

Data Repository Item 2007047

Table 1. Stable isotope data from Tanzanian Cores. Samples for multi-species analysis are presented in age order. Species data from within each sample are presented in ascending $\delta^{18}\text{O}$ order. For the isotopic analyses, sediment samples were placed in beakers and gently disaggregated by hand in tapwater then washed over a 63 μm mesh and dried. An average of 10-20 adult specimens of the common species were picked for isotopic analysis from various size fractions. Particulate adhesions were removed by ultrasonic bathing in methanol. Prior to analysis, samples were treated with 3% peroxide to remove organic matter. Samples were analysed at Cardiff using a ThermoFinnegan MAT 252 mass spectrometer except the two samples from TDP Site 12 which were analyzed at Rutgers. All isotopic results are expressed with reference to the Vienna PDB standard and subject to a $\pm 0.08\%$ analytical precision. Within a sample, the oxygen isotope ratios primarily reflect temperature differences between the species, resulting from calcification at different depths in the water column and at different times of year. The most negative value from the planktonic species is taken to represent the seasonal maximum SST, subject to the above uncertainties. The carbon isotope ratios reflect different depth habitats and symbiotic associations, and long-term differences between sediment samples reflect secular changes in the carbon isotopic ratios of dissolved inorganic carbon.

Sample 1. TDP12/9-2, 26-36 cm. Age: 33.50 (early Oligocene, Zone O1).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
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<i>Globoturborotalita cf. woodi</i>	250-300	1.08	-3.23	29.6
<i>Pseudohastigerina naguewichiensis</i>	63-125	-0.09	-3.17	29.3
<i>Turborotalia increbescens</i>	250-300	1.20	-2.87	27.9
<i>Turbootalia ampliapertura</i>	250-300	1.27	-2.84	27.7
<i>Globoquadrina euapertura</i>	250-300	1.28	-2.48	26.1
<i>Dentoglob.pseudovenezuelana</i>	250-300	1.42	-2.44	25.9
<i>Dentoglobigerina globularis</i>	355-425	1.40	-2.43	25.8
<i>Dentoglobigerina globularis</i>	250-300	1.43	-2.39	25.6
<i>Subbotina eocaena</i>	250-300	1.38	-2.37	25.6
<i>Subbotina corpulenta</i>	355-425	1.49	-2.34	25.4
<i>Subbotina corpulenta</i>	250-300	1.32	-2.32	25.3
<i>Dentoglobigerina galavisi</i>	250-300	1.28	-2.22	24.9
<i>Dentoglobigerina venezuelana</i>	355-425	1.49	-2.14	24.5
<i>Dentoglobigerina globularis</i> var.	355-425	1.54	-2.11	24.4
<i>Globoquadrina euapertura</i>	355-425	1.37	-1.89	23.3
<i>Subbotina eocaena</i>	355-425	1.26	-1.87	23.2

Sample. 2. TDP12/20-3, 74-83 cm. Age 33.75 (latest Eocene, from below the *Hantkenina* extinction).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
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<i>Globoturborotalita ouachitaensis</i>	125-180	1.31	-3.42	30.5
<i>Subbotina gortanii</i>	125-180	1.30	-3.42	30.5
<i>Pseudohastigerina naguewichiensis</i>	63-125	-0.29	-3.23	29.6
<i>Pseudohastigerina naguewichiensis</i>	125-212	0.41	-3.23	29.6
<i>Subbotina eocaena</i>	125-180	0.61	-3.07	28.8
<i>Subbotina corpulenta</i>	355-425	1.23	-3.02	28.6
<i>Turborotalia ampliapertura</i>	250-300	0.12	-3.00	28.5
<i>Hantkenina nanggulanensis</i>	250-300	1.48	-2.93	28.2
<i>Turborotalia cunialensis</i>	250-300	1.11	-2.89	28.0
<i>Turborotalia cerroazuelensis</i>	355-425	1.19	-2.76	27.4
<i>Cribrohantkenina inflata</i>	355-425	1.67	-2.75	27.3
<i>Dentoglobigerina galavisi</i>	355-425	1.39	-2.72	27.2
<i>Hantkenina nanggulanensis</i>	355-425	1.48	-2.61	26.7
<i>Dentoglobigerina tripartita</i>	250-300	1.19	-2.59	26.6
<i>Dentoglobigerina globularis</i>	355-425	1.14	-2.52	26.3
<i>Turborotalia cocoaensis</i>	355-425	1.10	-2.51	26.2
<i>Dentoglobigerina tripartita</i>	355-425	1.20	-2.32	25.3
<i>Dentoglob. pseudovenezuelana</i>	250-300	1.03	-2.31	25.3
<i>Dentoglob. pseudovenezuelana</i>	355-425	1.15	-1.91	23.4

