90	0.26	this	3.18	11	-8.81	0.45	-0.91	size					**-8.81**	**0.45**
508	247.86		-6.60	0.29	this	1.80	9	-7.97	0.47	-1.37	size					**-7.97**	**0.47**
512	249.29		-7.59	0.26	this	3.89	11	-8.28	0.45	-0.68	size					**-8.28**	**0.45**
518	251.43											-8.48	0.19	5.60	4	**-8.48**	**0.19**

Notes:

This table includes decarbonated leachates from *Piotrowski et al.* [2009] (‘EPSL’ in column ‘Ref’), decarbonated leachates from this study (‘this’ in column ‘Ref’), corrected decarbonated leachates and details of the correction, and non-decarbonated leachates. All Nd isotope measurements were standard corrected to a JNdi-1 ε_{Nd} value of 0.512115 that is consistent with *Tanaka et al.* [2000]. In the ‘Notes’ column, ‘small’ and ‘large’ refer to the leaching sample size tests (see Figures 2 and 3). Sample sizes are wet weights after decarbonation.

Table S5: Neodymium isotope data from uncleaned foraminifera and fish teeth in SK129-CR2.

Depth (cm)	**Age (ka BP)**	**ε_{Nd} uncleaned foraminifera**	**2σ**	**ε_{Nd} fish teeth**	**2σ**
6	4.66	-9.82	0.40		
44	17.25	-7.21	0.40		
86	37.90	-8.03	0.40		
140	64.98	-7.96	0.28		
244	123.86	-9.20	0.40		
320	157.76	-7.14	0.28	-7.32	0.44
366	176.87	-8.59	0.28	-9.08	0.68
394	188.51			-7.89	0.68
404	193.84			-9.70	0.44
414	200.95			-9.83	0.68
424	208.05	-9.27	0.40		
498	243.80			-9.40	0.37
512	249.29	-8.38	0.28		

Notes:
All Nd isotope data is corrected to a JNdi-1 ε_{Nd} value of 0.512115 that is consistent with *Tanaka et al.* [2000].

Table S6: Composite neodymium isotope record from SK129-CR2, including data from decarbonated leachates, non-decarbonated leachates, uncleaned foraminifera and fish teeth.

Depth (cm)	Age (ka BP)	ε_{Nd} composite	2σ
2.5	3.62	-9.90	0.36
6	4.66	-10.20	0.44
6	4.66	-9.82	0.40
10	5.86	-9.58	0.38
14	7.28	-9.12	0.36
18	8.93	-8.81	0.47
18	8.93	-8.75	0.38
22	10.97	-8.82	0.36
26	13.41	-7.71	0.38
30	14.80	-7.69	0.36
38	16.17	-7.15	0.36
44	17.25	-7.21	0.40
44	17.25	-7.06	0.37
44	17.25	-6.96	0.38
52	20.68	-6.61	0.38
52	20.68	-6.61	0.38
56	23.84	-7.23	0.37
58	25.42	-6.68	0.39
60	25.79	-6.82	0.38
62	26.16	-7.22	0.39
64	26.54	-7.78	0.36
66	27.59	-6.93	0.39
68	28.64	-6.96	0.39
70	29.69	-8.05	0.37
74	31.79	-7.76	0.36
76	32.84	-7.26	0.39
78	33.89	-7.54	0.39
78	33.89	-6.60	0.39
80	34.89	-7.39	0.39
82	35.89	-7.35	0.38
86	37.90	-8.06	0.36
86	37.90	-8.03	0.40
90	39.91	-7.67	0.37
92	40.91	-7.30	0.39
94	41.91	-7.43	0.39
96	42.91	-7.59	0.36
98	43.92	-7.28	0.39
100	44.92	-7.06	0.39
102	45.92	-7.36	0.38
104	46.93	-7.62	0.39
106	47.93	-8.09	0.36
108	48.93	-8.10	0.39
110	49.93	-8.52	0.38
112	50.94	-7.87	0.39
114	51.94	-8.30	0.36
116	52.94	-7.20	0.47
118	53.95	-7.66	0.39
124	56.95	-7.67	0.38
132	60.97	-7.89	0.37
140	64.98	-7.92	0.35
140	64.98	-7.96	0.28
148	68.99	-7.58	0.38
152	70.99	-8.66	0.35
158	74.00	-8.50	0.37
162	76.16	-9.32	0.35
174	83.14	-9.39	0.35
186	90.12	-9.26	0.36
194	94.78	-9.35	0.36
210	104.08	-9.51	0.38
210	104.08	-9.43	0.37
214	106.41	-9.60	0.36
218	108.73	-9.34	0.39
222	111.06	-9.02	0.38
228	114.55	-8.86	0.38
232	116.88	-8.68	0.36
236	119.20	-8.81	0.38
240	121.53	-9.16	0.38
240	121.53	-9.54	0.36
244	123.86	-9.20	0.40
244	123.86	-9.03	0.37
244	123.86	-8.91	0.36
246	125.02	-8.68	0.37
250	127.35	-8.85	0.36
252	128.51	-8.97	0.39
254	129.67	-7.79	0.36
256	130.84	-7.22	0.39
258	132.00	-7.66	0.37
260	132.83	-6.39	0.37
264	134.49	-7.62	0.38
266	135.32	-7.33	0.39
278	140.31	-6.74	0.36
282	141.97	-7.63	0.37
286	143.63	-7.06	0.36
290	145.30	-7.69	0.37
296	147.79	-7.83	0.23
304	151.11	-8.15	0.19
306	151.94	-6.64	0.39
310	153.61	-6.83	0.25

