

Supplement 1: GeoB20616-1 Oxygen and carbon isotopic composition of planktonic foraminifera.

age (cal. yrs BP)	depth (cm)	$\delta^{18}\text{O}$ (‰ VPDB)	$\delta^{13}\text{C}$ (‰ VPDB)
37173	395	-0.44	0.554
45285	455	-0.65	0.709
50017	490	-0.58	0.276
52045	505	-0.72	0.669
57453	545	-0.63	0.622
65565	605	-0.73	0.435
68945	630	-0.87	0.624
75029	675	-0.35	0.267
77733	695	-0.39	1.277
85845	755	-1.03	0.954
87197	765	-0.93	0.719
88549	775	-1.03	0.683
89901	785	-1.00	0.267
91253	795	-0.86	0.772
93281	810	-1.37	0.519
94633	820	-1.00	0.125
95985	830	-1.25	1.091
96525	834	-1.27	0.519
98013	845	-1.27	0.561
99365	855	-1.10	0.711
100717	865	-0.77	0.625
102069	875	-1.27	0.663
103421	885	-1.42	0.939
104773	895	-1.16	0.147
106125	905	-1.66	0.208
107477	915	-1.58	0.927
108829	925	-1.29	0.616
110181	935	-1.56	0.101

Supplement 2:GeoB20616-1 downcore sea surface temperatures (SST) calculated following Lea et al. 2003 using the listed ICP-OES measurement results.

age (cal. yrs BP)	depth (cm)	Mg/Ca	SST (°C)
5179	40.5	4.38	27.5
16512	145.5	3.77	25.8
21125	195.5	3.44	24.7
23832	245.5	3.40	24.6
26461	295.5	3.26	24.1
32869	345.5	3.89	26.1
38427	385.5	3.40	24.6
39467	395.5	2.97	23.1
40712	410.5	3.42	24.7
41542	420.5	3.20	23.9
42372	430.5	3.44	24.7
43202	440.5	3.53	25.0
44447	455.5	3.37	24.5
45692	470.5	3.35	24.5
46522	480.5	3.30	24.3
47352	490.5	3.09	23.5
48597	505.5	3.28	24.2
49012	510.5	3.44	24.8
49842	520.5	3.33	24.4
50258	525.5	3.26	24.2
51088	535.5	3.60	25.3
51918	545.5	3.28	24.2
52748	555.5	3.60	25.3
53578	565.5	3.48	24.9
54408	575.5	3.61	25.3
55238	585.5	3.50	25.0
56068	595.5	3.24	24.1
56898	605.5	3.56	25.1
57728	615.5	3.55	25.1
58973	630.5	4.04	26.6
59803	640.5	3.22	24.0
61048	655.5	3.30	24.3
61878	665.5	3.82	25.9
62748	675.5	3.62	25.3
64023	685.5	3.71	25.6
65298	695.5	3.61	25.3
66573	705.5	3.70	25.6
67848	715.5	3.66	25.4
69123	725.5	3.80	25.9
70397	735.5	3.97	26.4
71672	745.5	3.78	25.8
74222	765.5	3.74	25.7
78046	795.5	3.46	24.8
79321	805.5	3.64	25.4
82508	830.5	3.72	25.6
86970	865.5	3.72	25.6
89520	885.5	3.75	25.7
93344	915.5	4.22	27.1

Supplement 3: GeoB20616-1 organic geochemical down-core data. *n*-Alkane isotopic composition and distribution descriptive parameters averaged. The elevated CPI values ranging from 3.8 to 14 indicate that the *n* alkanes within the terrestrial and marine samples were likely derived from nondegraded, terrestrial, higher plant material (Eglinton & Hamilton, 1967). We focus the discussion on the isotopic signals of the *n*-C31 alkane but note that the *n*-C29 and *n*-C33 alkanes reveal similar trends.