Sample 3. TDP18/18-2, 13-23 cm. Age 40.40 (lower Zone E12, from above the first occurrence of *Orbulinoides beckmanni*).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Morozovelloides cf. lehneri</i>	212-250	3.13	-3.51	30.9
<i>Acarinina topilensis</i>	250-300	3.60	-3.43	30.5
<i>Acarinina topilensis</i>	300-355	3.64	-3.29	29.8
<i>Morozovelloides crassatus</i>	300-355	3.76	-3.26	29.7
<i>Acarinina topilensis</i>	212-250	2.79	-3.16	29.2
<i>Turborotalia pomeroli</i>	>355	0.97	-3.02	28.6
<i>Turborotalia pomeroli</i>	300-355	0.93	-2.96	28.3
<i>Orbulinoides beckmanni</i>	>355	2.88	-2.90	28.0
<i>Globigerinatheka subconglobata</i>	250-300	2.22	-2.76	27.4
<i>Globigerinatheka euganea</i>	>355	2.20	-2.69	27.0
<i>Globigerinatheka curryi</i>	>355	2.13	-2.60	26.6
<i>Subbotina crociapertura</i>	>355	1.20	-2.58	26.5
<i>Globigerinatheka subconglobata</i>	>355	2.34	-2.50	26.2
<i>Hantkenina liebusi / lehneri</i>	300-355	0.81	-2.44	25.9
<i>Hantkenina dumblei</i>	>355	0.93	-2.11	24.4
<i>Subbotina linaperta</i>	212-250	0.72	-1.90	23.4
<i>Subbotina eocaena</i>	300-355	0.92	-1.89	23.3
<i>Subbotina eocaena</i>	>355	0.76	-1.85	23.2
<i>Acarinina rohri</i>	300-355	Too small		

Sample 4. TDP13/9-1, 01-11 cm. Age 41.1 (middle Zone E11).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Morozovelloides bandyi</i>	212-250	3.33	-3.31	29.9
<i>Morozovelloides lehneri</i>	212-250	3.15	-3.26	29.7
<i>Acarinina praetopilensis</i>	212-250	3.10	-3.26	29.7
<i>Acarinina topilensis</i>	212-250	3.19	-3.20	29.4
<i>Morozovelloides 'densa'</i>	300-350	3.21	-3.14	29.1
<i>Morozovelloides crassatus</i>	212-250	3.41	-3.12	29.0
<i>Acarinina rohri</i>	212-250	2.83	-2.99	28.4
<i>Acarinina bullbrooki</i>	212-250	2.15	-2.93	28.2
<i>Acarinina cuneicamerata</i>	212-250	2.98	-2.91	28.1
<i>Turborotalia pomeroli</i>	>350	0.95	-2.82	27.6
<i>Subbotina crociapertura</i>	>350	1.30	-2.37	25.6
<i>Globigerinatheka curryi</i>	>350	2.56	-2.17	24.6
<i>Subbotina eocaena</i>	212-250	1.15	-2.05	24.1
<i>Hantkenina liebusi</i>	various	0.79	-1.94	23.6

