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

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)
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	

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)
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

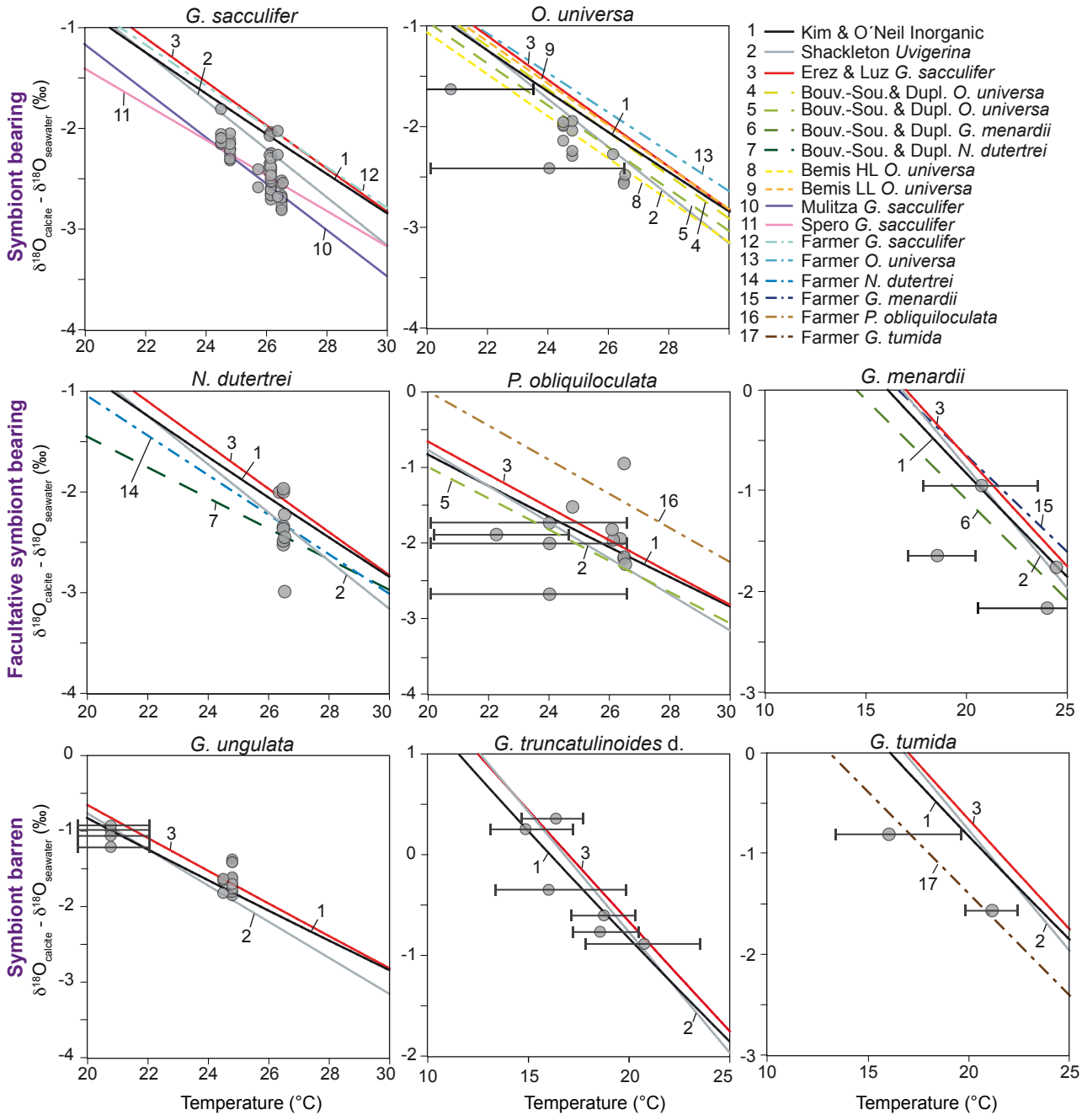
S1 Table 3**:** Stable isotope values in seawater ($\delta^{18}O_{seawater}$), measured temperature (°C) and salinity (psu) during RV *Meteor* cruise M78/1 (Schönfeld et al., 2011, by courtesy of C. Dullo and S. Flögel).

