Supplement S1

S1 Table 1: Stable isotope values ($\delta^{18}O_{calcite}$ and $\delta^{13}C_{calcite}$) of foraminiferal calcite from plankton tows and surface sediments. 1 indicates $\delta^{18}O_{calcite}$ from Steph et al. (2009); # indicates stations of cruise SO164.

Species	Station	Sampling interval (m)	Size-fraction (µm)	Number of specimens/ sample	$\delta^{18}O_{calcite}$ (‰ VPDB)	$\delta^{13}C_{calcite}$ (‰ VPDB)
G. sacculifer	211-6	0–60	>500	3	-1.56	1.20
	211-6				-1.49	1.24
	211-6				-1.44	1.24
	211-6				-1.50	1.51
	211-5				-1.41	0.91
	211-5				-1.49	1.68
	211-5				-1.51	0.85
	211-5				-1.61	1.02
	211-6				-1.45	1.23
	211-5		400–500	7	-1.34	0.54
	211-6		300–400	6	-1.59	-0.3
	211-6	60–100	>500	3	-1.06	1.26
	211-5				-1.40	1.35
	211-6				-1.39	1.21
	211-5				-1.30	0.70
	211-5		400–500	3	-1.34	0.65
	211-5	100–200	>500	3	-1.26	1.25
	212-1	Sediment	355–400	30	-1.02	
	212-1				-1.37	
	212-1				-0.95	
	212-1				-1.43	
	219-7	0–60	>500	3	-1.71	0.91
	219-7				-1.68	0.03
	219-7				-1.60	0.52
	219-7				-1.71	0.84
	219-7				-1.73	-0.04
	219-7		400–500	5	-1.34	-0.05
	219-8			6	-1.79	-0.43
	219-8			6	-1.76	0.21
	219-8			5	-1.77	-0.08
	219-7			5	-1.69	0.45
	219-8			5	-1.55	0.07
	219-7		300–400	10	-1.56	-0.19
	219-7				-1.55	-0.19
	219-8				-1.71	-0.04
	219-8				-1.89	-0.18
	219-7	60–125	>500	3	-1.76	0.77
	219-7				-1.67	1.14
	219-8				-1.37	1.06
	219-7				-1.71	0.87
	219-7				-1.69	0.71

S1 Table 1: Continued.

Species	Station	Sampling interval (m)	Size-fraction (µm)	Number of specimens/ sample	$\delta^{18}O_{calcite}$ (‰ VPDB)	$\delta^{13}C_{calcite}$ (‰ VPDB)
G. sacculifer	219-7	60–125	400–500	5	-1.39	0.41
	219-7		300–400	10	-1.59	-0.41
	219-7	125–180	>500	3	-1.55	0.82
	02-3#	Sediment[1]	355–400		-1.39	
	220-8	0–70	>500	3	-1.65	1.08
	220-9			5	-1.88	0.99
	220-9			5	-1.97	0.51
	220-9			5	-1.92	1.12
	220-9			5	-1.93	0.74
	220-8			5	-1.88	0.84
	220-8			5	-1.79	0.57
	220-8			5	-1.65	1.35
	220-9		400–500	9	-1.76	0.08
	220-9			9	-1.56	0.96
	220-9			12	-1.73	0.34
	220-8	70–100	>500	3	-1.65	1.52
	220-8		400–500	5	-1.47	0.70
	22-2#	Sediment[1]	355–400		-1.25	
	221-8	0–40	>500	3	-1.79	0.83
	221-8		400–500	5	-1.83	1.73
	221-7			7	-2.07	0.39
	221-8			8	-1.99	0.82
	221-8			7	-1.96	0.96
	221-8		300–400	9	-1.94	0.18
	221-8			9	-1.99	0.35
	221-8			9	-1.98	0.41
	221-8			9	-2.03	0.46
	221-8			7	-2.08	1.00
	221-8			7	-1.96	0.68
	221-7	40–60	400–500	5	-1.66	1.26
	221-8		300–400	6	-1.66	0.98
	221-8	60–150	400–500	5	-1.59	1.67
	24-3#	Sediment[1]	355–400		-1.5	
	222-7	0–40	>500	3	-1.52	2.13
	222-6		400–500	5	-1.29	0.73
	222-7		300–400	7	-1.94	1.42
	222-6	40–80	300–400	5	-1.68	1.33
	222-8	Sediment	355–400	30	-1.59	
O. universa	211-6	0–60	>500	10	-1.33	2.38
	211-5			5	-1.58	1.83
	211-5			5	-1.54	2.21
	211-6			8	-1.24	1.35
	211-5	60–100	>500	5	-1.23	1.22
	211-5			5	-1.20	1.16
	211-6			5	-1.39	1.30
	211-6			10	-1.24	1.32
	211-6	100–200	>500	7	-0.85	0.99

Supplement S1

S1 Table 1: Continued.

Species	Station	Sampling interval (m)	Size-fraction (µm)	Number of specimens/ sample	$\delta^{18}O_{calcite}$ (‰ VPDB)	$\delta^{13}C_{calcite}$ (‰ VPDB)
O. universa	212-1	Sediment	355–400	10	-0.73	
	220-9	0–70	>500	6	-1.55	1.84
	22-2#	Sediment	355–400	18	-1.33	
	22-2#				-1.14	
	221-8	0–40	>500	10	-1.82	1.63
	221-7			9	-1.84	1.39
	221-8	40–60	>500	7	-1.6	1.47
	221-7	60–150	>500	5	-1.42	1.25
	24-3#	Sediment	355–400	18	-1.21	
	24-3#				-1.88	
	24-3#				-1.40	
N. dutertrei	221-8	0–40	400–500	3	-1.28	2.65
	221-8		300–400	5	-1.68	2.02
	221-7		250–300	6	-1.65	1.61
	221-7			5	-1.81	0.88
	221-8			6	-1.25	1.67
	221-8			6	-1.77	1.42
	221-8	40–60	400–500	2	-1.35	2.12
	221-7		300–400	3	-1.58	2.2
	221-7		250–300	6	-2.12	1.05
	221-8	60–150	400–500	2	-1.28	1.59
	221-8		300–400	3	-1.39	1.98
	221-7		250–300	6	-1.44	0.53
	24-3#	Sediment[1]	355–400		-0.53	
	222-7	0–40	300–400	5	-1.27	1.03
	222-8	Sediment	355–400	13	-0.26	
P. obliquiloculata	211-5	0–60	300–400	3	-0.83	0.05
	212-1	Sediment	355–400	18	-0.14	
	212-1				-0.11	
	212-1				-0.16	
	219-8	60–125	300–400	3	-1.15	0.06
	02-3#	Sediment	355–400	12	-0.87	
	220-8	0–70	300–400	3	-1.24	0.12
	220-8	110–150	300–400	3	-0.98	0.16
	22-2#	Sediment	355–400	12	-0.65	
	22-2#				-0.91	
	22-2#				-0.67	
	221-7	0–40	300–400	3	-1.48	0.03
	221-8				-0.23	0.51
	221-8				-1.47	0.24
	221-8	40–60	300–400	3	-1.41	-0.07
	221-8	60–150	300–400	3	-1.01	0.09
	221-7				-0.74	0.29
	221-7				-1.68	-0.20
	24-3#	Sediment	355–400	11	-0.99	
	24-3#				0.05	

S1 Table 1: Continued.

Species	**Station**	**Sampling interval (m)**	**Size-fraction (µm)**	**Number of specimens/ sample**	**$\delta^{18}O_{calcite}$ (‰ VPDB)**	**$\delta^{13}C_{calcite}$ (‰ VPDB)**
P. obliquiloculata	222-6	0–40	300–400	3	-1.22	0.22
G. menardii	211-6	60–100	300–400	3	-1.01	0.78
	211-6	100–200	300–400	5	-0.16	0.21
	212-1	Sediment	355–400	8	-0.46	
	212-1				-0.85	
	212-1				-1.25	
	221-8	60–150	300–400	5	-1.17	0.59
	221-8	150–210	400–500	2	-0.87	0.49
	24-3#	Sediment[1]	355–400		-0.24	
G. ungulata	211-5	0–60	400–500	4	-1.08	0.99
	211-6				-0.98	1.33
	211-6				-0.67	0.70
	211-5				-0.70	0.99
	211-6		300–400	5	-1.03	1.08
	211-5			4	-1.14	1.24
	211-5			4	-0.71	0.64
	211-6			4	-0.92	1.04
	211-5		250–300	7	-0.99	1.10
	211-5				-1.09	1.21
	211-6				-1.06	1.34
	211-6				-0.90	1.27
	211-6				-0.99	1.09
	211-6	60–100	300–400	5	-0.90	0.65
	211-5			5	-0.88	0.44
	211-6			6	-1.07	0.93
	211-6	100–200	400–500	3	-0.27	0.63
	211-5		300–400	5	-0.20	0.46
	211-5			5	-0.42	0.37
	211-6			4	-0.14	0.52
	212-1	Sediment	355–400	12	0.30	
	212-1				-1.20	
	212-1				-0.95	
	212-1				-0.83	
G. truncatulinoides d.	211-6	100–200	300–400	4	-0.10	-0.44
	211-6	200–300	300–400	2	0.89	-0.02
	212-1	Sediment	355–400	7	1.35	
	212-1				1.29	
	212-1				0.95	
	219-7	220–400	300–400	2	0.18	0.10
	02-3#	Sediment[1]	355–400		0.98	
	220-8	150–220	300–400	2	0.20	0.14
	22-2#	Sediment[1]	355-400		0.8	
	221-7	150–210	300–400	4	0.01	-0.08
	221-7	210–300	300–400	3	0.52	0.05
	24-3#	Sediment[1]	355–400		1.54	
G. tumida	219-8	180–220	400–500	2	-0.88	0.87
	219-8	220–400	400–500	3	-0.28	0.84
	02-3#	Sediment[1]	355–400		-0.11	

Supplement S1

S1 Table 2**:** Mg/Ca ratios of foraminiferal calcite measured on bulk foraminiferal samples (ICP-OES) and on single chambers (LA-ICP-MS) from plankton tows and surface sediments. For the LA-ICP-MS measurements, average values (± standard deviation) of all chambers from single specimens are calculated. 2 indicates Mg/Ca ratios from Regenberg et al. (2006), *with dissolution correction (published in Regenberg et al., 2009); # stations of cruise SO164.