Sample 5. TDP2/9-CC. Age 45.5 (lower Zone E9; nanofossil zone NP15c).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Morozovelloides coronatus</i>	250-425	3.09	-3.60	31.3
<i>Igorina broedermanni</i>	212-250	3.40	-3.40	30.4
<i>Morozovelloides crassatus</i>	250-425	3.14	-3.23	29.6
<i>Acarinina bullbrooki</i>	300-425	3.22	-3.22	29.6
<i>Acarinina topilensis</i>	300-425	3.71	-3.21	29.5
<i>Acarinina praetopilensis</i>	300-425	3.76	-3.17	29.3
<i>Acarinina praetopilensis</i>	250-300	3.14	-3.14	29.1
<i>Acarinina soldadoensis</i>	425-500	2.63	-3.07	28.8
<i>Acarinina boudreauxi</i>	250-300	2.26	-2.93	28.2
<i>Turborotalia possagnoensis</i>	300-425	0.86	-2.73	27.2
<i>Guembelitrioides nuttalli</i> s.str.	300-500	1.54	-2.71	27.1
<i>Globigerinatheka</i> cf. <i>index</i>	300-425	2.30	-2.66	26.9
<i>Turborotalia frontosa</i>	300-425	0.78	-2.64	26.8
<i>Guembelitrioides</i> cf. <i>nuttalli</i>	300-500	1.59	-2.58	26.5
<i>Globigerinatheka subconglobata</i>	300-425	2.17	-2.56	26.4
<i>Subbotina crociapertura</i>	300-425	1.05	-2.53	26.3
<i>Globigerinatheka micra</i>	300-425	2.09	-2.52	26.3
<i>Subbotina senni</i>	300-425	1.79	-2.40	25.7
<i>Hantkenina mexicana</i>	300-500	0.45	-1.95	23.6

<i>Subbotina</i> sp.	300-425	0.72	-1.42	21.2
<i>Subbotina eocaena</i>	300-425	0.69	-1.38	21.0
<i>Cibicidoides</i> spp.	300-500	-0.03	-0.97	19.1

Sample 6. TDP2/19-1, 10-20 cm. Age 49.0 (E7-E8 transition interval, at first appearance of *Guembelitrionides nuttalli*).

<i>Acarinina pseudosphaerica</i>	212-250	2.34	-3.68	31.7
<i>Igorina broedermanni</i>	212-250	3.43	-3.63	31.4
<i>Acarinina praetopilensis</i>	250-300	3.42	-3.41	30.4
<i>Acarinina boudreauxi</i> , non-encrusted	250-300	2.78	-3.34	30.1
<i>Guembelitrionides</i> cf. <i>nuttalli</i>	212-300	2.21	-3.23	29.6
<i>Acarinina boudreauxi</i> , encrusted	300-425	2.65	-3.20	29.4
<i>Turborotalia frontosa</i>	300-425	1.22	-3.19	29.3
<i>Globoturborotalita martini</i>	180-212	2.51	-3.17	29.3
<i>Morozovella aragonensis</i>	300-425	2.59	-3.12	29.1
<i>Subbotina crociapertura</i>	300-425	1.17	-2.93	28.2
<i>Subbotina senni</i>	300-425	2.04	-2.75	27.3
Mixed benthics	212-300	0.26	-1.79	22.9
<i>Subbotina eocaena</i>	250-425	0.90	-1.78	22.9

Sample 7. TDP2/25-CC. Age 49.4 (upper Zone E7)

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Acarinina cuneicamerata</i>	250-300	2.09	-3.93	31.7
<i>Planoglob. pseudoalgeriana</i>	<212	0.04	-3.91	31.6
<i>Igorina lodoensis</i>	212-250	1.89	-3.87	31.4
<i>Acarinina pseudosubphaerica</i>	212-250	1.50	-3.64	30.3
<i>Acarinina mcgowrani</i>	212-250	1.57	-3.62	30.2
<i>Acarinina aspensis</i>	212-250	1.15	-3.53	29.8
<i>Globigerinatheka micra</i>	250-300	0.55	-3.52	29.8
<i>Morozovella aragonensis</i>	300-425	1.88	-3.51	29.7
<i>Morozovella lensiformis</i>	300-425	1.49	-3.48	29.5
<i>Parasubbotina pseudowilsoni</i>	212-250	-0.51	-3.05	27.5
<i>Parasubbotina inaequispira</i>	212-250	0.28	-2.30	24.1
<i>Subbotina roesnaesensis</i>	250-300	-0.04	-2.22	23.7
<i>Subbotina eocaena</i>	212-250	-0.58	-1.96	22.5
Mixed benthics	300-425	-0.52	-1.84	22.0