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

Supplement S1

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

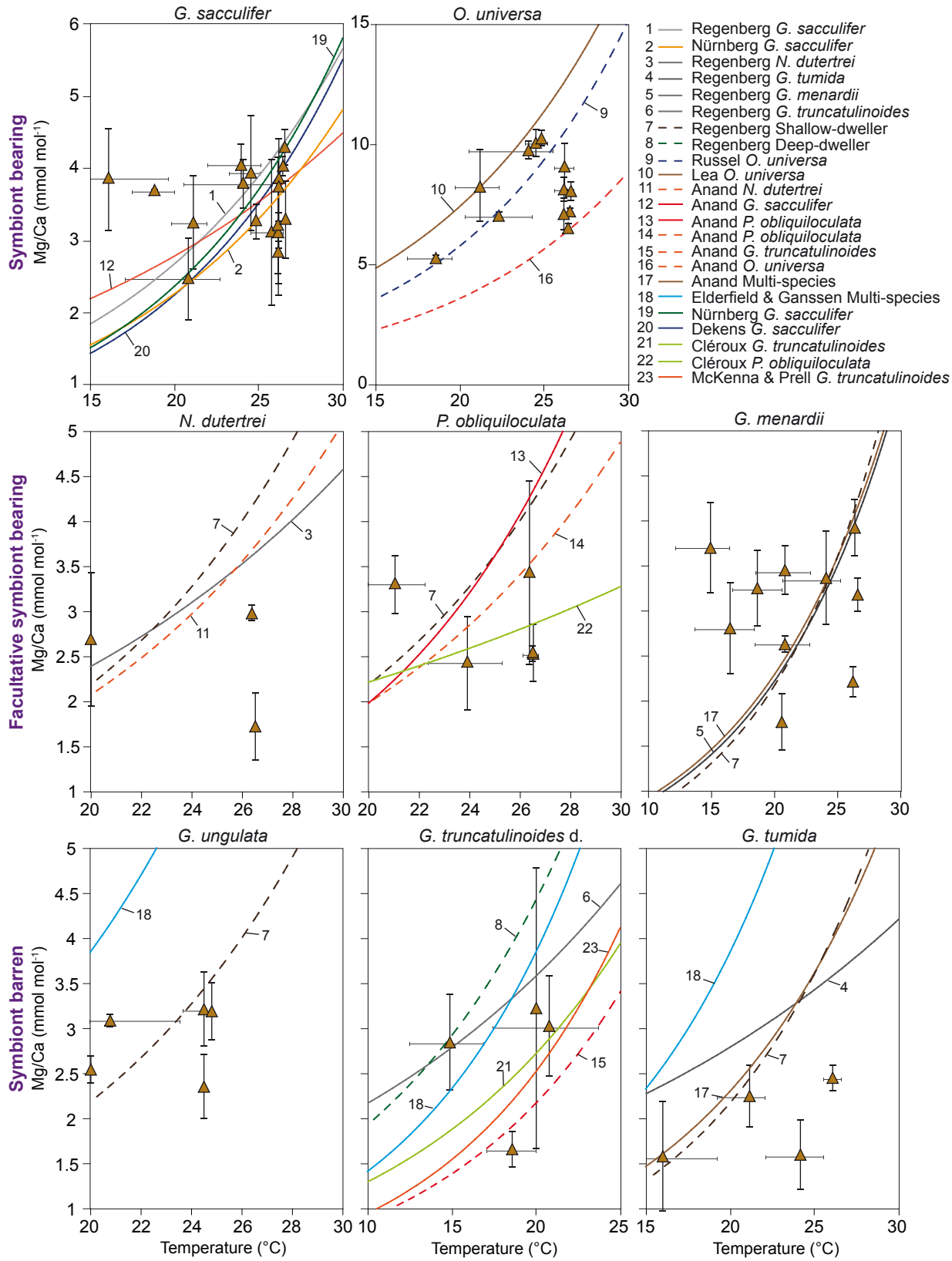


S2 Figure 1**:** Assessment of existing $\delta^{18}O$-paleotemperature relationships. Grey dots: Difference between the measured $\delta^{18}O_{calcite}$ and the measured $\delta^{18}O_{seawater}$, depicted at the average in situ temperature of the plankton net intervals measured during cruise M78/1. 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 V-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 V-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



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) and temperature ranges of the sampling intervals, respectively. The various published Mg/Ca calibration curves are colour-coded and labelled by numbers (cf. Supplement S2 Table 2).

Supplement S2

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*.

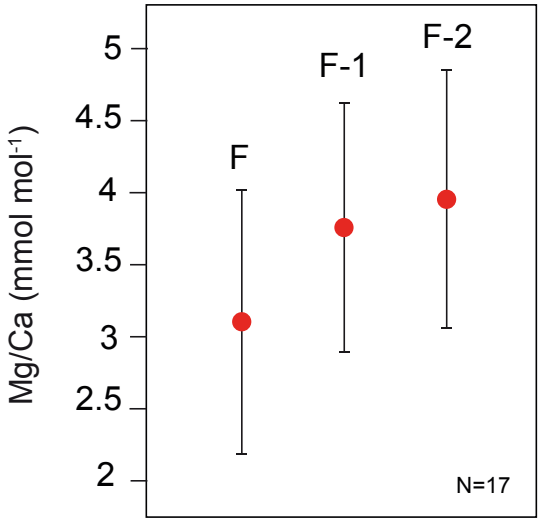
Mg/Ca = **b** * exp(**a** * T)						
Nr.	Reference	Species		Material/Method	**b**	**a**
1	Regenberg et al. 2009	*G. sacculifer*	A	Surface sediment/ICP-OES	0.596	0.075
2	Nürnberg et al. 2000	*G. sacculifer*		ICP-OES	0.491	0.076
3	Regenberg et al. 2009	*N. dutertrei*	C	Surface sediment/ICP-OES	0.65	0.065
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