Species	**Station**	**Sampling interval (m)**	**Size fraction (µm)**	**Number ind. /sample**	**Mg/Ca ($mmol\ mol^{-1}$) ICP-OES**	**Chambers /ind.**	**Mg/Ca ($mmol\ mol^{-1}$) LA-ICP-MS**
G. sacculifer	211-6	0–60	>500	12	3.95		
	211-6			12	3.08		
	211-6			12	3.49		
	211-6			12	3.26		
	211-6			12	3.35		
	211-5			12	3.64	F, F-1, F-2 /tri83	3.27 ± 0.24
	211-5			12	3.46		
	211-5			12	3.37		
	211-5			12	3.26		
	211-5			12	3.53		
	211-5			12	3.37		
	211-6			12	3.6		
	211-6			12	3.44		
	211-6		400–500	42	3.51		
	211-5/211-6		300–400	64	3.72		
	211-5	60–100	>500	12	3.44	F, F-1, F-2 /tri85	3.95 ± 0.8
	211-6			12	3.63		
	211-6		400–500	10	3.94		
	211-5	100–200	>500	-	-	F, F-1, F-2 /tri87	2.48 ± 0.57
	212-1	Sediment	355–400	30	4.44		
	212-1				4.17		
	212-1				4.39		
	212-1				4.39		
	219-7	0–60	>500	16	3.9		
	219-8				4.24	F, F-1, F-2 /tri6	3.11 ± 0.7
	219-8				4.16	F, F-1, F-2 /tri7	3.87 ± 0.2
	219-7		400–500	40	4.37		
	219-7/219-8		300–400	70	4.29		
	219-8	60–125	>500	17	4.30	F, F-1, F-2 /tri8	3.18 ± 0.62
	219-7/219-8		400–500	24	4.22		
	219-7/219-8		300–400	54	4.37		
	219-8	220–400	>500	-	-	F, F-1, F-2 /tri12	3.86 ± 0.7
	02-3#	Sediment[2]	355–400		4.2		
	220-9	0–70	>500	10	3.87	F, F-1, F-2 /tri2	3.72 ± 0.44
	220-8			11	4.15	F, F-1,F-2 /tri99	2.82 ± 0.56
	220-9			10	4.15		
	220-8			12	4.2		
	220-8			12	4.14		
	220-9			11	4.36		
	220-9			12	4.08		
	220-8			11	4.0		
	220-8		400–500	38	4.20		
	220-8		300–400	80	3.90		
	220-8	70–110	>500	-	-	F, F-1, F-2 /tri100	3.12 ± 1.00
	220-9	150–220	250–300	-	-	F, F-1 /tri4	3.7 ± 0.02
	22-2#	Sediment[2]	355–400		3.71/4.45*		

S1 Table 2**:** Continued.

Species	**Station**	**Sampling interval (m)**	**Size fraction (µm)**	**Number ind. /sample**	**Mg/Ca (mmol mol^{-1}) ICP-OES**	**Chambers /ind.**	**Mg/Ca (mmol mol^{-1}) LA-ICP-MS**
G. sacculifer	221-8	0–40	>500	20	4.00		
	221-7					F,F1, F2 /tri101	4.3 ± 0.25
	221-7		400–500	80	4.01		
	221-7		300–400	86	3.91		
	221-7	40–60	>500	-	-	F, F1, F2 /tri19	3.3 ± 0.53
	221-8		400–500	15	4.02	-	
	221-7/221-8		300–400	54	4.06	-	
	221-7	60–150	>500	-	-	F, F1, F2 /tri20	3.8 ± 0.35
	24-3#	Sediment²	355–400		4.23		
	222-6	0–40	>500	-	-	F, F-1, F-2 /tri110	4.0 ± 0.14
	222-7		400–500	12	4.55		
	222-6		300–400	30	4.13		
	222-7	40–80	400–500	-	-	F, F-1, F-2 /tri111	4.0 ± 0.3
	222-7	80–120	>500	-	-	F, F-1, F-2 /tri23	3.27 ± 0.65
	222-8	Sediment	355–400	30	3.84		
N. dutertrei	PF 12	3.5	365	-	-	F, F-1, F-2 /dut116	2.7 ± 0.74
	02-3#	Sediment²	355–400		2.58/2.86*		
	22-2#	Sediment²	355–400		1.84/3.15*		
	221-7	0–40	300–400	-	-	F, F-1, F-2 /dut104	1.73 ± 0.38
	221-7/221-8			50	2.97		
	221-7/221-8	40–60		19	4.21		
	24-3#	Sediment²	355–400		2.63		
	222-6	0–40	300–400	-	-	F, F-1, F-2 /dut112	2.99 ± 0.77
G. ungulata	PF 7	3.5	425	-	-	F, F-1, F-2 /ung113	2.35 ± 0.35
	PF 12		450	-	-	F, F-1, F-2 /ung117	2.55 ± 0.15
	211-5	0–60	>500	-	-	F-1, F-2 /ung28	3.19 ± 0.32
	211-5/221-6		400–500	14	3.39		
	211-5/221-6		300–400	28	3.32		
	211-5	60–100	>500	-	-	F, F-1, F-2 /ung29	3.22 ± 0.41
	211-5/211-6		400–500	14	3.19		
	211-5/211-6		300–400	22	3.33		
	211-5	100–200	>500	-	-	F, F-1, F-2 /ung30	3.1 ± 0.06
	211-5/211-6		400–500	17	3.48		
	211-5/211-6		300–400	20	3.17		
O. universa	211-6	0–60	>500	-	-	F /uni36	10.3 ± 0.33
	211-6	60–100	>500	-	-	F /uni37	10.09 ± 0.54
	219-8	0–60	>500	-	-	F /uni39	9.08 ± 0.95
	219-7	60–125	>500	-	-	F /uni40	7.13 ± 0.68
	219-7	180–220	>500	-	-	F /uni41	8.31 ± 1.5
	220-8	0–70	>500	-	-	F /uni42	8.16 ± 0.50
	220-8	110–150	>500	-	-	F /uni44	7.05 ± 0.18
	221-8	0–40	>500	-	-	F /uni106	7.28 ± 0.06
	221-8	40–60	>500	-	-	F /uni46	8.09 ± 0.4
	221-8	60–150	>500	-	-	F /uni47	9.79 ± 0.4
	222-7	0–40	>500	-	-	F /uni48	6.55 ± 0.16
	222-7	120–180	>500	-	-	F /uni50	5.3 ± 0.08

S1 Table 2**:** Continued.