age (cal. yrs BP)	Depth (cm)	$\delta^{13}\text{C}-n\text{C}_{29}$ (‰ VPDB)	$\delta^{13}\text{C}-n\text{C}_{31}$ (‰ VPDB)	$\delta^{13}\text{C}-n\text{C}_{33}$ (‰ VPDB)	$\delta\text{D}-n\text{C}_{29}$ (‰ VSMOW)	$\delta\text{D}-n\text{C}_{31}$ (‰ VSMOW)	$\delta\text{D}-n\text{C}_{33}$ (‰ VSMOW)	CPI ₂₅₋₃₃
1504	2	-26.0	-25.2	-23.3	-133	-147	-150	6
2705	12	-25.6	-24.8	-23.2	-140	-147	-150	6
3580	22	-26.2	-25.1	-23.3	-138	-145	-148	7
4442	32	-26.1	-25.0	-23.2	-144	-147	-151	7
5306	42	-26.0	-24.8	-23.0	-130	-146	-148	7
6197	52	-25.7	-25.3	-23.2				7
7535	62				-140	-147	-148	7
9007	72	-25.9	-24.9	-23.0	-137	-150	-150	8
10513	82	-25.2	-24.3	-22.5	-134	-145	-149	7
11985	92	-24.9	-24.5	-22.4	-136	-150	-151	8
13363	102	-25.1	-24.4	-22.5	-141	-150	-151	7
14163	112	-25.2	-24.5	-22.6	-136	-150	-150	7
14871	122	-25.2	-24.4	-22.5	-145	-151	-151	8
15571	132	-25.4	-24.5	-22.7	-135	-150	-149	7
16271	142	-25.5	-24.9	-22.8	-141	-147	-147	7
16979	152	-24.8	-24.1	-22.2	-139	-148	-145	7
17878	162	-25.0	-24.7	-22.6	-143	-149	-149	8
18839	172	-25.2	-24.6	-22.6	-135	-148	-149	7
19822	182	-24.9	-24.2	-22.3	-138	-149	-151	7
20787	192	-25.0	-24.3	-22.4	-139	-147	-147	7
21724	202	-25.1	-24.4	-22.5	-138	-148	-148	7
22300	212	-25.0	-24.2	-22.4	-130	-147	-148	7
22756	222	-24.7	-24.1	-22.2	-137	-150	-150	11
23217	232	-25.0	-24.2	-22.4	-135	-151	-149	8
23673	242	-25.5	-24.4	-22.5	-135	-151	-150	7
24131	252	-24.7	-24.2	-22.3	-132	-149	-148	7
24642	262	-25.3	-24.3	-22.5	-132	-148	-148	7
25187	272	-25.4	-24.3	-22.4	-131	-147	-148	7
25731	282	-25.0	-24.0	-22.3	-135	-145	-149	7
26273	292				-138	-146	-148	8
27880	312	-25.2	-24.3	-22.4	-138	-144	-148	7
29364	322	-25.4	-24.3	-22.6	-130	-145	-147	7
30853	332	-25.4	-24.6	-22.6	-132	-145	-147	7
32351	342	-25.3	-24.3	-22.5	-142	-149	-151	7
33833	352	-25.5	-24.5	-22.6	-127	-144	-147	7
35256	362	-25.9	-25.2	-23.2	-141	-145	-150	8
36591	372	-25.1	-24.0	-22.1	-133	-148	-152	8
37949	382	-25.1	-24.2	-22.3	-132	-148	-149	7
39177	392	-25.0	-24.3	-22.6	-143	-151	-153	7
40007	402	-24.9	-23.9	-22.2	-137	-152	-152	8
40837	412	-24.8	-23.9	-22.1	-143	-153	-155	7
41667	422	-24.8	-23.9	-22.0	-144	-153	-153	8
42497	432	-24.9	-23.9	-22.1	-142	-152	-154	8
43327	442	-25.0	-24.0	-22.2	-136	-151	-152	7
