



*Supplement of*

## **Particle fluxes by subtropical pelagic communities under ocean alkalinity enhancement**

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## Supplementary Material

### Supplementary Tables

**Table S1** | Carbonate Chemistry Parameters of Day 7 in all OAE levels, calculated by CO2SYS (Pierrot et al., 2011) corrected for water-column averaged temperature and salinity. Carbonate dissociation constants (K1 and K2) from Lueker et al (2000) were chosen. pH is on total scale and calculated from hydrogen ion concentrations in mol kg<sup>-1</sup>.

OAE	TA ( $\mu\text{mol kg}^{-1}$ )	DIC ( $\mu\text{mol kg}^{-1}$ )	pH <sub>T</sub>	pCO <sub>2</sub> ( $\mu\text{atm}$ )	HCO <sub>3</sub> <sup>-</sup> ( $\mu\text{mol kg}^{-1}$ )	CO <sub>3</sub> <sup>2-</sup> ( $\mu\text{mol kg}^{-1}$ )	R- Factor	$\Omega_{\text{Ca}}$	$\Omega_{\text{Ar}}$
<b>0</b>	2402.7	2096.5	8.053	404.5	1865.8	218.79	9.74	5.19	3.41
<b>300</b>	2690.5	2327.9	8.098	400.5	2049.5	266.60	9.56	6.32	4.15
<b>600</b>	2968.1	2558.7	8.123	412.6	2237.8	308.70	9.53	7.32	4.81
<b>900</b>	3272.0	2795.1	8.165	404.2	2415.9	367.27	9.34	8.71	5.72
<b>1200</b>	3576.2	3051.1	8.180	424.4	2625.6	412.97	9.37	9.79	6.43
<b>1500</b>	3837.9	3253.5	8.209	420.2	2775.1	465.96	9.26	11.05	7.26
<b>1800</b>	4107.4	3463.0	8.233	419.6	2930.2	520.42	9.17	12.34	8.10
<b>2100</b>	4417.5	3699.4	8.261	416.0	3099.6	587.47	9.07	13.93	9.15
<b>2400</b>	4689.3	3911.5	8.279	419.6	3256.1	643.00	9.020	15.24	10.01

**Table S 2** | Output of two-tailed Welch's t-test for unequal variances in sample population. Differing total alkalinity in  $\Delta\text{TA}_{2400}$  was tested for in two phases (Phase I: Day 4 – 17, Phase II: Day 19 – 33)

Response variable	sample estimates		t	df	p-value
	Phase I	Phase II			
<b>Total Alkalinity</b>	4701.07	4610.54	2.565	7.823	<b>0.0340</b>