Species	Station	Sampling interval (m)	Size fraction (µm)	Number ind. /sample	Mg/Ca (mmol mol^{-1}) ICP-OES	Chambers /ind.	Mg/Ca (mmol mol^{-1}) LA-ICP-MS
G. menardii	PF 19	3.5	355	-	-	F, F-1, F-2 /men118	1.76 ± 0.31
	211-5	100–200	300–400	-	-	F, F-1, F-2 /men91	3.45 ± 0.27
	211-5		300–400	-	-	F, F-1, F-2 /men92	2.62 ± 0.95
	211-5	200–300	>500	-	-	F, F-1, F-2 /men31	2.8 ± 0.5
	02-3#	Sediment²	355–400		3.49/3.52*		
	220-8	0–70	400–500	-	-	F, F-1, F-2 /men26	2.21 ± 0.17
	22-2#	Sediment²	355–400		2.20/3.31*		
	221-7	0–40	400–500	-	-	F, F-1, F-2 /men32	3.18 ± 0.19
	221-8	60–150	400–500	-	-	F, F-1, F-2 /men105	3.36 ± 0.52
	221-7	150–210	>500	-	-	F, F-1, F-2 /men34	3.24 ± 0.42
	221-8	210–300	>500	-	-	F, F-1, F-2 /men35	3.69 ± 0.49
	24-3#	Sediment²	400–500		2.98		
	222-6	0-40	400–500	-	-	F, F-1, F-2 /men27	3.92 ± 0.31
G. truncatulinoides d.	PF 11	3.5	325	-	-	F, F-1, F-2, F-3 / tdex115	3.22 ± 1.56
	211-5	100–200	300–400	-	-	F-1, F-2, F-3 / tdex90	3.0 ± 0.55
	22-2#	Sediment²	355–400		1.62/2.76*		
	221-8	150–210	300–400	-	-	F, F-1, F-2, F-3 / tdex108	1.66 ± 0.19
	221-8	210–300	400–500	-	-	F, F-1, F-2, F-3 / tdex109	2.84 ± 0.53
	24-3#	Sediment²	400–500		2.28		
G. tumida	219-8	60–125	>500	-	-	F, F-1, F-2 /tum61	2.45 ± 0.13
	219-8	125–180	>500	-	-	F ,F-1, F-2 /tum62	1.6 ± 0.38
	219-7	180–220	>500	-	-	F, F-1, F-2 /tum63	2.25 ± 0.35
	219-7	220–400	>500	-	-	F, F-1, F-2 /tum64	1.57 ± 0.62
	02-3#	Sediment²	400–500		2.43		
	22-2#	Sediment²	355–400		1.95/2.93*		
P. obliquiloculata	221-8	0–40	400–500	-	-	F, F-1 /obli77	2.54 ± 0.09
	221-7	40–60	400–500	-	-	F, F-1 /obli78	2.55 ± 0.31
	222-7	0–40	300–400	-	-	F, F-1, F-2 /obli80	3.44 ± 1.01
	222-7	40–80	300–400	-	-	F, F-1, F-2 /obli81	2.43 ± 0.51
	222-6	80–120	300–400	-	-	F, F-1, F-2 /obli82	3.3 ± 0.32

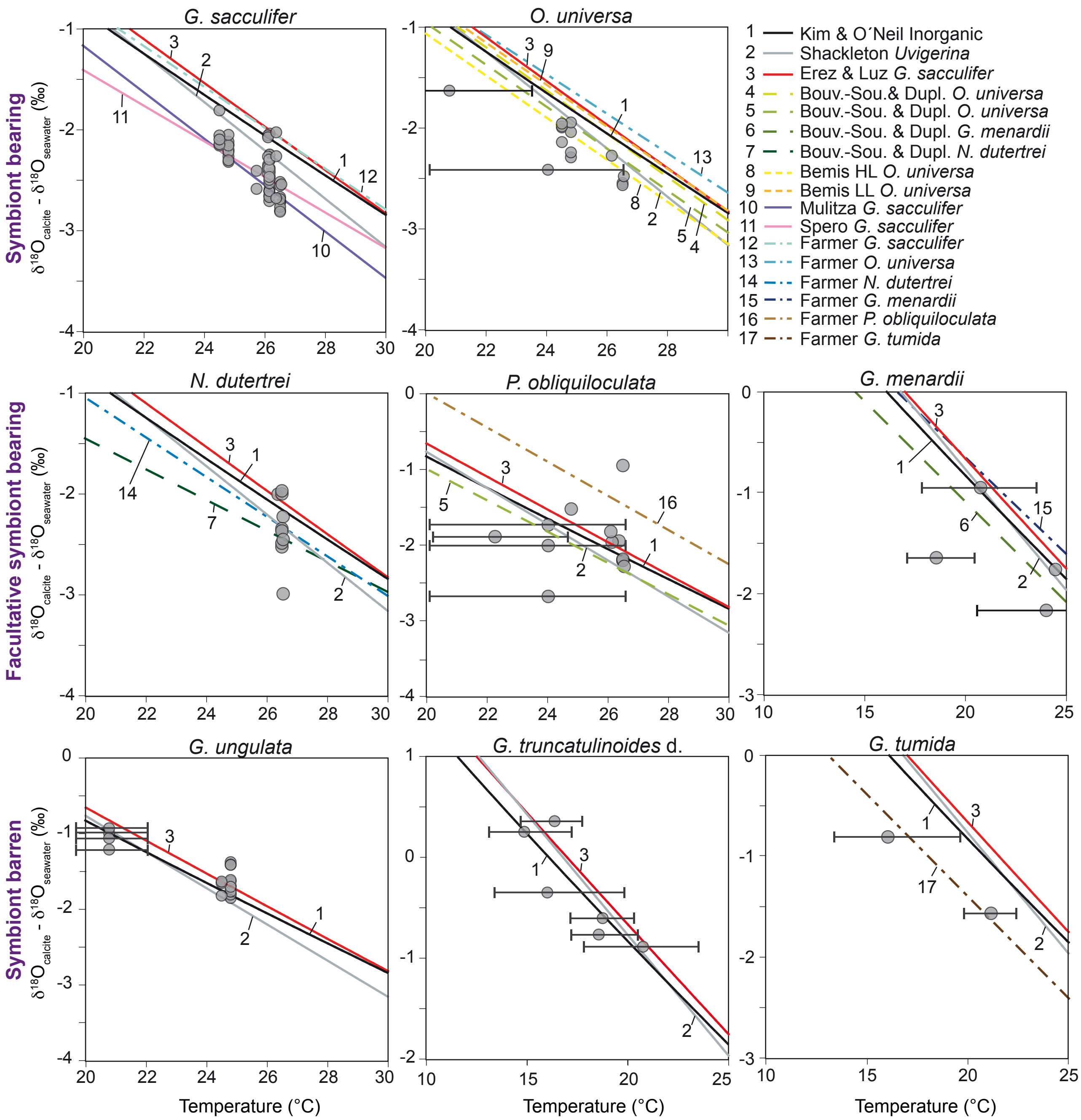
Supplement S1

S1 Table 3**:** Stable isotope values in seawater ($\delta^{18}O_{seawater}$), measured temperature (°C) and salinity (psu) during RV *Meteor* cruise M78/1 (Schönfeld et al., 2011, by courtesy of C. Dullo and S. Flögel).

Station	Sampling depth (m)	$\delta^{18}O_{seawater}$ (‰ VSMOW)	Temperature (°C)	Salinity (psu)
210-13	40	0.98	24.8	36.0
210-13	85	1.02	24.2	36.2
210-13	100	1.01	24.0	36.8
210-13	150	1.05	21.0	36.4
210-13	190	0.92	19.2	36.4
210-13	275	0.75	15.9	36.1
210-13	400	0.45	11.8	35.4
219-1	50	0.96	26.1	35.9
219-1	100	0.94	26.1	36.0
219-1	220	0.96	19.5	36.6
219-1	600	0.27	8.5	34.9
220-1	10	0.97	26.2	35.7
220-1	61	1.02	26.1	35.7
220-1	91	1.21	26.1	36.8
220-2	136	1.17	22.1	36.8
220-2	196	1.04	18.4	36.5
220-2	485	0.3	9.3	35.0
221-1	10	0.97	26.4	35.5
221-1	30	1.01	26.4	35.5
221-1	60	1.21	26.5	36.6
221-2	100	1.28	24.0	37.2
221-2	150	1.11	20.2	36.8
221-2	200	0.99	17.7	36.4
221-2	500	0.31	8.9	34.9
222-1	10	1.0	26.5	35.7
222-1	30	1.0	26.6	35.7
222-1	55	1.12	22.7	36.7
222-1	75	1.11	21.8	36.8
222-1	140	1.04	18.3	36.5
222-1	229	0.74	14.4	35.7

S1 Table 4**:** Data (average values) of the Thermosalinograph during cruises M78/1 (Schönfeld et al., 2009).

Cruise	Station Nr.	Temperature (°C)	Salinity (psu)
M78/1	1	26.65	35.93
M78/1	2	25.60	36.00
M78/1	3	26.87	35.54
M78/1	4	26.60	35.80
M78/1	5	26.00	35.70
M78/1	6	25.50	35.70
M78/1	7	24.94	35.93
M78/1	10	20.00	36.30
M78/1	11	20.00	36.40
M78/1	14	19.90	36.40
M78/1	15	20.00	36.40
M78/1	16	20.10	36.40
M78/1	17	20.00	36.40
M78/1	18	20.00	36.50
M78/1	19	20.50	36.40
M78/1	20	20.00	36.40
M78/1	21	20.20	36.40
M78/1	23	24.40	35.90
M78/1	24	24.20	35.90
M78/1	33	24.40	35.70
M78/1	34	26.00	35.20
M78/1	35	25.90	35.20
M78/1	36	26.16	33.46
M78/1	37	26.30	31.10
M78/1	39	25.30	33.50
M78/1	40	25.90	35.30
M78/1	41	26.70	34.60
M78/1	42	26.40	34.80
M78/1	43	26.70	34.90
M78/1	44	26.90	34.90
M78/1	45	27.00	34.50
M78/1	47	27.20	34.60



S2 Figure 1**:** Assessment of existing $\delta^{18}O$-paleotemperature relationships. Grey dots: Difference between the measured $\delta^{18}O_{calcite}$ and the measured $\delta^{18}O_{seawater}$, depicted at the average in situ temperature of the plankton net intervals measured during cruise M78/1. Black error bars denote the temperature ranges of the sampling intervals. Coloured-coded lines labelled by numbers are published $\delta^{18}O$-paleotemperature equations (cf. Supplement S2 Table 1).