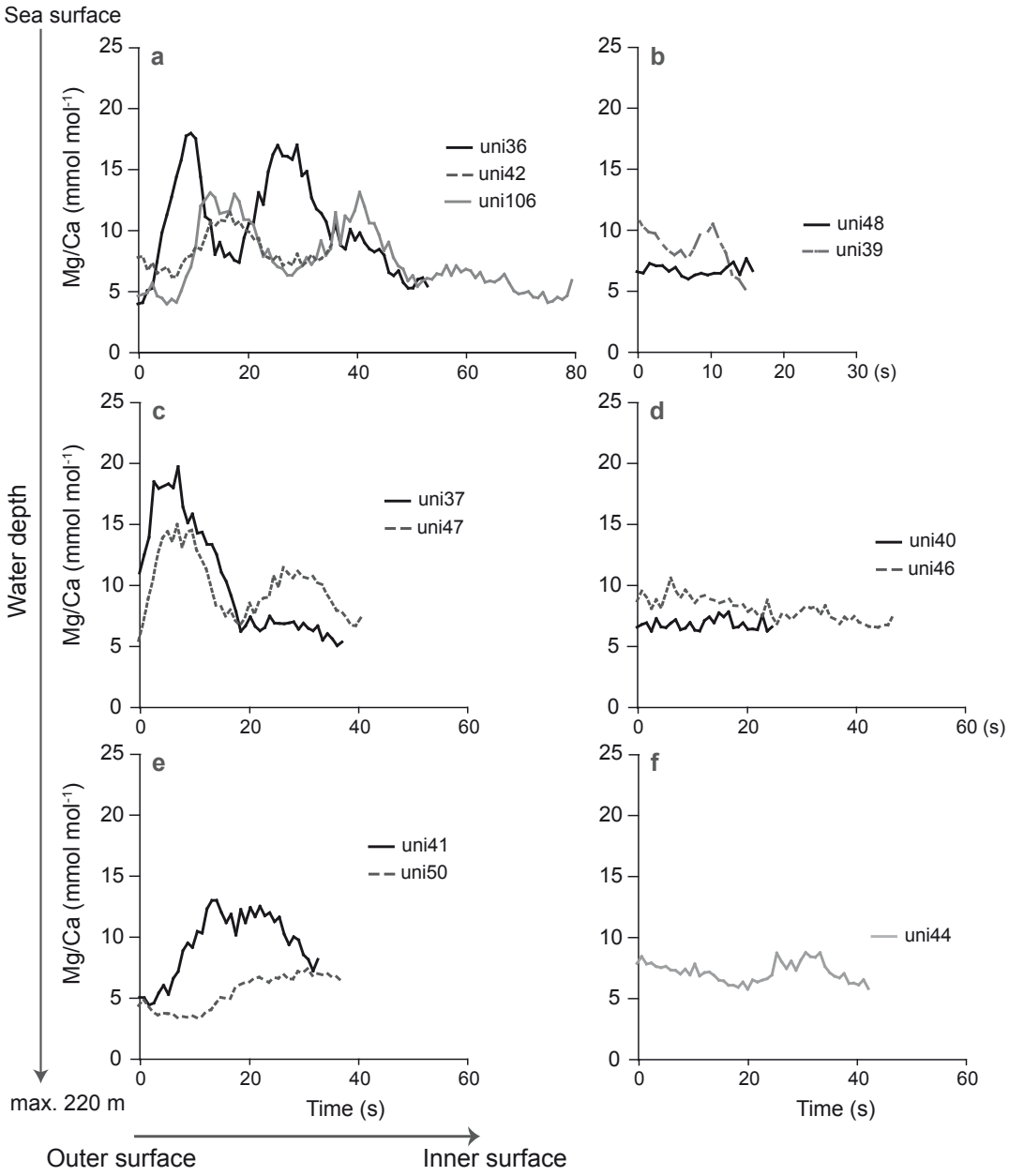
S3 Table 1**:** Spearman rank correlation obtained from PAST (Hammer et al., 2001).