44157	452	-25.3	-24.1	-22.4	-138	-154	-154	7
44987	462	-24.9	-23.9	-22.2	-137	-153	-154	7
45817	472	-25.0	-23.9	-22.0	-143	-150	-152	7
46647	482	-24.7	-23.8	-22.0	-145	-150	-152	6
47477	492	-25.0	-24.0	-22.1	-138	-153	-154	7
48307	502	-24.7	-24.0	-22.1	-142	-153	-153	7
49137	512	-25.0	-24.1	-22.1	-145	-152	-153	7
49967	522	-24.9	-24.3	-22.2	-143	-154	-155	7
50797	532	-24.9	-23.9	-22.0	-142	-152	-154	7
51627	542	-24.9	-23.9	-22.1	-141	-152	-155	6
52457	552	-24.1	-24.3	-22.7	-139	-151	-154	7
53287	562	-24.7	-23.6	-22.0	-141	-154	-155	9
54117	572	-24.4	-23.6	-21.9	-137	-151	-153	7
54947	582	-24.6	-23.6	-22.1	-147	-153	-154	7
55777	592	-24.3	-23.6	-22.0	-147	-153	-155	7
56607	602	-24.8	-23.7	-21.9	-138	-153	-155	6
57437	612	-24.7	-23.6	-22.1	-147	-156	-156	7
58267	622	-25.1	-24.1	-22.3	-145	-151	-152	7
59097	632	-25.1	-24.0	-22.3	-138	-150	-152	7
59927	642	-25.0	-23.9	-22.1	-134	-147	-148	6
60757	652	-25.1	-24.1	-22.4	-139	-149	-148	7
61588	662	-25.1	-24.1	-22.4	-136	-148	-149	7
62418	672	-25.4	-24.5	-22.8	-132	-149	-148	7
63577	682	-25.4	-23.9	-22.5	-146	-153	-153	8
64852	692	-24.8	-24.0	-22.4	-134	-151	-152	7
66127	702	-25.0	-24.1	-22.6	-134	-150	-151	7
67402	712	-24.8	-24.1	-22.5	-134	-151	-153	7
68676	722	-25.1	-24.0	-22.6	-144	-151	-152	7
69951	732	-25.3	-24.2	-22.8	-138	-154	-156	7
71226	742	-25.6	-24.1	-22.7	-138	-153	-155	7
72501	752	-25.4	-24.2	-22.6	-138	-153	-156	7
73776	762	-25.4	-24.1	-22.6	-140	-152	-153	7
75050	772	-25.4	-24.1	-22.6	-145	-151	-153	7
76325	782	-26.3	-24.5	-23.0	-137	-147	-150	6
77728	793	-25.8	-24.4	-22.7	-142	-151	-154	8
78875	802	-25.2	-24.2	-22.3	-153	-157	-159	7
80150	812	-25.3	-24.0	-22.3	-137	-157	-159	6
81425	822	-25.3	-23.9	-22.3	-149	-156	-159	6
82699	832	-24.0	-23.8	-22.2	-137	-154	-155	5
83974	842	-25.5	-24.2	-22.6	-144	-151	-153	6
85249	852	-25.6	-24.5	-22.8	-141	-147	-152	7
86524	862	-26.2	-24.9	-23.1	-142	-146	-151	1
87799	872	-25.9	-24.5	-22.8	-146	-156	-157	6
89074	882	-26.2	-24.6	-22.9	-147	-157	-157	6
90348	892	-25.8	-24.4	-22.7	-151	-158	-161	7
91623	902	-26.1	-24.5	-22.9	-150	-159	-160	6
92898	912	-26.4	-25.0	-22.9	-139	-154	-157	7
94173	922	-26.6	-25.2	-23.1	-141	-155	-158	7
95448	932	-26.3	-25.7	-23.6	-134	-144	-146	7