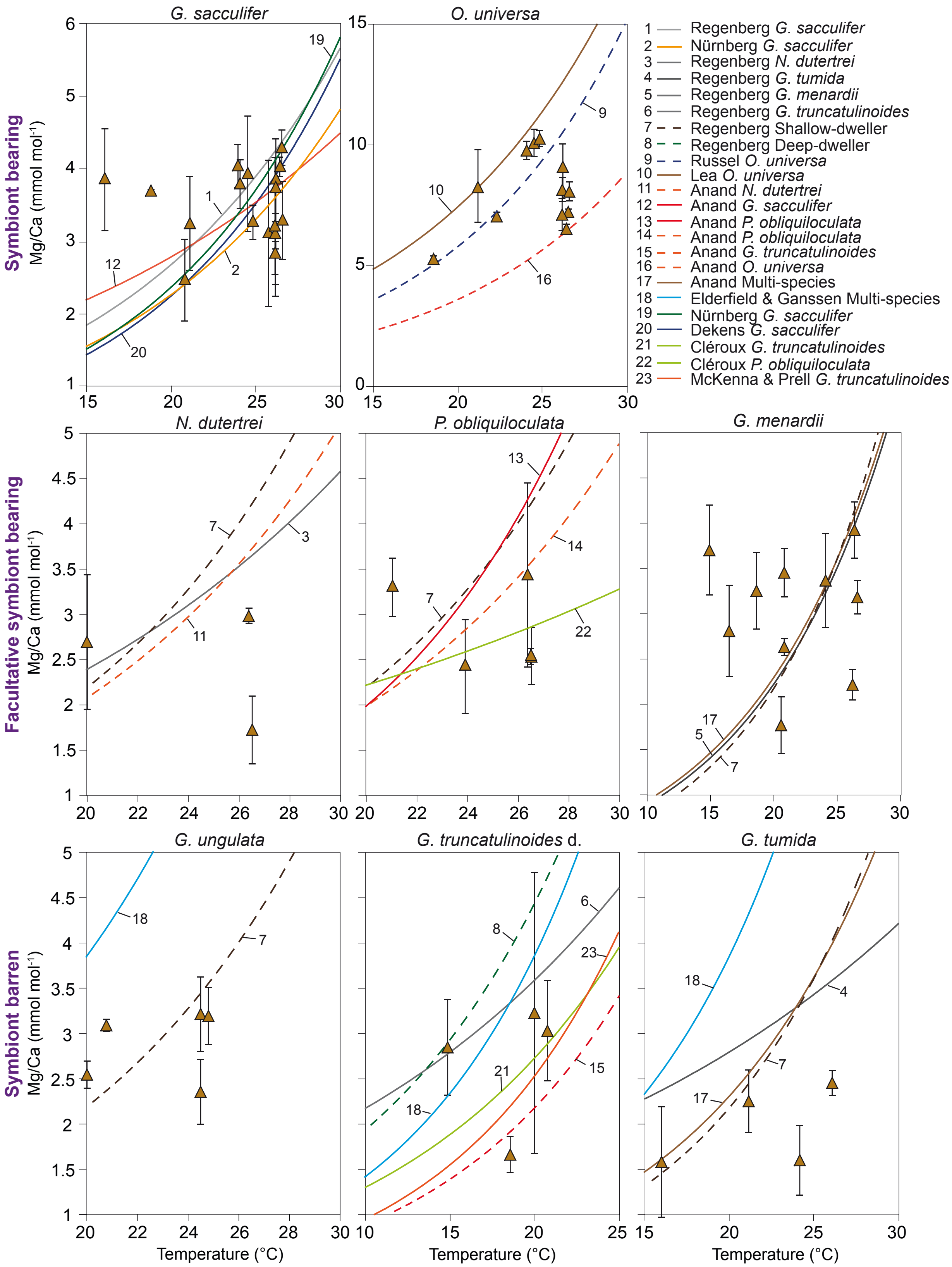
Supplement S2

S2 Table 1**:** Temperature: $\delta^{18}O$ relationship from different studies including different conversion factors (SMOW to PDB; cf. Bemis et al., 1998). A = species-specific equation used to estimate $\delta^{18}O_{seawater}$ for *G. sacculifer*.

$$T = \mathbf{a} + \mathbf{b}*(\delta^{18}O_{calcite} - \delta^{18}O_{seawater}) + \mathbf{c}*(\delta^{18}O_{calcite} - \delta^{18}O_{seawater})^2$$

Nr.	Reference	Species		Material	**a**	**b**	**c**	SMOW to PDB conversion
1	Kim and O´Neil 1997	Inorganic		Experiment	16.1	-4.64	0.09	-0.27
2	Shackleton 1974	*Uvigerina*		Sediment	16.9	-4.38	0.1	-0.20
3	Erez and Luz 1983	*G. sacculifer*		Culture experiment	17.0	-4.52	0.03	-0.22
4	Bouvier-Soumagnac and Duplessy 1985	*O. universa*		Culture experiment	16.4	-4.67		-0.20
5	Bouvier-Soumagnac and Duplessy 1985	*O. universa*		Plankton tow	15.4	-4.81		-0.20
6	Bouvier-Soumagnac and Duplessy 1985	*G. menardii*		Plankton tow	14.6	-5.03		-0.20
7	Bouvier-Soumagnac and Duplessy 1985	*N. dutertrei*		Plankton tow	10.5	-6.58		-0.20
8	Bemis et al. 1998	*O. universa*		Culture experiment, high-light conditions	14.9	-4.8		-0.27
9	Bemis et al. 1998	*O. universa*		Culture experiment, low-light conditions	16.5	-4.8		-0.27
10	Mulitza et al. 2003	*G. sacculifer*		Surface pump samples	14.91	-4.35		-0.27
11	Spero et al. 2003	*G. sacculifer*	A	Culture experiment, high-light conditions	12.0	-5.67		-0.27
12	Farmer et al. 2007	*G. sacculifer*		Surface sediment	16.2	-4.94		-0.27
13	Farmer et al. 2007	*O. universa*		Surface sediment	16.5	-5.11		-0.27
14	Farmer et al. 2007	*N. dutertrei*		Surface sediment	14.6	-5.09		-0.27
15	Farmer et al. 2007	*G. menardii*		Surface sediment	16.6	-5.20		-0.27
16	Farmer et al. 2007	*P. obliquiloculata*		Surface sediment	16.8	-5.22		-0.27
17	Farmer et al. 2007	*G. tumida*		Surface sediment	13.1	-4.95		-0.27

Supplement S2



S2 Figure 2**:** Average Mg/Ca values (± standard deviations) of LA-ICP-MS measurements of single tests vs. in situ temperature (recorded during M78/1). Brown triangles: Mg/Ca values of living specimens depicted at the average in situ temperature of the plankton net intervals (MSN and PF) during cruise M78/1. Black error bars indicate the standard deviations of single foraminiferal tests (cf. Supplement S1). The various published Mg/Ca calibration curves are colour-coded and labelled by numbers (cf. Supplement S2 Table 2).

S2 Table 2**:** Relationship between temperature and Mg/Ca ratios from different authors, species and material. A–H indicate species-specific calibrations used to estimate calcification temperature from Mg/Ca for A=*G. sacculifer*; B=*O. universa*; C=*N. dutertrei*; D=*P. obliquiloculata*; E=*G. menardii*; F=*G. ungulata*; G=*G. truncatulinoides* dextral; H=*G. tumida*.