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

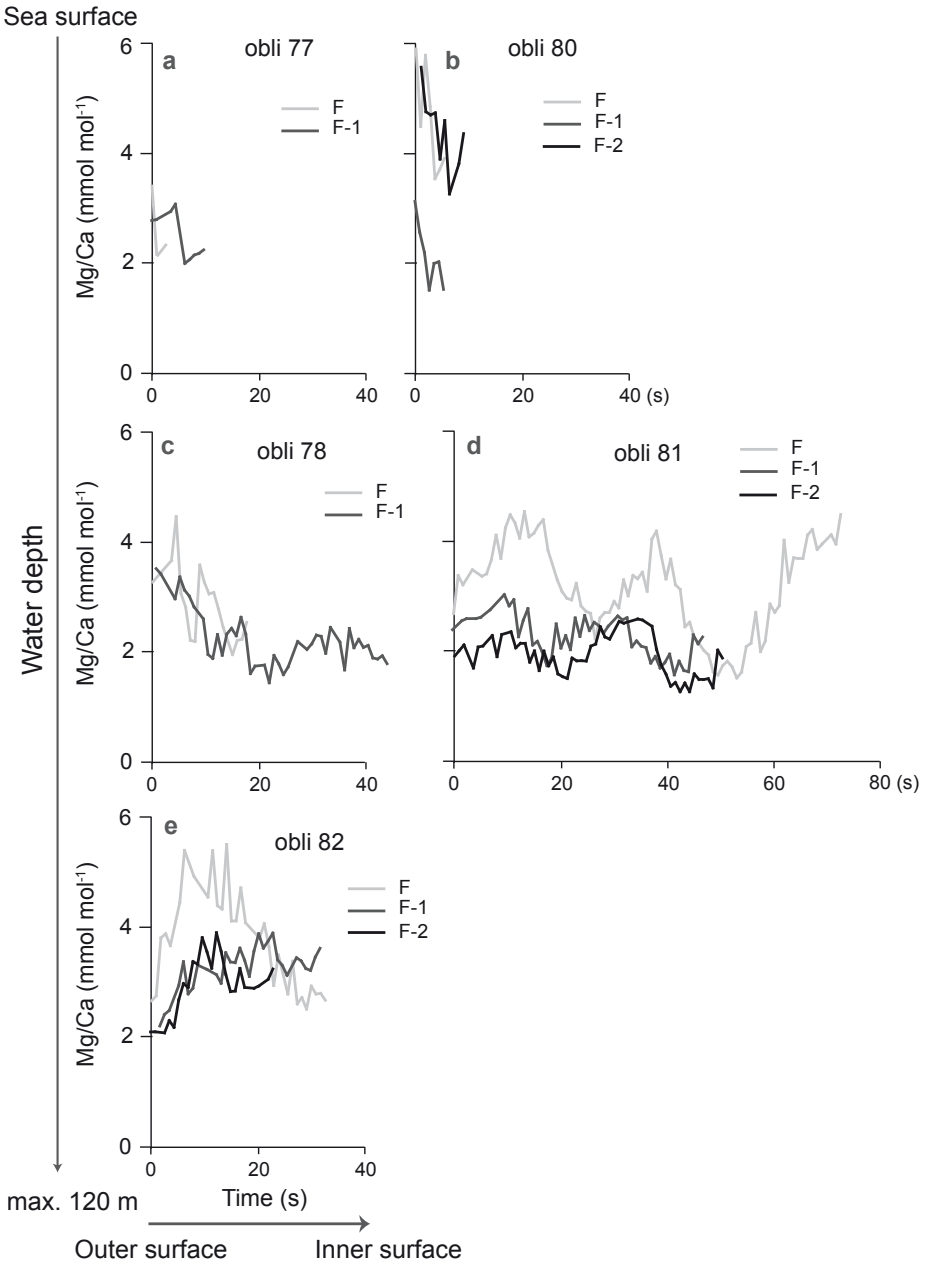
Supplement S4



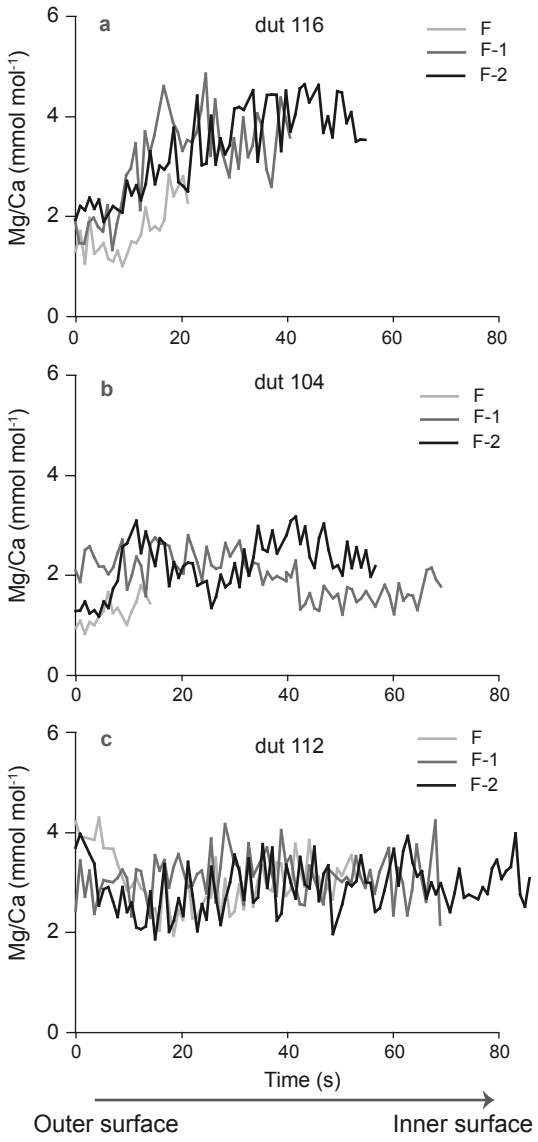
S4 Figure 1**:** Average Mg/Ca values (± standard deviation) of single chambers (F, F-1 and F-2) from 17 specimens of *G. sacculifer*. Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



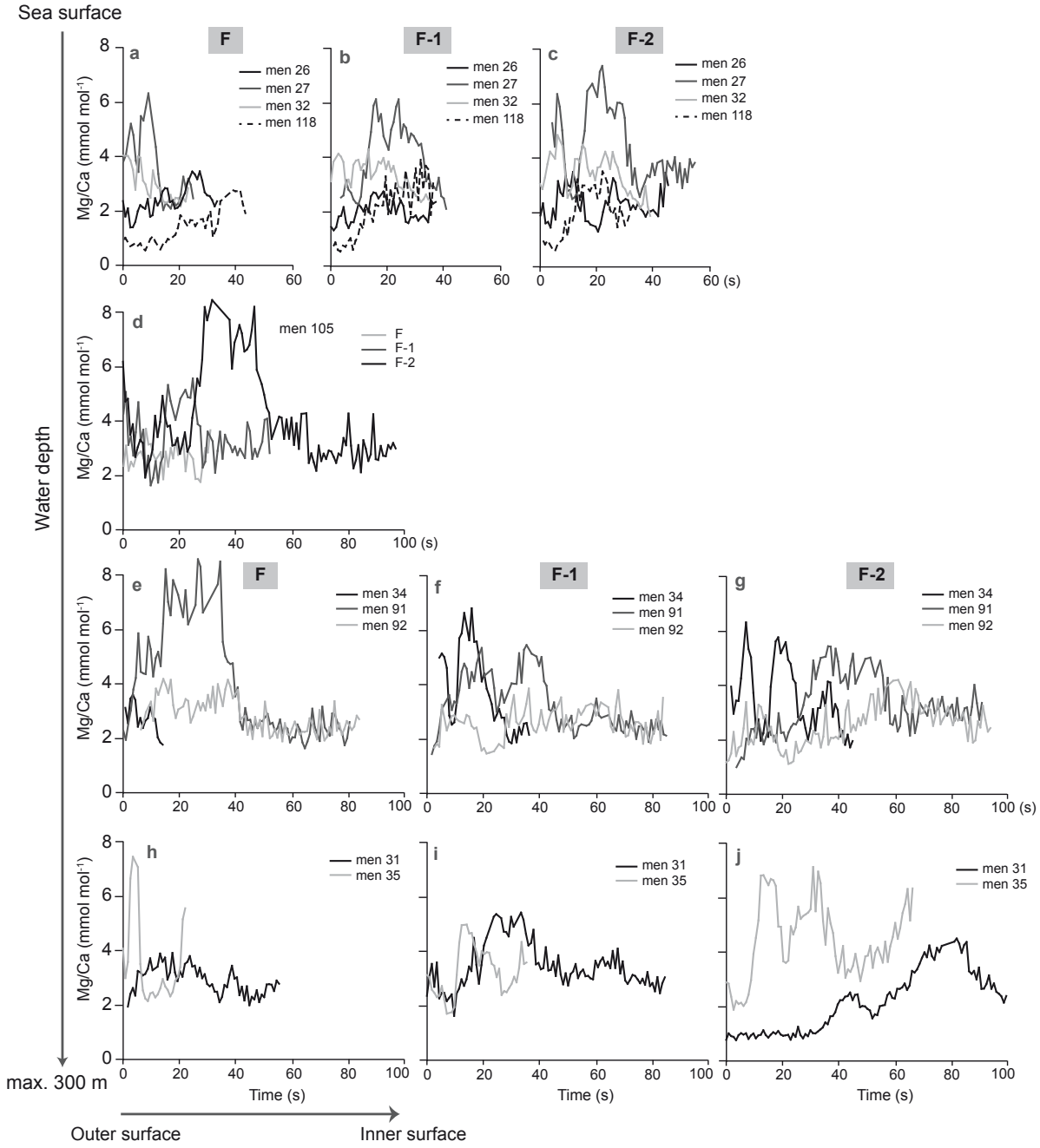
S4 Figure 2**:** Laser ablation ICP-MS profiles of Mg/Ca (average values) through *O. universa*. Spherical chambers were measured three times from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement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