Supplement 4: GeoB20616-1 inorganic geochemical down-core data from

depth (cm)	age (cal. years BP)	Al (mg/kg)	Ca (mg/kg)	Fe (mg/kg)	K (mg/kg)
5.5	2141	41601	177248	27139	8911
10.5	2575	40009	184378	26882	8863
15.5	3008	33894	202638	23765	8045
20.5	3446	32489	209794	22430	7864
25.5	3891	42712	174836	30180	10010
30.5	4315	51353	145437	36638	11646
35.5	4741	52964	143556	38025	12066
40.5	5179	61319	114217	41607	13549
45.5	5600	62755	114701	43780	13466
50.5	6032	76367	67954	51567	15949
55.5	6602	64118	106827	43037	13586
60.5	7317	81808	55271	53594	16917
65.5	8040	78369	59242	50854	16399
70.5	8781	75738	70803	48374	15809
75.5	9523	78203	60655	52427	16661
80.5	10290	78352	59011	51635	16528
85.5	11035	77321	59370	54169	16743
90.5	11767	76465	63916	55399	16351
95.5	12501	75170	61400	53243	16427
100.5	13211	77240	61674	55229	16505
105.5	13696	74527	68091	55522	16528
110.5	14057	74176	67078	52330	15914
115.5	14409	71905	75806	48928	15316
120.5	14766	68726	82184	47674	15031
125.5	15118	64537	95917	45311	13962
130.5	15468	61688	99668	41571	13308
135.5	15813	59928	106381	41391	13475
140.5	16168	62339	102200	42106	13815
145.5	16512	53917	124124	38125	12401
150.5	16868	53583	129426	38349	12385
155.5	17255	62403	104697	43747	13950
160.5	17734	66270	88069	48473	14453
165.5	18215	56286	115156	39825	13046
170.5	18696	67792	80244	44942	14654
175.5	19176	66981	88478	45807	14197
180.5	19674	62491	95931	42658	13873
185.5	20162	65334	99870	47296	14113
190.5	20643	62511	102887	41707	13467
195.5	21125	66868	96885	48235	14988
200.5	21597	67068	89420	49711	15021
205.5	22000	69028	90573	44979	14341
210.5	22233	60283	114739	42526	13499
215.5	22458	69104	88862	45349	14645
220.5	22687	70456	88409	45770	14638
225.5	22917	72078	84770	46615	14792
230.5	23146	65131	103541	43173	13557
235.5	23379	56941	129414	38257	12407
240.5	23605	60846	120300	40670	12692
245.5	23832	57609	129981	41183	12521
250.5	24063	58536	123484	41087	12795
255.5	24298	58042	123364	40032	12580
260.5	24562	57797	129772	43387	13060
280.5	25648	60102	118404	40438	13120
285.5	25922	59111	122979	41101	12896
290.5	26193	60619	123278	41523	12833
295.5	26461	48348	167591	34485	10447
300.5	26733	44819	174138	31605	10008
305.5	27045	44879	172727	32203	10102
310.5	27652	45798	169598	32696	10287
315.5	28407	51376	146621	36184	11618
320.5	29142	45342	164907	31759	10547
325.5	29884	54584	140547	36636	12082
330.5	30625	49338	155126	34580	11003
335.5	31378	49564	154649	34299	11218
340.5	32130	52464	140437	37184	11815
345.5	32869	53070	137093	36736	11702
350.5	33615	53940	137642	38276	12143
355	34273	55917	113821	35189	12547
355.5	34346	56963	129853	40731	12948
360	34982	56742	111906	36524	12790
360	34982	51631	124407	35717	11300
360.5	35050	57729	127739	40217	12990
365	35663	55346	112114	34237	12311
365.5	35731	56217	128293	39866	12775
370	36319	52984	117699	35315	11500
370	36319	54704	116866	36474	12137
370.5	36386	57846	110492	39138	13301
375.5	37069	66718	83800	46061	14718
380	37677	66930	72739	41065	14458
380	37677	64675	79088	44574	13757
380.5	37744	65197	85613	44766	14634
385.5	38427	64755	94671	44168	14123
390	39011	63041	93578	42042	12755
390.5	39052	64839	97063	45540	13991
395.5	39467	64293	101333	43352	13659
400	39841	56336	111917	37771	11815
400.5	39882	59540	116418	40174	12958
405	40256	60525	101730	35780	13075
405.5	40297	60053	113436	41620	13286
410	40671	56134	111014	37702	11909
410.5	40712	61267	115181	40783	13059
415.5	41127	68070	96946	45136	14410
420	41501	60132	92248	41222	12966
420.5	41542	63673	107364	44591	13908
425	41916	64280	79834	42446	14274
425.5	41957	67059	90673	43957	14495
430	42331	66538	74768	44034	13772
430.5	42372	74425	72721	49023	16000
435	42746	68276	73664	46167	14581
435.5	42787	74586	74830	48272	15428
440	43161	68894	68864	42636	13686
440.5	43202	73481	85417	52971	15420
445	43576	63726	90121	43258	13714
445.5	43617	70805	90745	47880	14455
450	43991	62794	94709	41966	12541