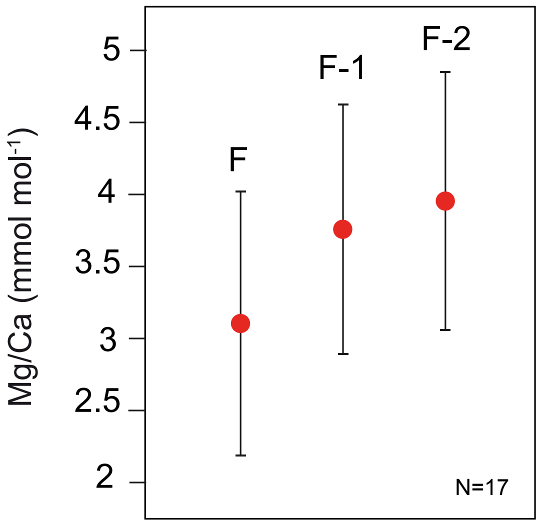
Mg/Ca = **b** * exp(**a** * T)						
Nr.	Reference	Species		Material/Method	**b**	**a**
1	Regenberg et al. 2009	*G. sacculifer*	A	Surface sediment/ICP-OES	0.596	0.075
2	Nürnberg et al. 2000	*G. sacculifer*		ICP-OES	0.491	0.076
3	Regenberg et al. 2009	*N. dutertrei*	C	Surface sediment/ICP-OES	0.65	0.065
4	Regenberg et al. 2009	*G. tumida*	H	Surface sediment/ICP-OES	1.23	0.041
5	Regenberg et al. 2009	*G. menardii*	E	Surface sediment/ICP-OES	0.36	0.091
6	Regenberg et al. 2009	*G. truncatulinoides* d.		Surface sediment/ICP-OES	1.32	0.05
7	Regenberg et al. 2009	Shallow-dweller	F	Surface sediment/ICP-OES	0.29	0.101
8	Regenberg et al. 2009	Deep-dweller		Surface sediment/ICP-OES	0.84	0.083
9	Russel et al. 2004	*O. universa*	B	Culture experiments/ICP-MS	0.85	0.096
10	Lea et al. 1999	*O. universa*		Culture experiments/ICP-MS	1.36	0.085
11	Anand et al. 2003	*N. dutertrei*		Sediment-Trap/ICP-OES	0.342	0.09
12	Anand et al. 2003	*G. sacculifer*		Sediment-Trap/ICP-OES	1.06	0.048
13	Anand et al. 2003	*P. obliquiloculata*		Sediment-Trap/ICP-OES	0.18	0.12
14	Anand et al. 2003	*P. obliquiloculata*		Sediment-Trap/ICP-OES	0.328	0.09
15	Anand et al. 2003	*G. truncatulinoides* d.		Sediment-Trap/ICP-OES	0.359	0.09
16	Anand et al. 2003	*O. universa*		Sediment-Trap/ICP-OES	0.595	0.09
17	Anand et al. 2003	Multi-species		Sediment-Trap/ICP-OES	0.38	0.09
18	Elderfield and Ganssen 2000	Multi-species		Surface sediment/ICP-OES	0.52	0.1
19	Nürnberg et al. 1996	*G. sacculifer*		Culture experiment/EPMA	0.39	0.09
20	Dekens et al. 2002	*G. sacculifer*		Surface sediment/ICP-MS	0.37	0.09
21	Cléroux et al. 2008	*G. truncatulinoides* d.	G	Surface sediment/ICP-AES	0.62	0.074
22	Cléroux et al. 2008	*P. obliquiloculata*	D	Surface sediment/ICP-AES	1.02	0.039
23	McKenna and Prell 2004	*G. truncatulinoides* d.		Surface sediment/EPMA	0.355	0.098

Supplement S3

S3 Table 1**:** Spearman rank correlation obtained from PAST (Hammer et al., 2001).

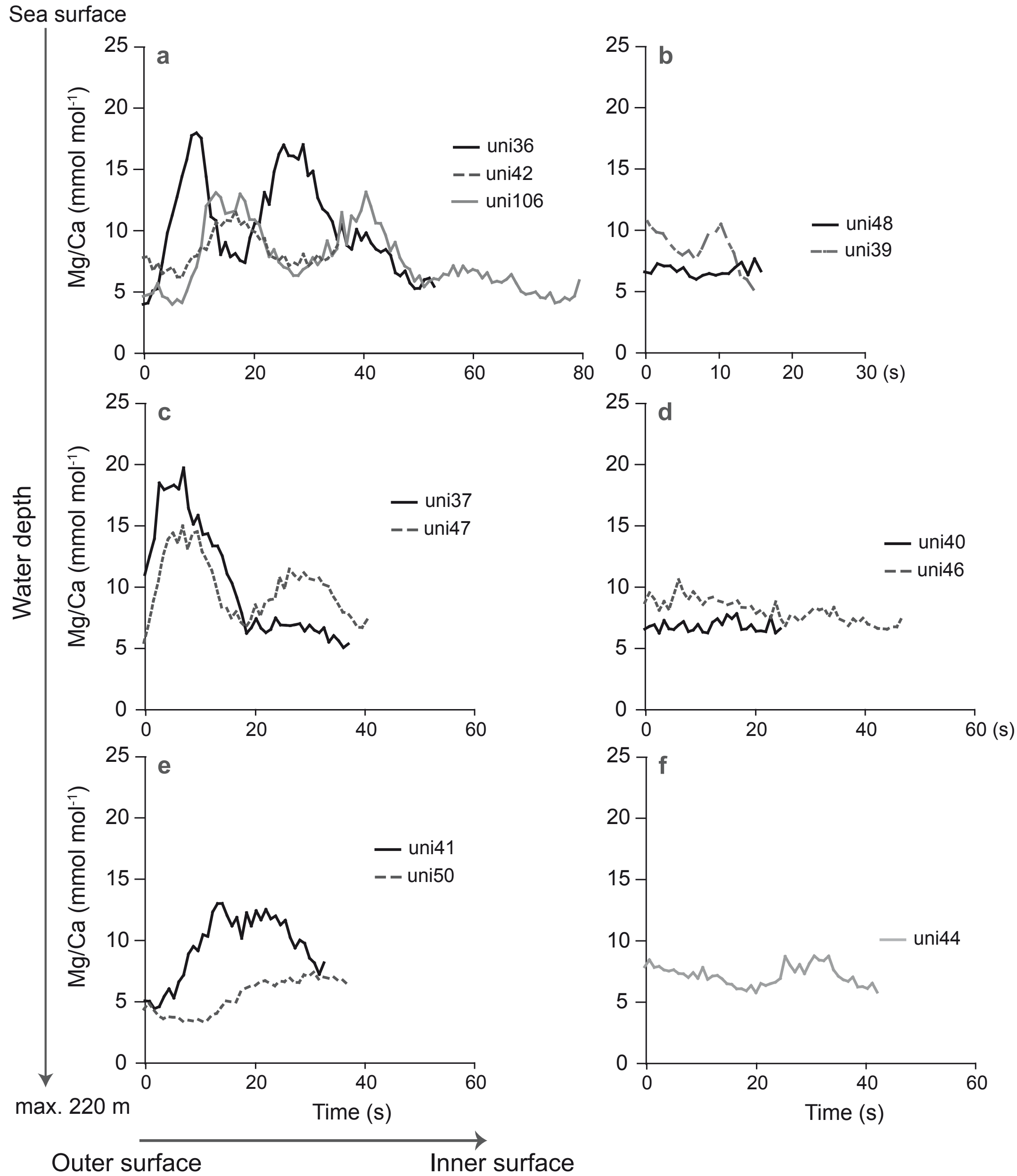
Species	$\delta^{18}O_{calcite}$ Two tailed probability	$\delta^{18}O_{calcite}$ Correlation value	$\delta^{13}C_{calcite}$ Two tailed probability	$\delta^{13}C_{calcite}$ Correlation value
G. sacculifer	0.00	0.34	0.00	0.45
G. ungulata	0.28	0.25	0.43	-0.19
G. menardii	0.90	-0.10	0.93	-0.07
N. dutertrei	0.04	0.57	0.02	0.64

Supplement S4

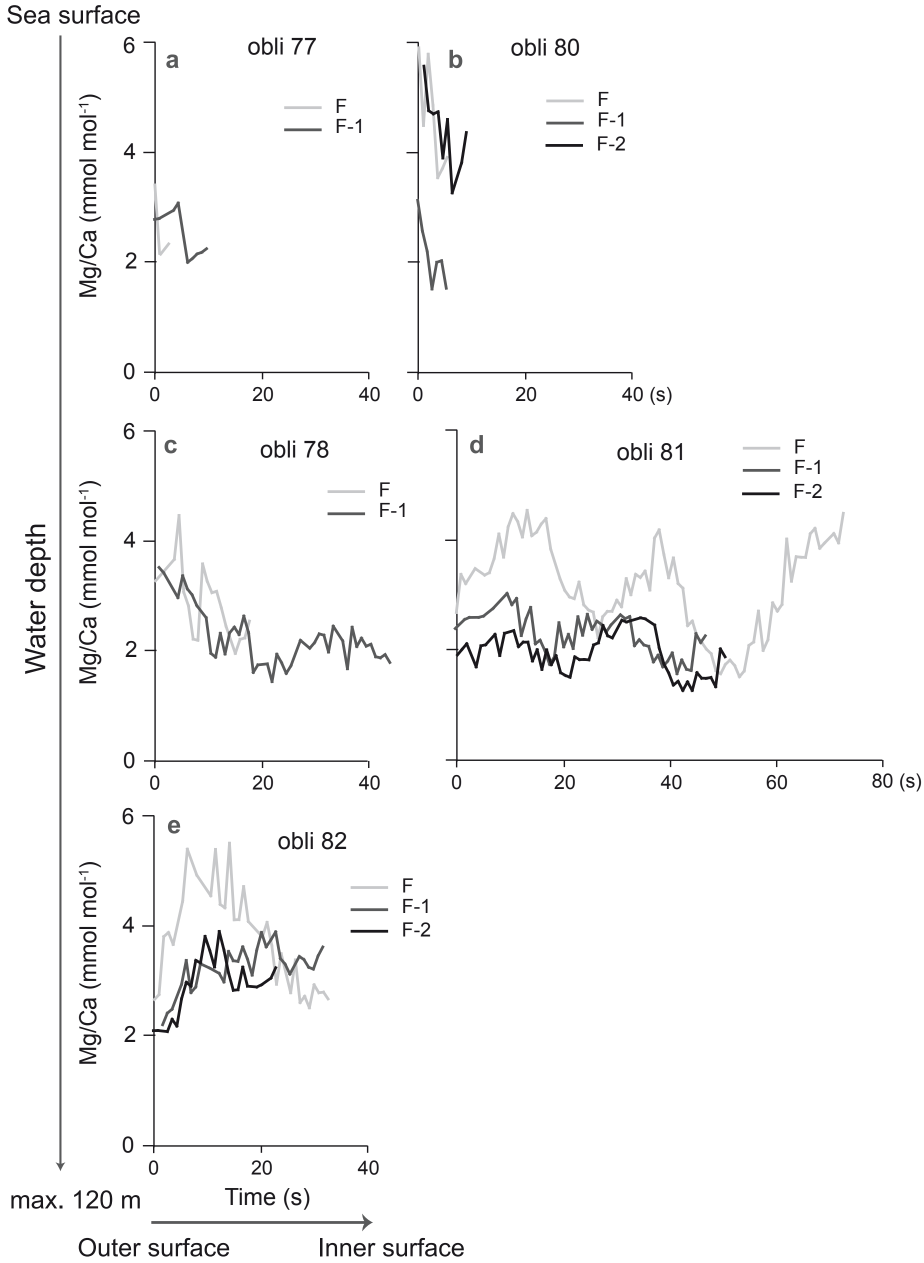


S4 Figure 1**:** Average Mg/Ca values (± standard deviation) of single chambers (F, F-1 and F-2) from 17 specimens of *G. sacculifer*. Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).