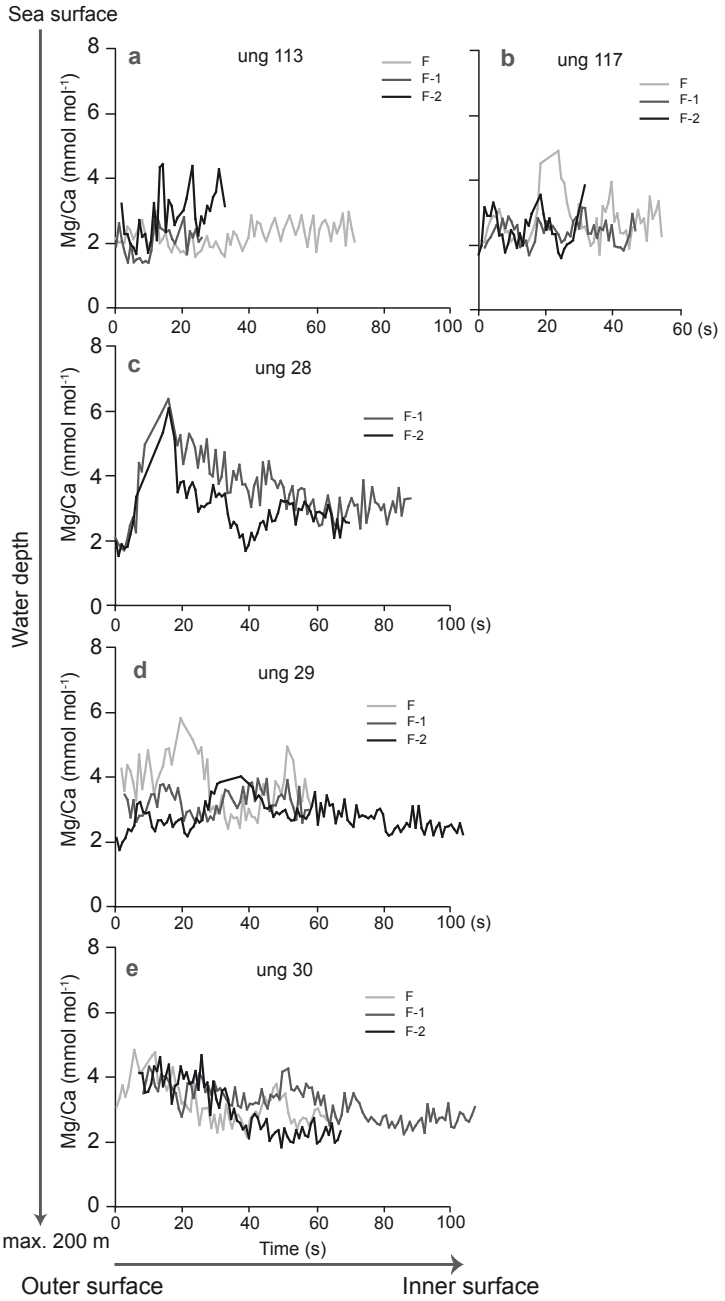
S4 Figure 3**:** Laser ablation ICP-MS profiles of Mg/Ca through *P. obliquiloculata*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