Depth (cm)	Age (ka BP)	ε_{Nd} composite	2σ
320	157.76	-7.29	0.47
320	157.76	-7.14	0.28
320	157.76	-7.32	0.44
326	160.25	-7.44	0.43
328	161.08	-7.47	0.45
328	161.08	-7.20	0.45
334	163.58	-7.82	0.47
342	166.90	-8.42	0.43
344	167.73	-8.78	0.45
346	168.56	-8.64	0.41
350	170.23	-8.94	0.45
352	171.06	-9.15	0.44
356	172.72	-8.96	0.41
358	173.55	-8.98	0.45
364	176.04	-8.90	0.44
366	176.87	-8.59	0.28
366	176.87	-9.70	0.47
370	178.54	-9.97	0.43
372	179.37	-9.41	0.43
374	180.20	-9.80	0.44
378	181.86	-8.20	0.47
382	183.52	-8.17	0.41
386	185.18	-8.46	0.47
394	188.51	-8.63	0.47
400	191.00	-9.27	0.43
404	193.84	-9.44	0.45
404	193.84	-9.70	0.44
408	196.68	-9.45	0.19
410	198.11	-9.80	0.41
414	200.95	-10.10	0.45
420	205.21	-9.24	0.43
422	206.63	-9.46	0.19
424	208.05	-9.27	0.40
424	208.05	-10.12	0.47
426	209.47	-9.64	0.45
428	210.89	-9.95	0.43
434	215.16	-10.56	0.45
434	215.16	-10.16	0.45
438	218.00	-9.49	0.19
444	220.14	-9.38	0.43
446	220.86	-9.19	0.19
450	222.29	-9.00	0.47
456	224.43	-8.38	0.43
462	226.57	-8.67	0.19
468	228.71	-8.61	0.47
474	230.86	-8.72	0.45
480	233.00	-9.61	0.43
484	235.40	-9.54	0.19
488	237.80	-9.99	0.45
494	241.40	-9.53	0.19
498	243.80	-9.58	0.45
498	243.80	-9.40	0.37
500	245.00	-9.18	0.43
504	246.43	-8.81	0.45
508	247.86	-7.97	0.47
512	249.29	-8.28	0.45
512	249.29	-8.38	0.28
518	251.43	-8.48	0.19

Notes:
This composite record includes data from decarbonated leachates, non-decarbonated leachates, uncleaned foraminifera and fish teeth. The decarbonated leachate data were corrected for sample size as described in the manuscript text and Table S4. Three fish teeth data with large analytical uncertainties (0.68) are not included. All Nd isotope data is corrected to a JNdi-1 ε_{Nd} value of 0.512115 that is consistent with *Tanaka et al.* [2000].

References in Supplementary Information

Banakar, V. K. (2005), δ^{13}C depleted oceans before the Termination 2: More nutrient-rich deep-water formation or light-carbon transfer?, *Indian J. Mar. Sci.*, *34*(3), 249-258.

Butzin, M., M. Prange, and G. Lohmann (2005), Radiocarbon simulations for the glacial ocean: The effects of wind stress, Southern Ocean sea ice and Heinrich events, *Earth Planet. Sci. Lett.*, *235*(1-2), 45-61.

Cao, L., R. G. Fairbanks, R. A. Mortlock, and M. J. Risk (2007), Radiocarbon reservoir age of high latitude North Atlantic surface water during the last deglacial, *Quat. Sci. Rev.*, *26*(5-6), 732-742.

Fairbanks, R. G., R. A. Mortlock, T. C. Chiu, L. Cao, A. Kaplan, T. P. Guilderson, T. W. Fairbanks, A. L. Bloom, P. M. Grootes, and M. J. Nadeau (2005), Radiocarbon calibration curve spanning 0 to 50,000 years BP based on paired ^{230}Th/ ^{234}U/ ^{238}U and ^{14}C dates on pristine corals, *Quat. Sci. Rev.*, *24*(16-17), 1781-1796.

Lisiecki, L. E., and M. E. Raymo (2005), A Pliocene-Pleistocene stack of 57 globally distributed benthic δ^{18}O records, *Paleoceanography*, *20*(1), doi: 10.1029/2004pa001071.

Mark, D. F., M. Petraglia, V. C. Smith, L. E. Morgan, D. N. Barfod, B. S. Ellis, N. J. Pearce, J. N. Pal, and R. Korisettar (2014), A high-precision ^{40}Ar/^{39}Ar age for the Young Toba Tuff and dating of ultra-distal tephra: forcing of Quaternary climate and implications for hominin occupation of India, *Quaternary Geochronology*, *21*, 90-103.

Piotrowski, A. M., V. K. Banakar, A. E. Scrivner, H. Elderfield, A. Galy, and A. Dennis (2009), Indian Ocean circulation and productivity during the last glacial cycle, *Earth Planet. Sci. Lett.*, *285*(1-2), 179-189.

Tanaka, T., et al. (2000), JNdi-1: a neodymium isotopic reference in consistency with LaJolla neodymium, *Chemical Geology*, *168*(3-4), 279-281.