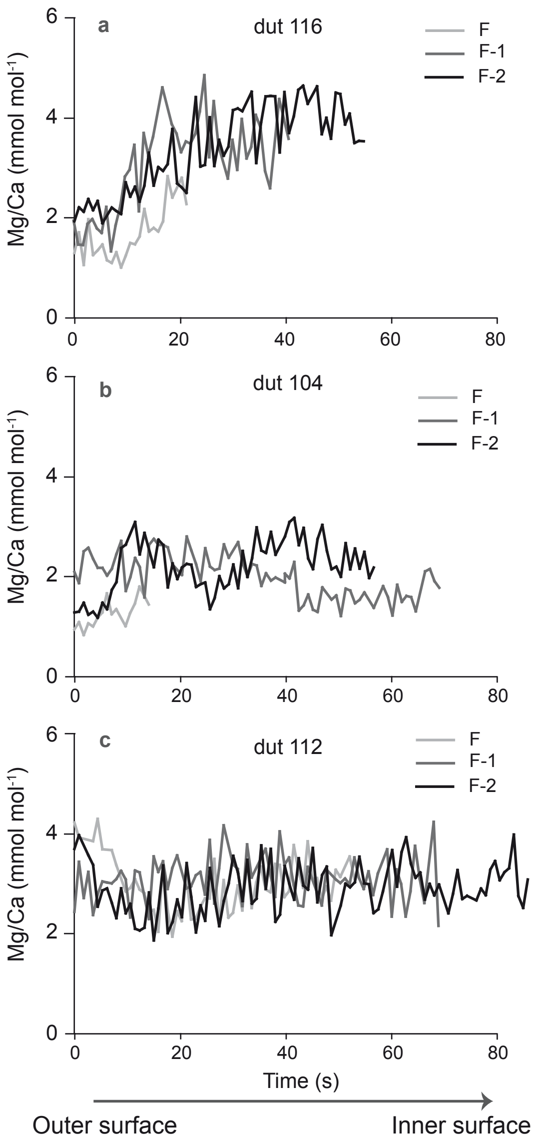
Supplement S4



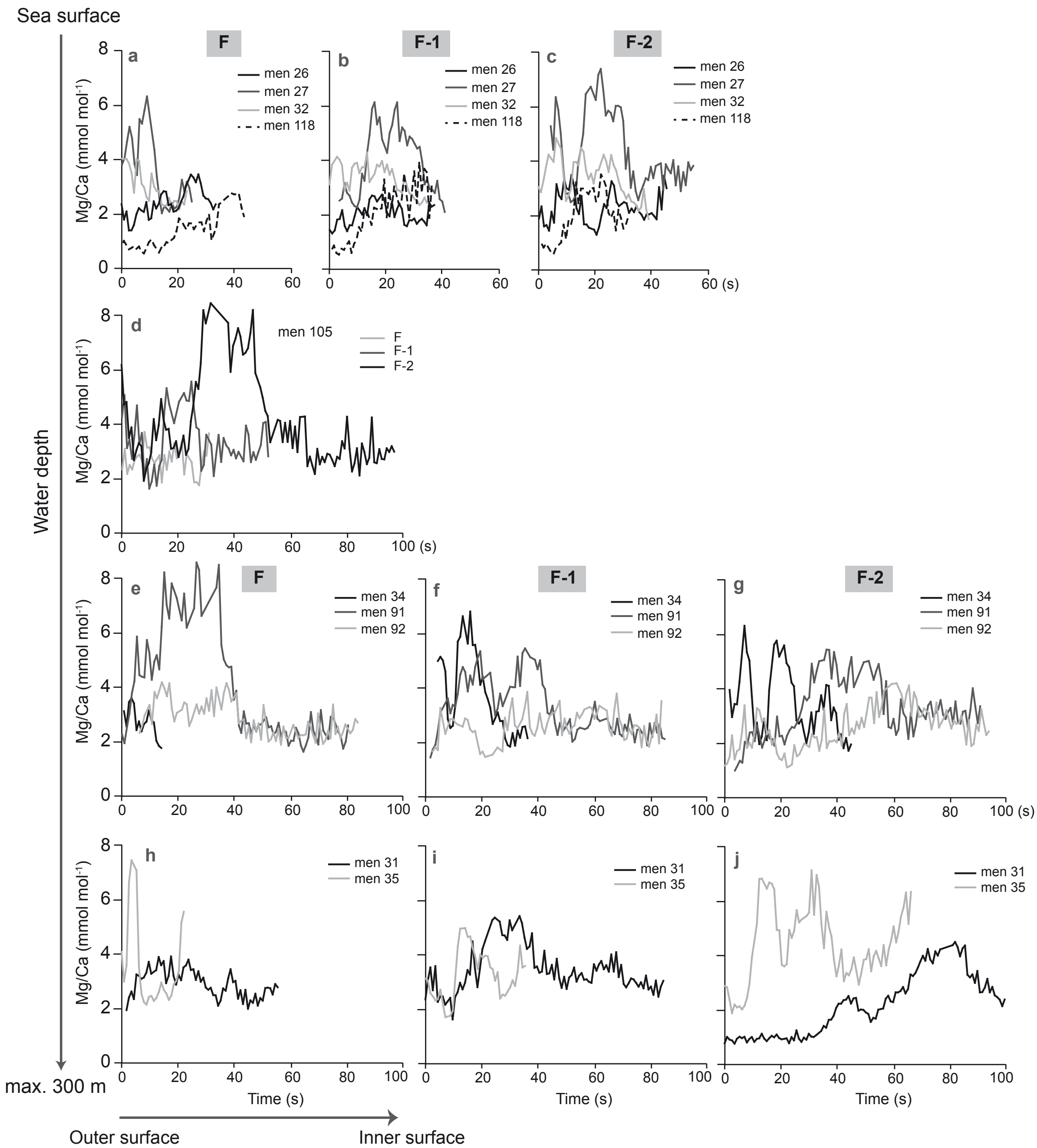
S4 Figure 2**:** Laser ablation ICP-MS profiles of Mg/Ca (average values) through *O. universa*. Spherical chambers were measured three times from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



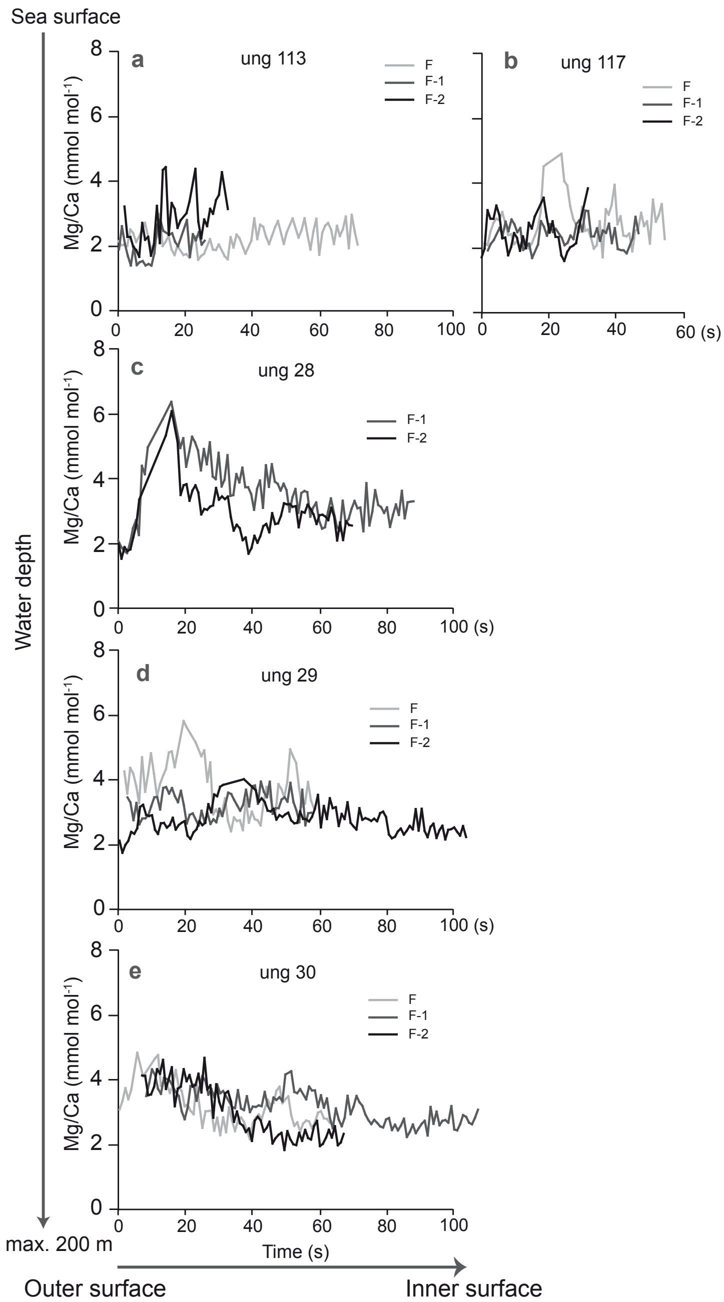
S4 Figure 3**:** Laser ablation ICP-MS profiles of Mg/Ca through *P. obliquiloculata*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