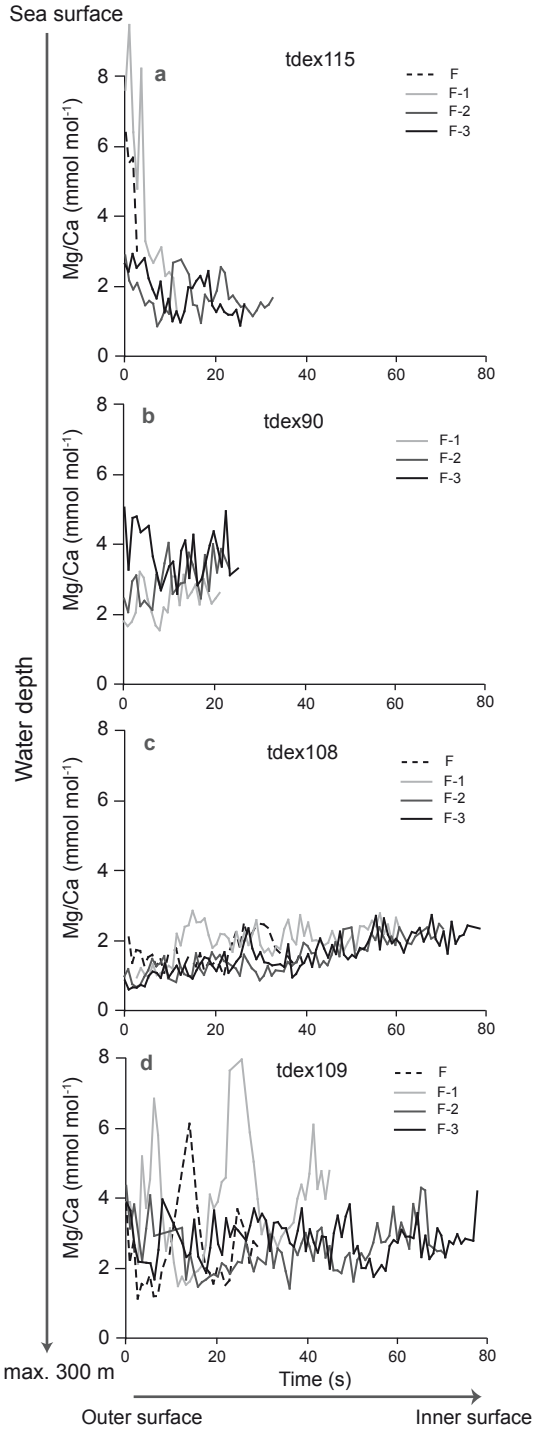
S4 Figure 4**:** Laser ablation ICP-MS profiles of Mg/Ca through *N. dutertrei*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



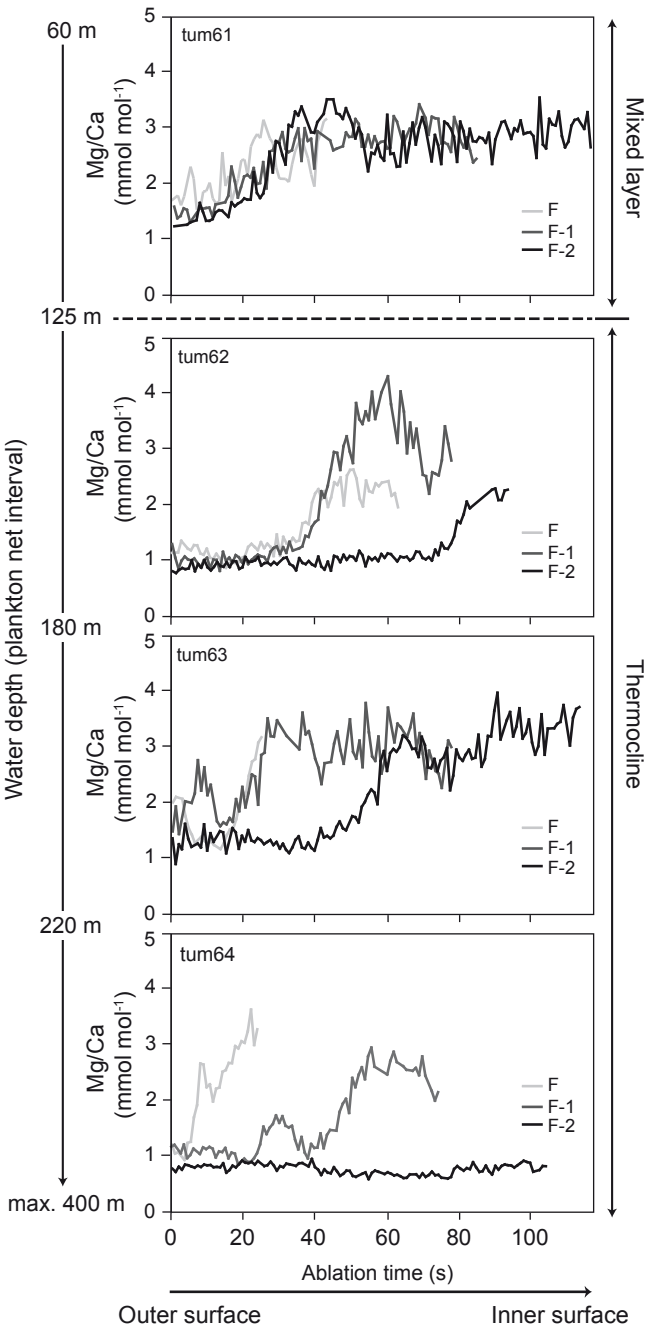
S4 Figure 5**:** Laser ablation ICP-MS profiles of Mg/Ca through *G. menardii*. Single chambers (F, F-1 and F-2) were measured from the outside of the tests toward the inside (left to right). Single individuals were collected at different stations and water depth intervals (cf. Supplement S1).



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).