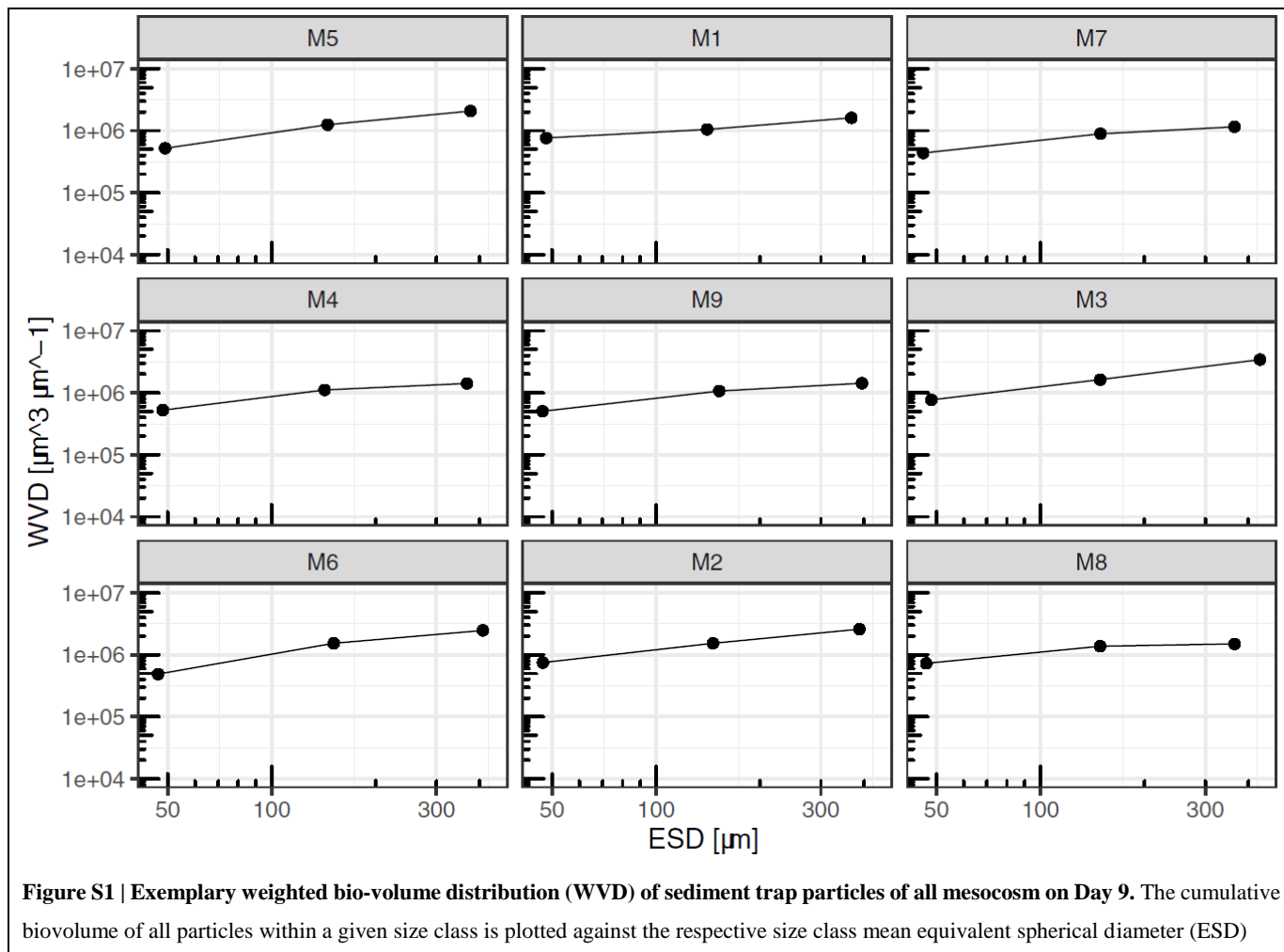
**Table S3** Output of fit parameters and p-values levels from linear mixed effects models of numerous parameters fitted to the predictor variables  $\Delta TA$  and Day with Mesocosm assigned as a random effect. Associated data transformation is shown if assumptions of normally distributed data were violated. Note, that all models excluded the highest treatment level  $\Delta TA_{2400}$ .

