



Supplement of

Decoupled carbonate chemistry controls on the incorporation of boron into *Orbulina universa*

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Supplementary Table 1: Individual *Orbulina universa* $\delta^{11}\text{B}$ displayed with boron isotopic composition of the seawater medium and seawater chemistry.

CO_3^{2-} ($\mu\text{mol kg}^{-1}$)	pH _T	HCO_3^- ($\mu\text{mol kg}^{-1}$)	Isotopic composition H_2O	$\delta^{11}\text{B}$ (‰)
285	8.05	2371	37.63	21.16
285	8.05	2371	37.63	20.97
285	8.05	2371	37.63	21.00
285	8.05	2371	37.63	21.18
285	8.05	2371	37.63	17.94
285	8.05	2371	4.98	18.32
285	8.05	2371	4.98	19.03
285	8.05	2371	4.98	20.30
285	8.05	2371	4.98	20.57
285	8.05	2371	4.98	19.10
285	8.05	2371	4.98	19.62
285	8.05	2371	4.98	19.10
285	8.05	2371	4.98	19.62
238	8.05	1981	4.98	19.22
238	8.05	1981	4.98	19.98
238	8.05	1981	4.98	17.54
238	8.05	1981	4.98	18.07
238	8.05	1981	4.98	17.50
238	8.05	1981	5.35	17.81
238	8.05	1981	5.35	18.18
238	8.05	1981	5.35	17.79
238	8.05	1981	5.35	21.31
610	8.05	5069	5.35	19.49
610	8.05	5069	5.35	19.02
610	8.05	5069	5.35	19.88
610	8.05	5069	5.35	18.64
610	8.05	5069	5.35	23.10
610	8.05	5069	4.2	19.96
610	8.05	5069	4.2	22.57
610	8.05	5069	4.2	22.96
610	8.05	5069	4.2	21.33
610	8.05	5069	4.2	22.32
610	8.05	5069	4.2	22.42
610	8.05	5069	4.2	17.75
296	7.9	3478	4.2	17.19
296	7.9	3478	4.2	16.55
296	7.9	3478	4.2	16.58
296	7.9	3478	4.2	15.82
296	7.9	3478	4.2	17.42

296	7.9	3478	4.11	15.98
296	7.9	3478	4.11	16.80
296	7.9	3478	4.11	15.80
296	7.9	3478	4.11	18.02
296	7.9	3478	4.11	18.56
296	7.9	3478	4.11	18.66
296	7.9	3478	4.11	18.58
296	7.9	3478	4.11	20.35
296	7.9	3478	4.11	16.19
296	7.9	3478	4.11	18.80
296	7.9	3478	4.11	18.67
296	7.9	3478	4.11	18.79
296	7.9	3478	4.11	18.55
258	7.7	4791	4.11	15.86
258	7.7	4791	4.11	15.74
258	7.7	4791	4.11	16.71
258	7.7	4791	4.11	15.38
258	7.7	4791	4.11	16.04
258	7.7	4791	4.69	14.72
258	7.7	4791	4.69	13.59
258	7.7	4791	4.69	11.86
258	7.7	4791	4.69	14.80
258	7.7	4791	4.69	15.99
258	7.7	4791	4.69	17.04
258	7.7	4791	4.69	16.91
258	7.7	4791	4.69	17.91
258	7.7	4791	4.69	16.78
258	7.7	4791	4.69	15.76
258	7.7	4791	4.69	17.91
258	7.7	4791	4.69	16.78
258	7.7	4791	4.69	15.76

Supplementary Table 2: Individual *Orbulina universa* B/Ca values displayed with seawater chemistry.

CO_3^{2-} ($\mu\text{mol kg}^{-1}$)	pH _T	HCO_3^- ($\mu\text{mol kg}^{-1}$)	B/Ca
239	8.05	1984	1.63
239	8.05	1984	1.66
239	8.05	1984	1.45
239	8.05	1984	1.43
239	8.05	1984	1.63
239	8.05	1984	1.14
239	8.05	1984	1.89
239	8.05	1984	1.77
239	8.05	1984	1.54
239	8.05	1984	0.16
239	8.05	1984	1.60
239	8.05	1984	1.73
239	8.05	1984	1.14
239	8.05	1984	1.30
239	8.05	1984	2.19
239	8.05	1984	1.25
239	8.05	1984	1.54
239	8.05	1984	2.16
239	8.05	1984	1.75
239	8.05	1984	1.42
239	8.05	1984	1.57
239	8.05	1984	1.21
239	8.05	1984	1.56
239	8.05	1984	1.19
239	8.05	1984	1.31
239	8.05	1984	1.45
285	8.05	2374	1.00
285	8.05	2374	1.07
285	8.05	2374	1.10
285	8.05	2374	1.10
285	8.05	2374	1.21
285	8.05	2374	1.25
285	8.05	2374	1.30
285	8.05	2374	1.32
285	8.05	2374	1.36
285	8.05	2374	1.36
285	8.05	2374	1.52
285	8.05	2374	1.56
285	8.05	2374	1.73