Sample 8. TDP2/28-3, 16-24 cm. Age 49.7 (middle Zone E7; nannofossil zone NP15c).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
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<i>Planoglob. pseudoalgeriana</i>	<180	0.69	-3.87	31.4
<i>Igorina lodoensis</i>	180-212	2.23	-3.80	31.1
<i>Acarinina pentacamerata</i>	180-250	2.20	-3.80	31.1
<i>Acarinina aspensis</i>	180-250	2.25	-3.66	30.4
<i>Morozovella lensiformis</i>	212-250	1.88	-3.37	29.1
<i>Subbotina</i> sp.	180-250	0.32	-2.68	25.8

Sample 9. TDP3/5-1, 14-24 cm. Age 53.0 (middle Zone E4; nannofossil zone NP11).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Acarinina quetra</i>	300-425	2.78	-3.73	30.7
<i>Morozovella gracilis</i>	300-425	2.39	-3.61	30.2
<i>Morozovella formosa</i>	425-500	2.94	-3.45	29.4
<i>Acarinina triplex</i>	300-425	2.23	-3.39	29.1
<i>Morozovella lensiformis</i>	300-425	2.07	-3.39	29.1
<i>Morozovella subbotinae</i>	250-300	1.59	-3.29	28.7
<i>Acarinina coalingensis</i>	300-425	1.43	-3.18	28.2
<i>Subbotina velascoensis</i>	300-425	-0.63	-2.14	23.3
Mixed benthics	250-300	-1.48	-1.62	21.0

Sample 10. TDP7A/64-1, 50-65 cm. Age 54.9 (Zone E2).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Morozovella velascoensis</i>	300-355	4.02	-3.83	31.2
<i>Morozovella subbotinae</i>	250-300	4.68	-3.74	30.8
<i>Morozovella subbotinae</i>	300-355	4.80	-3.74	30.8
<i>Morozovella velascoensis</i>	212-250	3.75	-3.73	30.7
<i>Morozovella subbotinae</i>	212-250	3.76	-3.69	30.5
<i>Acarinina coalingensis</i>	250-300	3.76	-3.56	29.9
<i>Morozovella velascoensis</i>	250-300	4.14	-3.35	29.0
<i>Subbotina triangularis</i>	212-250	1.21	-2.93	27.0
<i>Subbotina triangularis</i>	300-355	1.25	-2.74	26.1
<i>Subbotina triangularis</i>	250-300	1.41	-2.73	26.1
<i>Cibicidoides</i> spp.	300-355	0.71	-0.75	17.0

Sample 11. TDP14/4-2, 10-20 cm. Age 55.4 (Zone E1, just above Paleocene - Eocene boundary).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
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<i>Morozovella aequa</i>	212-250	3.48	-3.71	30.6
<i>Chiloguembelina crinita</i>	212-250	1.80	-3.68	30.5
<i>Acarinina soldadoensis</i>	212-250	2.64	-3.62	30.2
<i>Acarinina soldadoensis</i>	250-300	3.06	-3.37	29.0
<i>Subbotina velascoensis</i>	212-250	1.39	-3.36	29.0
<i>Subbotina velascoensis</i>	250-300	1.53	-3.33	28.9
<i>Morozovella occlusa</i>	212-250	3.21	-3.30	28.7
<i>Morozovella aequa</i>	250-300	3.68	-3.28	28.6
<i>Morozovella subbotinae</i>	250-300	4.30	-3.08	27.7
<i>Subbotina triangularis</i>	250-300	1.16	-2.96	27.1
<i>Acarinina coalingensis</i>	212-250	2.00	-2.77	26.3
<i>Subbotina triangularis</i>	212-250	0.61	-2.36	24.4

Sample 12. TDP14/12-2, 2-10 cm. Age 55.6 (uppermost Zone P5, latest Paleocene).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Morozovella acuta</i>	250-300	4.50	-3.46	29.5
<i>Morozovella velascoensis</i>	300-355	5.17	-3.22	28.3
<i>Morozovella subbotinae</i>	300-355	5.40	-3.13	27.9

<i>Acarinina soldadoensis</i>	250-300	4.44	-3.03	27.5
<i>Acarinina coalingensis</i>	212-250	3.86	-3.03	27.5
<i>Morozovella occlusa</i>	250-300	4.69	-3.02	27.4
<i>Chiloguembelina wilcoxensis</i>	<212	2.13	-2.88	26.8
<i>Subbotina velascoensis</i>	250-300	1.95	-2.25	23.8

Sample 13. TDP19/12-2, 13-20 cm. Age 58.5 (middle Zone P4b).