Response variable	Fixed effect	df <sub>Num</sub>	df <sub>Den</sub>	F-ratio	p-Value	R <sup>2</sup> <sub>marginal</sub>
a) POC Flux (sqrt transformed)	$\Delta TA$	1	6	0.0576	0.8184	0.604
	Day	14	82	4.5633	< 0.0001	
	$\Delta TA \times Day$	14	82	0.2514	0.9970	
b) POC PON Ratio (not transformed)	$\Delta TA$	1	6	0.6817	0.4406	0.359
	Day	14	82	1.6459	0.0841	
	$\Delta TA \times Day$	14	82	0.4666	0.9444	
c) mean sinking velocity 25 – 100 $\mu m$ (log-10 transformation)	$\Delta TA$	1	6	1.1549	0.3238	0.476
	Day	14	81	2.2554	0.0120	
	$\Delta TA \times Day$	14	81	0.9939	0.4674	
d) mean sinking velocity 100 – 250 $\mu m$ (log-10 transformation)	$\Delta TA$	1	6	4.3185	0.0830	0.461
	Day	14	81	1.9048	0.0377	
	$\Delta TA \times Day$	14	81	0.5583	0.8892	
e) mean sinking velocity 250 – 1000 $\mu m$ (log-10 transformation)	$\Delta TA$	1	6	1.4978	0.2669	0.612
	Day	14	76	4.8663	< 0.0001	
	$\Delta TA \times Day$	14	76	1.0107	0.4520	
f) remineralization rates (not transformed)	$\Delta TA$	1	6	0.0014	0.9710	0.255
	Day	6	36	1.2418	0.3085	
	$\Delta TA \times Day$	6	36	0.9193	0.4926	
g) PIC Flux (sqrt transformed)	$\Delta TA$	1	6	6.8286	0.0400	0.569
	Day	14	82	2.4045	0.0072	
	$\Delta TA \times Day$	14	82	1.1647	0.3178	
h) PIC POC Ratio (sqrt transformed)	$\Delta TA$	1	6	7.3777	0.0348	0.615
	Day	14	82	1.9930	0.0282	
	$\Delta TA \times Day$	14	82	0.7323	0.7362	
i) BSi Flux (sqrt transformed)	$\Delta TA$	1	6	0.00224	0.9638	0.688
	Day	14	82	8.13492	<0.0001	
	$\Delta TA \times Day$	14	82	0.25376	0.9969	
j) POP Flux (log-10 transformation)	$\Delta TA$	1	6	0.0126	0.9142	0.441
	Day	14	82	2.8311	0.0017	
	$\Delta TA \times Day$	14	82	0.167	0.9997	
k) PON Flux (sqrt transformation)	$\Delta TA$	1	6	0.13688	0.7241	0.547
	Day	14	82	397.312	<.0001	
	$\Delta TA \times Day$	14	82	0.20413	0.9991	
l) BSi:POC Ratio (log-10 transformation)	$\Delta TA$	1	6	0,0607	0.8136	0.359
	Day	14	82	1,9865	0.0288	
	$\Delta TA \times Day$	14	82	1,4083	0.1681	
m) SV <sub>avg</sub> (log-10 transformation)	$\Delta TA$	1	6	1.1297	0.3287	0.508
	Day	14	82	3.299	0.0004	
	$\Delta TA \times Day$	14	82	1.0908	0.3784	

15 **Table S4** Fit parameters and correlation coefficients for the linear regressions shown in Figures 1, 2, 3, 4. Time periods of respective regressions are given in brackets. Note, that all regressions excluded the highest treatment level  $\Delta TA_{2400}$ .