285	8.05	2374	1.09
285	8.05	2374	1.22
285	8.05	2374	0.82
285	8.05	2374	1.07
237	8.05	1968	0.13
237	8.05	1968	0.12
237	8.05	1968	0.10
237	8.05	1968	0.10
237	8.05	1968	0.11
534	8.05	4424	0.84
534	8.05	4424	0.90
534	8.05	4424	0.84
534	8.05	4424	0.98
534	8.05	4424	0.99
534	8.05	4424	1.10
534	8.05	4424	0.90
534	8.05	4424	0.86
534	8.05	4424	0.74
534	8.05	4424	0.92
534	8.05	4424	0.97
534	8.05	4424	0.46
534	8.05	4424	0.45
534	8.05	4424	0.93
534	8.05	4424	0.66
534	8.05	4424	0.78
534	8.05	4424	0.55
534	8.05	4424	0.62
534	8.05	4424	0.60
534	8.05	4424	0.60
534	8.05	4424	0.82
534	8.05	4424	0.64
534	8.05	4424	0.64
534	8.05	4424	0.71
534	8.05	4424	0.65
534	8.05	4424	0.79
296	7.9	3481	0.91
296	7.9	3481	0.77
296	7.9	3481	0.86
296	7.9	3481	0.97
296	7.9	3481	1.20
296	7.9	3481	1.34
296	7.9	3481	0.87
296	7.9	3481	0.85
296	7.9	3481	1.03
296	7.9	3481	0.76

296	7.9	3481	0.67
296	7.9	3481	0.92
296	7.9	3481	0.80
296	7.9	3481	0.85
258	7.7	4793	0.70
258	7.7	4793	0.53
258	7.7	4793	0.80
258	7.7	4793	0.72
258	7.7	4793	0.86
258	7.7	4793	0.72
258	7.7	4793	0.64
258	7.7	4793	0.62
258	7.7	4793	1.10
258	7.7	4793	0.67
258	7.7	4793	0.57
258	7.7	4793	0.52
258	7.7	4793	0.62
258	7.7	4793	0.53

Supplementary Table 3: p-Values of the ANOVA using a Bonferroni test to verify significance of the mean $\delta^{11}\text{B}$ difference between the three $[\text{CO}_3^{2-}]$ treatments. Only the treatments 239 and 534 $\mu\text{mol/kg}$ are significantly different (in bold). The overall ANOVA p-value is 0.00203.

$[\text{CO}_3^{2-}]$	239	286	534
239	-	0.05599	0.00144
286	0.05599	-	0.31894
534	0.00144	0.31894	-

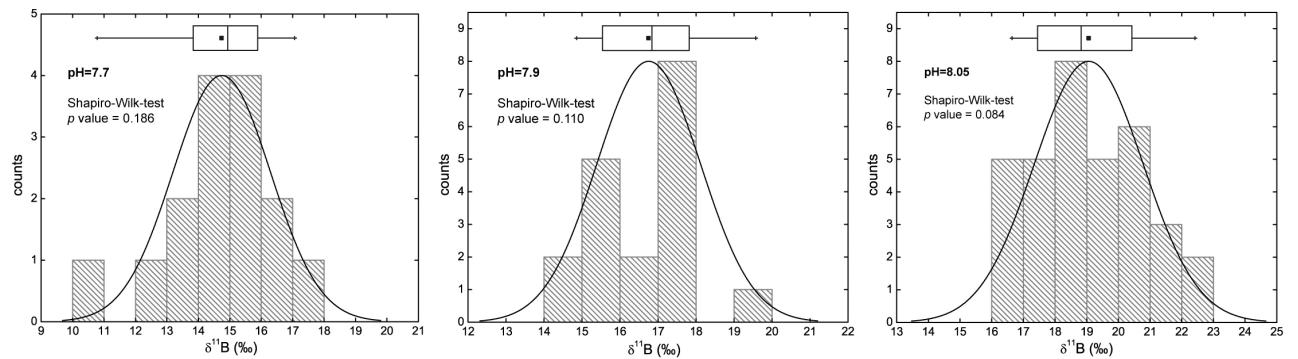
Supplementary Table 4: Error propagation of the uncertainty in the final $\delta^{11}\text{B}$ of *O. universa* stemming from the LA analysis of the shells and the culture water analysis using: $2SE_{O.universa}(\%) = \sqrt{(2SE_{calcite})^2 + (2SE_{seawater})^2}$

pH	CO_3^{2-}	2SE sw	2SE calcite	2SE propagated
8,05	239	0,53	1	1,13
8,05	286	0,85	0,7	1,10
8,05	534	1,03	1,1	1,51
7,9	297	0,94	0,7	1,17
7,7	258	2,4	0,8	2,53

Supplementary Table 5: Individual and averaged measurements of $\delta^{11}\text{B}$ in the culture waters for each treatment.

pH	$[\text{CO}_3^{2-}]$	$\delta^{11}\text{B}$ water	Average $\delta^{11}\text{B}$ of treatment water	Standard deviation
8.05	285.6	4.23	4.98	0.85
8.05	285.6	5.98		
8.05	285.6	4.31		
8.05	285.6	5.40		
8.05	238.7	5.77	5.35	0.53
8.05	238.7	4.75		
8.05	238.7	5.52		
8.05	533.9	5.97	4.20	1.03
8.05	533.9	3.69		
8.05	533.9	3.42		
8.05	533.9	4.24		
8.05	533.9	3.68		
7.9	296.6	4.11	4.11	0.95
7.9	296.6	3.00		
7.9	296.6	4.02		
7.9	296.6	5.31		
7.7	257.8	4.78	4.69	2.41
7.7	257.8	5.30		
7.7	257.8	4.00		

Supplementary Fig. 1: Histograms of single-foram $\delta^{11}\text{B}$ measurements for each pH treatment. The p values from Shapiro-Wilk-tests are all higher than 0.05 and hence approve a normal distribution for all treatments. The box plots also suggest a normal distribution of laser ablation analyses, with averages (black squares) very close to the medians (bars within boxes).



Supplementary Fig. 2: (A) B/Ca ($\mu\text{mol/mol}$) vs. $\delta^{11}\text{B}$ per treatment. Each data point corresponds to paired data from one specimen. (B) Mean values for each of the treatments. $[\text{CO}_3^{2-}]$ in μmol .