Species	Size fraction	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Estimated temperature ($^{\circ}\text{C}$)
<i>Acarinina nitida</i>	212-250	4.01	-3.15	28.0
<i>Morozovella velascoensis</i>	212-250	5.12	-2.97	27.2
<i>Morozovella occlusa</i>	212-250	4.52	-2.73	26.1
<i>Acarinina subsphaerica</i>	212-250	4.35	-2.65	25.7
<i>Suubbotina velascoensis</i>	212-250	1.99	-2.14	23.3
<i>Subbotina velascoensis</i>	250-300	2.14	-2.10	23.2
<i>Subbotina triangularis</i>	212-250	2.26	-1.96	22.5
Mixed benthics	mixed	1.54	-1.23	19.2

Table 2. Tetraether lipid values and TEX_{86} palaeotemperature estimates. For the glycerol dialkyl tetraether (GDGT) analyses, sediment samples were freeze-dried and

crushed. Extractions were made with a Soxhlet apparatus with dichloromethane/methanol (DCM/MeOH, 2:1, v/v) for 24 hr, and the total lipid extracts (TLE) were concentrated using rotary evaporation. These TLEs were separated into four fractions using a column packed with Al₂O₃ and as eluent hexane/DCM (9:1, v/v; 3 column volumes) to give the apolar fraction, hexane/DCM (1:1 v/v, 3 column volumes) for the ketone fraction, DCM/MeOH (95/5 v/v, 3 column volumes) to give the tetraether lipid fraction and dichloromethane/methanol (1/1 v/v, 3 column volumes) to obtain the residual polar fraction. The tetraether lipid fraction was dissolved in an HPLC grade mixture of hexane/isopropanol (99:1, v/v) and sonicated for 5 minutes in a sonication bath to let as much dissolve as possible. If there is some precipitate left the mixture was centrifuged and the supernatant used for further analyses. The solvent mixture/supernatant was filtered using a 0.45 micrometer, 4 mm diameter PTFE filter attached to a 5 or 10 ml syringe needle, prior to analyses by high-performance liquid chromatography/mass spectrometry (HPLC/MS). Conditions for HPLC-MS analyses of the purified extracts were as previously described (Ref. 20). GDGTs were detected by Single Ion Monitoring of their [M+H]⁺ ions (dwelltime 237ms) and quantified by integration of the peak areas.

Sample	Age	TEX ₈₆	Temperature	BIT
1	33.65	0.77	29.2	0.35
2	33.75	0.83	31.5	0.28
3	39.60	0.86	32.3	0.24
4.	41.10	0.86	32.5	0.23
5.	45.50	0.88	33.1	0.22

6.	49.60	0.89	33.5	0.20
7.	49.70	0.84	31.5	0.22
8.	52.70	0.82	31.1	0.50
9.	53.20	0.76	28.6	0.31
10	54.30	0.83	31.2	0.37
(11.*	54.90	0.67	25.4	0.58)

* Analysis rejected because of high contribution of terrestrial derived GDGTs as shown by high BIT value (see Hopmans et al., 2004).

Key to samples:

1. TDP11/11-1, 90-100 cm (early Oligocene).
2. TDP12/47-3, 48-53 cm (latest Eocene Zone E16, from below the *Hantkenina* extinction).
3. TDP4/1-2, 25-38 cm (lower Zone E13, from above the *Orbulinoides beckmanni* extinction).
4. TDP13/10-1, 60-75 cm (middle Zone E11).
5. TDP2/10-3, 16-30 cm (lower Zone E9).
6. TDP2/25-2, 53-60 cm (middle Zone E7).
7. TDP2/28-2, 6-20 cm (middle Zone E7).
8. TDP3/4-1, 84-93 cm (Zone E4).
- 9 TDP3/16-2, 73-85 cm. (Zone E4).

10. TDP7A/54-1, 26-36 cm (Zone E3).

11. TDP7A/64-1, 68-82 cm (Zone E2).