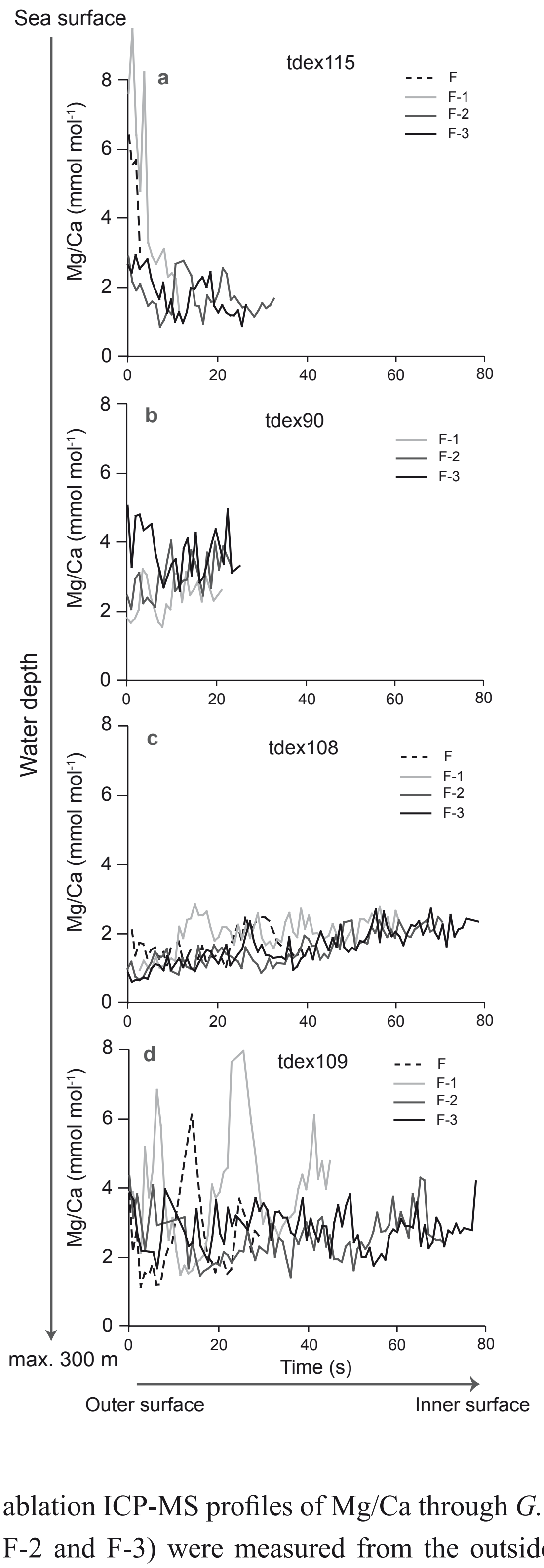
S4 Figure 4**:** Laser ablation ICP-MS profiles of Mg/Ca through *N. dutertrei*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



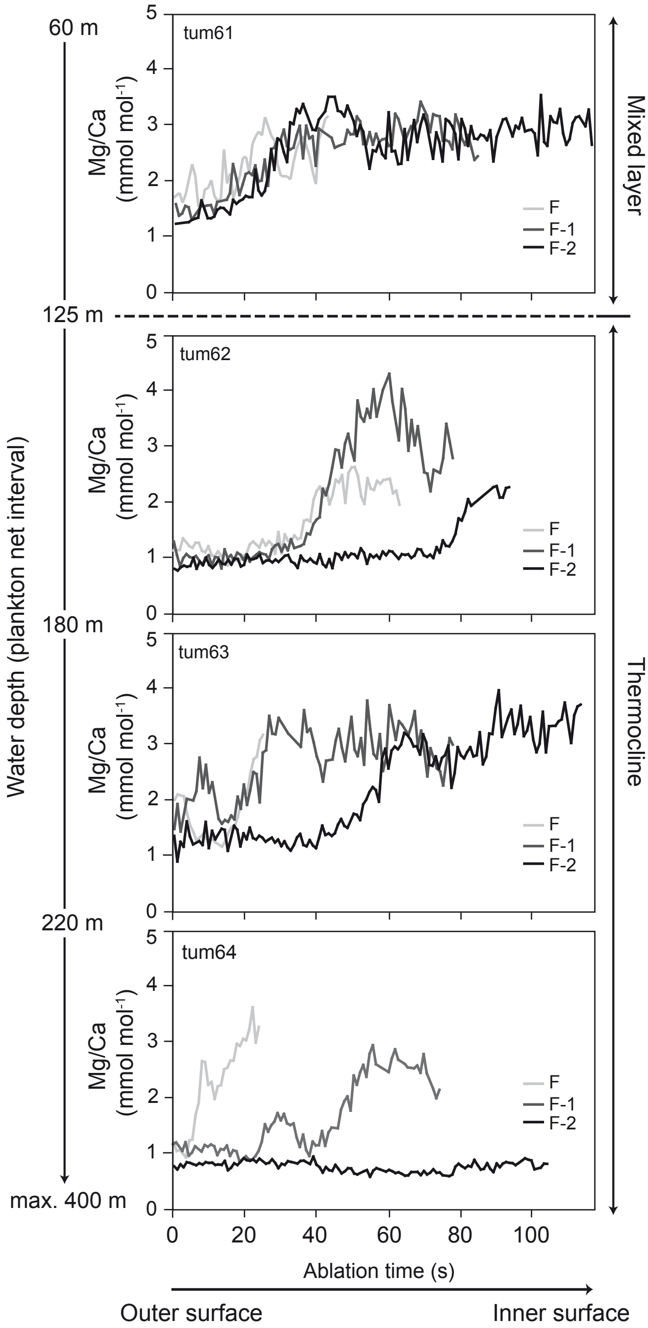
S4 Figure 5**:** Laser ablation ICP-MS profiles of Mg/Ca through *G. menardii*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



S4 Figure 6**:** Laser ablation ICP-MS profiles of Mg/Ca through *G. ungulata*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



S4 Figure 7**:** Laser ablation ICP-MS profiles of Mg/Ca through *G. truncatulinoides* dextral. Single chambers (F, F-1, F-2 and F-3) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



S4 Figure 8**:** Laser ablation ICP-MS profiles of Mg/Ca through *G. tumida*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).