450.5	44032	66645	102400	44605	14024
455.5	44447	63058	110000	43305	13270
460	44821	60234	103253	41532	12445
460	44821	63467	94432	41145	13774
460.5	44862	66633	99157	45814	14019
465.5	45277	63091	106734	43179	13627
470	45651	58903	94189	39768	12457
470.5	45692	63933	103868	45098	14305
475	46066	60994	86668	37042	13787
475.5	46107	61837	98873	41100	14153
480	46481	56561	90832	40272	12613
480.5	46522	66192	89069	45694	14571
485.5	46937	67609	86077	46304	14804
490	47311	62425	78589	42526	13456
490.5	47352	73996	74298	50343	15312
495	47726	63854	82115	42127	14185
495.5	47767	70040	79558	47674	14918
500	48141	58443	92436	39597	12792
500.5	48182	67806	89654	41300	14255
505.5	48597	64302	95964	42143	13817
510	48971	56298	89156	36482	12774
510.5	49012	58933	107154	37850	13198
515.5	49427	56637	121832	39000	13166
520	49801	69152	66613	44369	14418
520.5	49842	61249	102619	40085	14223
525.5	50258	59082	98837	38056	13993
530	50631	63717	71262	40987	13969
530.5	50673	62272	86967	41175	14570
535.5	51088	66636	77489	41972	15207
540	51461	67956	65810	40760	14770
540.5	51503	68530	79364	46688	15272
545.5	51918	71167	71372	47010	16052
550.5	52333	69486	77430	47457	15274
555.5	52748	73000	67616	47939	15957
560	53121	70124	57144	42084	15288
560	53121	65831	79730	43561	13966
560.5	53163	70140	86254	47706	15075
565.5	53578	72087	78510	46632	15068
570	53951	66312	82360	42526	14264
570	53951	66194	76845	43042	13921
580	54781	66247	80417	44078	14268
580	54781	68014	77544	46462	13950
590	55611	66355	83582	44236	14347
590	55611	65058	82253	45714	13717
600	56441	61234	89130	40404	13039
610	57271	55032	110938	38905	12495
610	57271	58564	100873	40606	12782
620	58101	45455	139095	31370	10910
620	58101	44378	145060	31074	10138
625	58516	43060	142267	29805	10433
630	58931	42528	144291	29578	9941
635	59346	42342	162679	30808	10345
640	59761	43435	145528	30639	10129
645	60176	43778	146212	29584	10425
650	60591	42732	148481	29140	10062
660	61422	51553	125405	35513	11277
670	62252	61084	96695	42103	12882
670	62252	64483	93359	45537	13816
680	63322	67129	77902	46161	14021
680	63322	62970	93170	43272	13659
690	64597	67932	76483	44205	13923
690	64597	68020	73796	46466	14663
700	65872	67826	80960	48905	14043
710	67147	58768	103678	40525	12421
710	67147	62192	95677	50634	13671
720	68421	62300	100698	43941	13308
720	68421	59517	102095	41114	12571
730	69696	51990	130019	36401	11173
730	69696	60917	103143	43866	13069
740	70971	42149	152024	32335	9772
740	70971	48978	143668	38215	11380
750	72246	48501	141805	34406	11020
760	73521	45861	150455	33980	10725
760	73521	47125	143183	34141	10539
770	74795	42528	162159	31551	10067
770	74795	39344	169696	30045	9127
780	76070	34419	192887	25895	8236
780	76070	31427	202857	23010	7502
790	77345	35777	183667	26151	8677
790	77345	35244	183499	24784	8237
800	78620	51577	132777	38252	11201
810	79895	55158	111085	40599	11873
820	81170	50305	125661	37449	11178
825	81807	52630	126976	38524	12155
830	82444	48311	141565	35482	10618
835	83082	48136	145329	35219	11257
840	83719	47482	150996	34356	10533
850	84994	32646	192928	21969	7706
860	86269	22912	239594	17648	5737
860	86269	26057	230951	18877	6348
870	87544	28890	213965	20328	6753
870	87544	52404	134379	37382	11542
880	88819	62396	105431	42914	13482
880	88819	57738	112182	39138	11802
890	90093	54070	123836	39282	11467
890	90093	61059	108961	41761	13009
900	91368	63645	102706	44565	13416
900	91368	62597	112688	41009	13450
910	92643	61222	107700	40574	12949
910	92643	62867	108253	42496	13677
920	93918	55146	133032	37836	11767
920	93918	55676	134602	38464	12232
930	95193	51392	139805	33200	11087
930	95193	50522	153534	33390	11269
940	96468	44837	163431	28193	9756
940	96468	22365	244843	14395	5517
950	97742	21712	244971	13257	5156