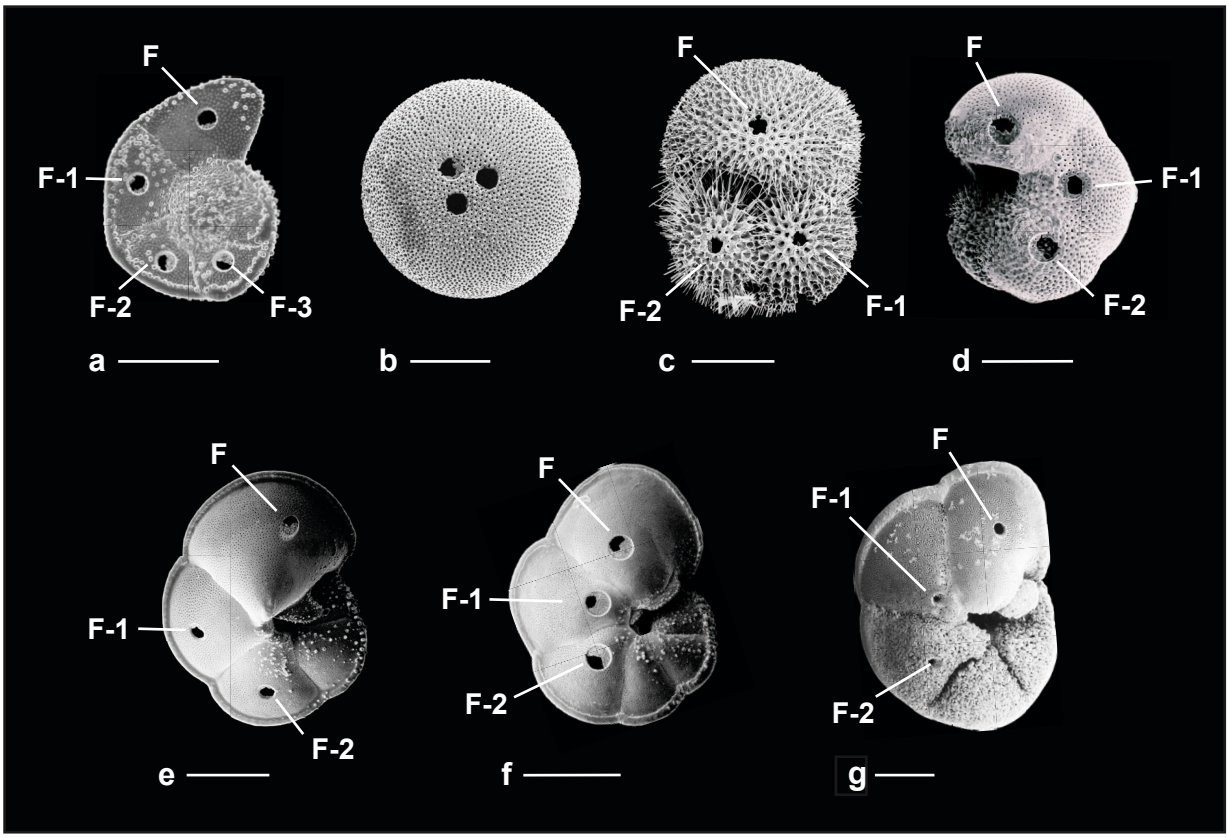
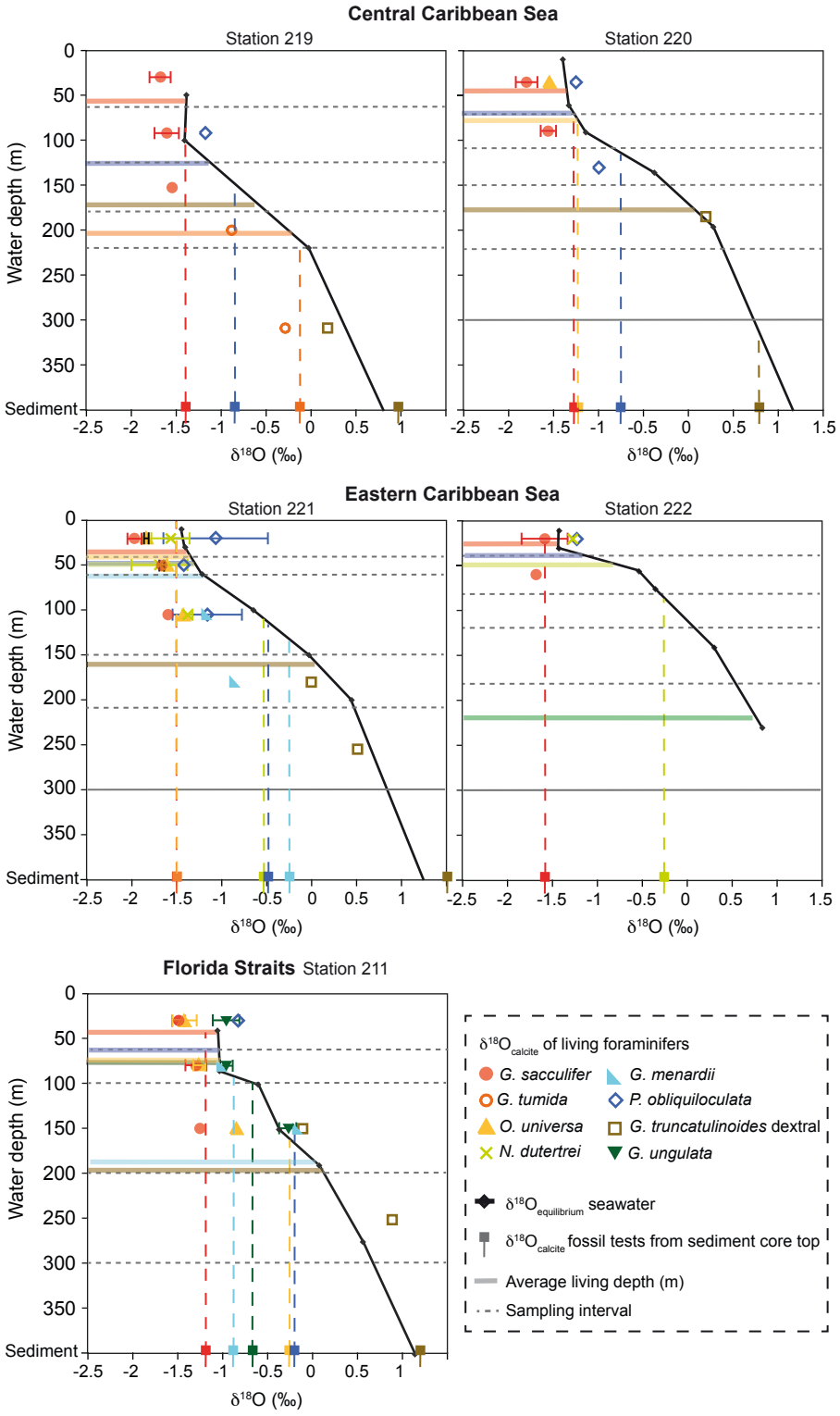
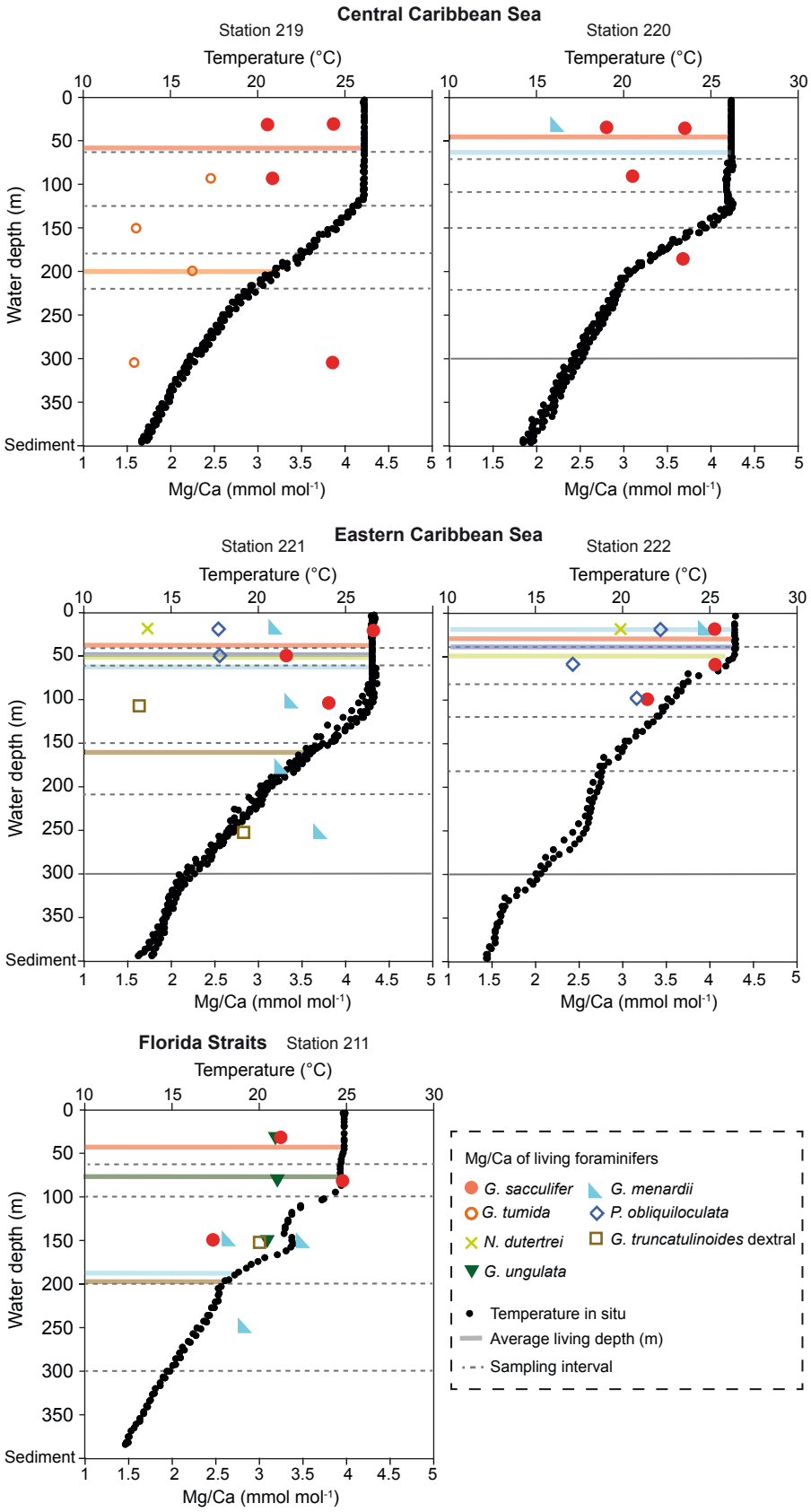


Plate 1: Scanning electron micrographs (SEM)
(a) *G. truncatulinoides* dextral (from station 221-8 in 150–210 m water depth)
(b) *O. universa* (from station 221-8 in 60–150 m water depth)
(c) *G. sacculifer* (from station 211-5 in 0–60 m water depth)
(d) *P. obliquiloculata* (from station 221-7 in 40–60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



S6 Figure 1**:** Average stable oxygen isotopes of living planktic foraminifers and fossil tests. Living foraminiferal $\delta^{18}O_{calcite}$ samples are plotted at the mean sampling depth interval. Coloured bars indicate the average weighted living depth for each species (see Jentzen et al., 2018). Black lines: $\delta^{18}O_{equilibrium}$ of the ambient seawater.



S6 Figure 2**:** Average Mg/Ca values (±standard deviations) of LA-ICP-MS measurements of single tests plotted at the mean sampling depth interval. Coloured bars indicate the average weighted living depth for each species (see Jentzen et al., 2018). Black lines: Temperature of the ambient seawater.

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