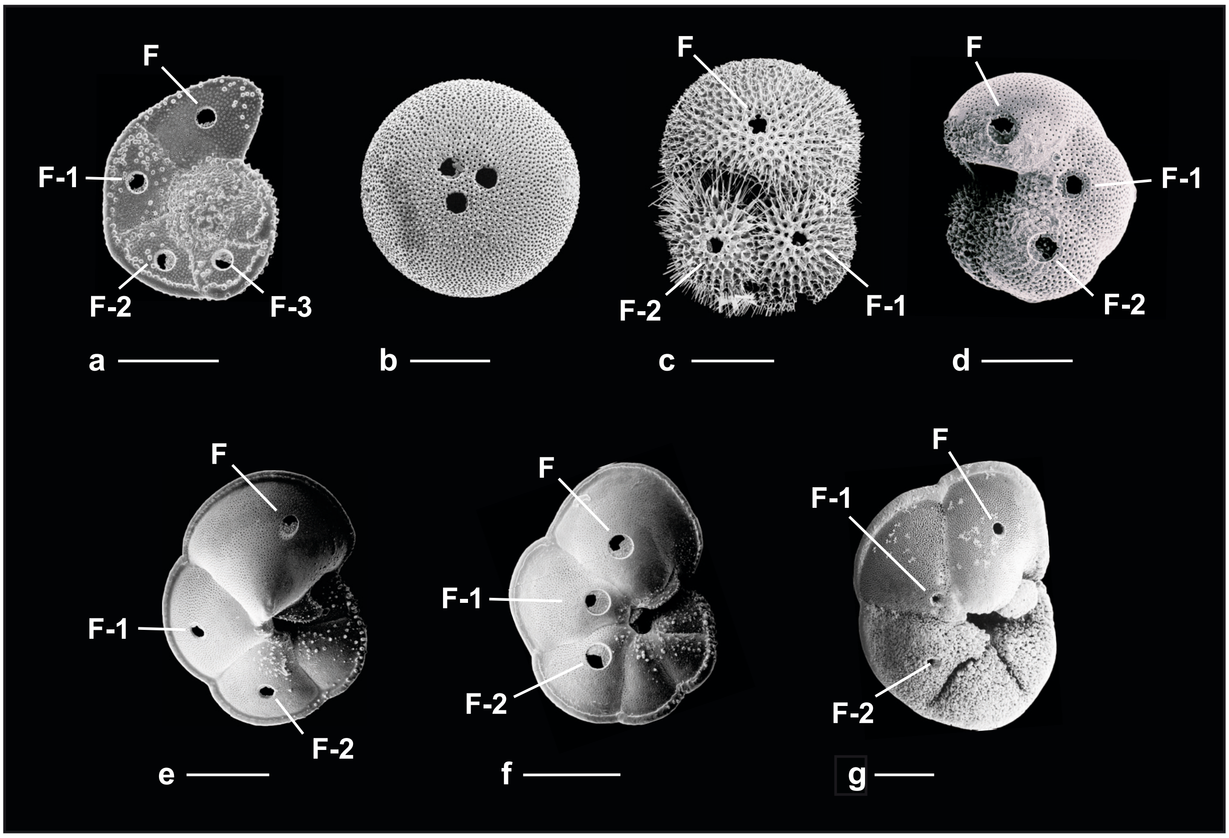


Plate 1: Scanning electron micrographs (SEM)
(a) *G. truncatulinoides* dextral (from station 221-8 in 150–210 m water depth)
(b) *O. universa* (from station 221-8 in 60–150 m water depth)
(c) *G. sacculifer* (from station 211-5 in 0–60 m water depth)
(d) *P. obliquiloculata* (from station 221-7 in 40–60 m water depth)
(e) *G. ungulata* (from station 211-5 in 0–60 m water depth)
(f) *G. menardii* (from station 221-7 in 0–40 m water depth)
(g) *G. tumida* (from station 219-7 in 220–400 m water depth)

Scale: 200 µm; The holes point to the spots from laser ablations in chamber F to F-3.

Supplement References

Anand, P., Elderfield, H., and Conte, M. H.: Calibration of Mg/Ca thermometry in planktonic foraminifera from a sediment trap time series, Paleoceanography, 18, 1050, doi:10.1029/2002PA000846, 2003.

Bemis, B. E., Spero, H. J., Bijma, J., and Lea, D. W.: Reevaluation of the oxygen isotopic composition of planktonic foraminifera: Experimental results and revised paleotemperature equations, Paleoceanography, 13, 150–160, doi:10.1029/98PA00070, 1998.

Bouvier-Soumagnac, Y., and Duplessy, J. C.: Carbon and oxygen isotopic composition of planktonic foraminifera from laboratory culture, plankton tows and Recent sediment: implications for the reconstruction of paleoclimatic conditions and of the global carbon cycle, The Journal of Foraminiferal Research, 15, 302–320, 1985.

Cléroux, C., Cortijo, E., Anand, P., Labeyrie, L., Bassinot, F., Caillon, N., and Duplessy, J.-C.: Mg/Ca and Sr/Ca ratios in planktonic foraminifera: Proxies for upper water column temperature reconstruction, Paleoceanography, 23, PA3214, doi:10.1029/2007PA001505, 2008.

Dekens, P. S., Lea, D. W., Pak, K., and Spero, H. J.: Core top calibration of Mg/Ca in tropical foraminifera: Refining paleotemperature estimation, Geochemistry, Geophysics, Geosystems, 3, doi:10.1029/2001GC000200, 2002.

Elderfield, H., and Ganssen, G.: Past temperature and $\delta^{18}O$ of surface ocean waters inferred from foraminiferal Mg/Ca ratios, Nature, 405, 442–445, 2000.

Erez, J., and Luz, B.: Experimental paleotemperature equation for planktonic foraminifera, Geochimica et Cosmochimica Acta, 47, 1025–1031, 1983.

Farmer, E. C., Kaplan, A., deMenocal, P. B., and Lynch-Stieglitz, J.: Corroborating ecological depth preferences of planktonic foraminifera in the tropical Atlantic with the stable oxygen isotope ratios of core top specimens, Paleoceanography 22, PA3205, doi: 10.1029/2006PA001361, 2007.

Hammer, Ø., Harper, D. A. T., and Ryan, P. D.: PAST: Paleontological statistics software package for education and data analysis, Palaeontologia Electronica 4, p. 9, 2001.

Kim, S.-T., and O´Neil, J. R.: Equilibrium and nonequilibrium oxygen isotope effects in synthetic carbonates, Geochimica et Cosmochimica Acta, 61, 3461–3475, 1997.

Lea, D. W., Mashiotta, T. A., and Spero, H. J.: Controls on magnesium and strontium uptake in planktonic foraminifera determined by live culturing, Geochimica et Cosmochimica Acta, 63, 2369–2379, 1999.

McKenna, V. S., and Prell, W. L.: Calibration of *Globorotalia truncatulinoides* (R) for the reconstruction of marine temperature gradients, Paleoceanography, 19, PA2006, doi:10.1029/2000PA000604, 2004.

Mulitza, S., Boltovskoy, D., Donner, B., Meggers, H., Paul, A., and Wefer, G.: Temperature: $\delta^{18}O$ relationships of planktonic foraminifera collected from surface waters, Palaeogeography, Palaeoclimatology, Palaeoecology, 202, 143–152, 2003.

Nürnberg, D., Bijma, J., and Hemleben, C.: Assessing the reliability of magnesium in foraminiferal calcite as a proxy for water mass temperatures, Geochimica et Cosmochimica Acta, 60, 803–814, 1996.

Nürnberg, D., Müller, A., and Schneider, R. R.: Paleo-sea surface temperature calculations in the equatorial east Atlantic from Mg/Ca ratios in planktic foraminifera: A comparison to sea surface temperature estimates from U_{37}^{K}, oxygen isotopes, and foraminiferal transfer function, Paleoceanography, 15, 124–134, doi:10.1029/1999PA000370, 2000.

Regenberg, M., Nürnberg, D., Steph, S., Groeneveld, J., Garbe-Schönberg, D., Tiedemann, R., and Dullo, W. C.: Assessing the effect of dissolution on planktonic foraminiferal Mg/Ca ratios: Evidence from Caribbean core tops, Geochemistry, Geophysics, Geosystems 7, Q07P15, doi:10.1029/2005GC001019, 2006.

Regenberg, M., Steph, S., Nürnberg, D., Tiedemann, R., and Garbe-Schönberg, D.: Calibrating Mg/Ca ratios of multiple planktonic foraminiferal species with δ18O-calcification temperatures: Paleothermometry for the upper water column, Earth and Planetary Science Letters, 278, 324–336, 2009.

Russel, A. D., Hönisch, B., Spero, H. J., and Lea, D. W.: Effects of seawater carbonate ion concentration and temperature on shell U, Mg, and Sr in cultured planktonic foraminifera, Geochimica et Cosmochimica Acta, 68, 4347–4361, 2004.

Schönfeld, J., Bahr, A., Bannert, B., Bayer, A. S., Bayer, M., Beer, C., Blanz, T., Dullo, W. C., Flögel, S., Garlichs, T., Haley, B., Hübscher, C., Joseph, N., Kučera, M., Langenbacher, J., Nürnberg, D., Ochsenhirt, W. T., Petersen, A., Pulm, P., Titschack, J., and Troccoli, L.: Surface and Intermediate water hydrography, planktonic and benthic biota in the Caribbean Sea - Climate, Bio and Geosphere linkages (OPOKA), Cruise No. 78, Leg 1, February 22 - March 28, 2009, Colón (Panama) - Port of Spain (Trinidad and Tobago), METEOR-Berichte, 1–196, 2011.

Shackleton, N. J.: Attainment of isotopic equilibrium between ocean water and the benthonic foraminifera genus Uvigerina: Isotopic changes in the ocean during the last glacial, Colloques Internationaux du C.N.R.S. 219, 203–209, 1974.

Spero, H. J., Mielke, K. M., Kalve, E. M., Lea, D. W., and Pak, D. K.: Multispecies approach to reconstructing eastern equatorial Pacific thermocline hydrography during the past 360 kyr, Paleoceanography, 18, 1022, doi:10.1029/2002PA000814, 2003.

Steph, S., Regenberg, M., Tiedemann, R., Mulitza, S., and Nürnberg, D.: Stable isotopes of planktonic foraminifera from tropical Atlantic/Caribbean core-tops: Implications for reconstructing upper ocean stratification, Marine Micropaleontology, 71, 1–19, 2009.