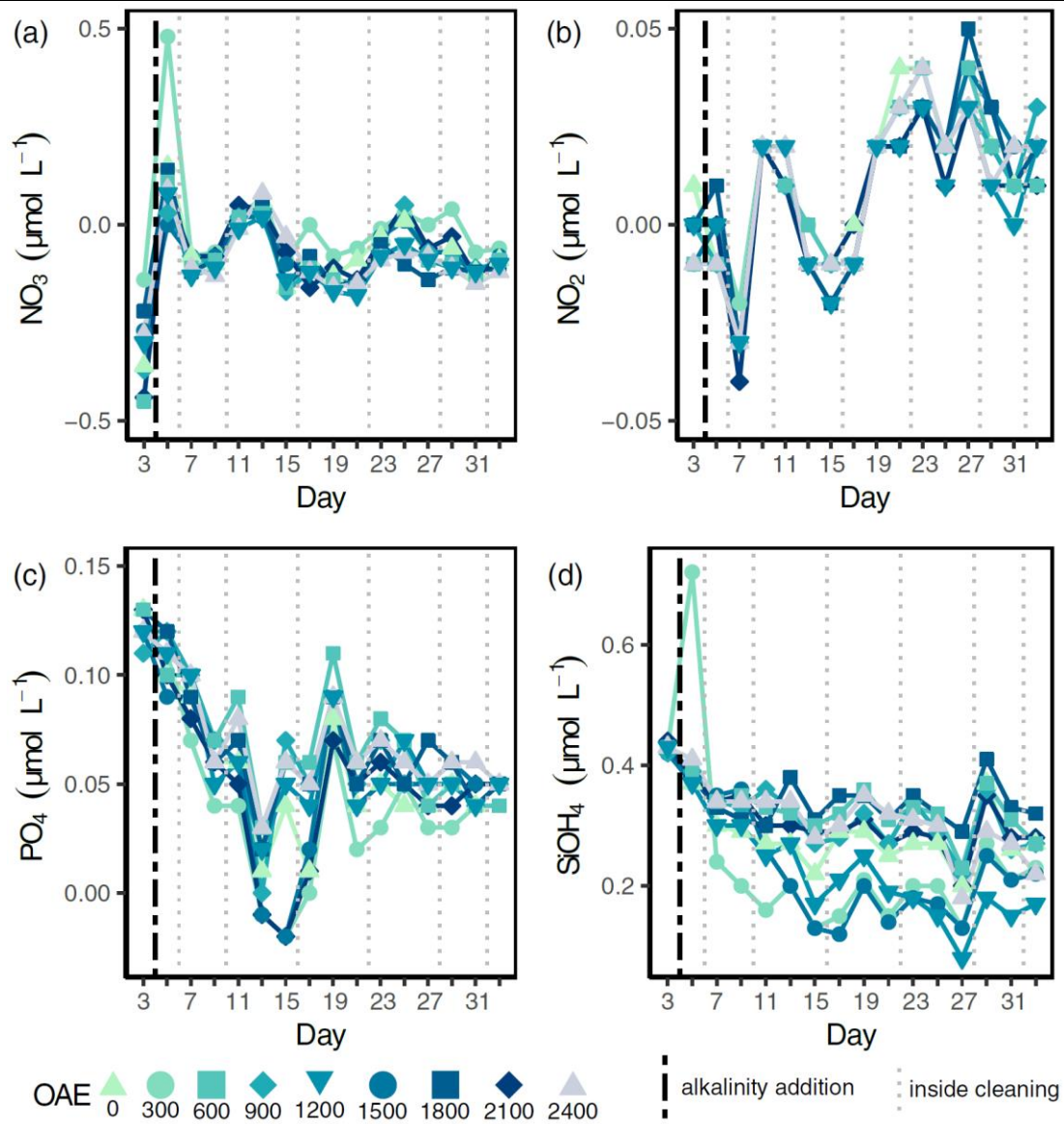
Dataset	Intercept	Slope	R <sup>2</sup>	p-value
<b>POC<sub>ST</sub> Flux vs. OAE</b> (Day 4 – 33)	0.428	0.00001	0.02	0.721
<b>POC<sub>ST</sub>:PON<sub>ST</sub> Ratio vs. OAE</b> (Day 4 – 33)	9.80	0.0002	0.11	0.426
<b>C<sub>remin</sub> vs. OAE</b> (Day 4 – 33)	0.127	-0.000001	0.02	0.738
<b>PIC<sub>ST</sub> Flux vs. OAE</b> (Day 19 – 31)	0.019	0.00002	0.55	<b>0.036</b>
<b>PIC<sub>ST</sub>:POC<sub>ST</sub> Ratio vs. OAE</b> (Day 19 – 31)	0.075	0.00005	0.61	<b>0.021</b>
<b>PIC<sub>ST</sub>:POC<sub>ST</sub> Ratio vs. SV<sub>25-100µm</sub></b> (Day 19 – 31)	13.4	18.1	0.46	0.065
<b>PIC<sub>ST</sub>:POC<sub>ST</sub> Ratio vs. SV<sub>100-250µm</sub></b> (Day 19 – 31)	20.03	30.1	0.53	<b>0.039</b>
<b>PIC<sub>ST</sub>:POC<sub>ST</sub> Ratio vs. SV<sub>250-1000µm</sub></b> (Day 19 – 31)	48.6	25.1	0.04	0.639
<b>POP<sub>ST</sub> Flux vs. OAE</b> (Day 4 – 33)	1014.0	8548.4	0.0004	0.960
<b>BSi<sub>ST</sub> Flux vs. OAE</b> (Day 4 – 33)	976.5	3848.6	0.0004	0.961
<b>POC<sub>wc</sub> vs. OAE</b> (Day 4 – 33)	684.8	55.4	0.005	0.857
<b>Chl a vs. OAE</b> (Day 4 – 33)	562.9	1453.1	0.20	0.265
<b>PON<sub>ST</sub> vs. OAE</b> (Day 4 – 33)	1807	-18473	0.04142	0.629
<b>BSi<sub>ST</sub>:POC<sub>ST</sub> vs. OAE</b> (Day 4 – 33)	-128,8	26152,5	0,105	0,433
<b>SV<sub>avg.</sub> vs. OAE</b> (Day 4 – 33)	1017,758	2,993	0,07491	0.984

Supplementary Figures



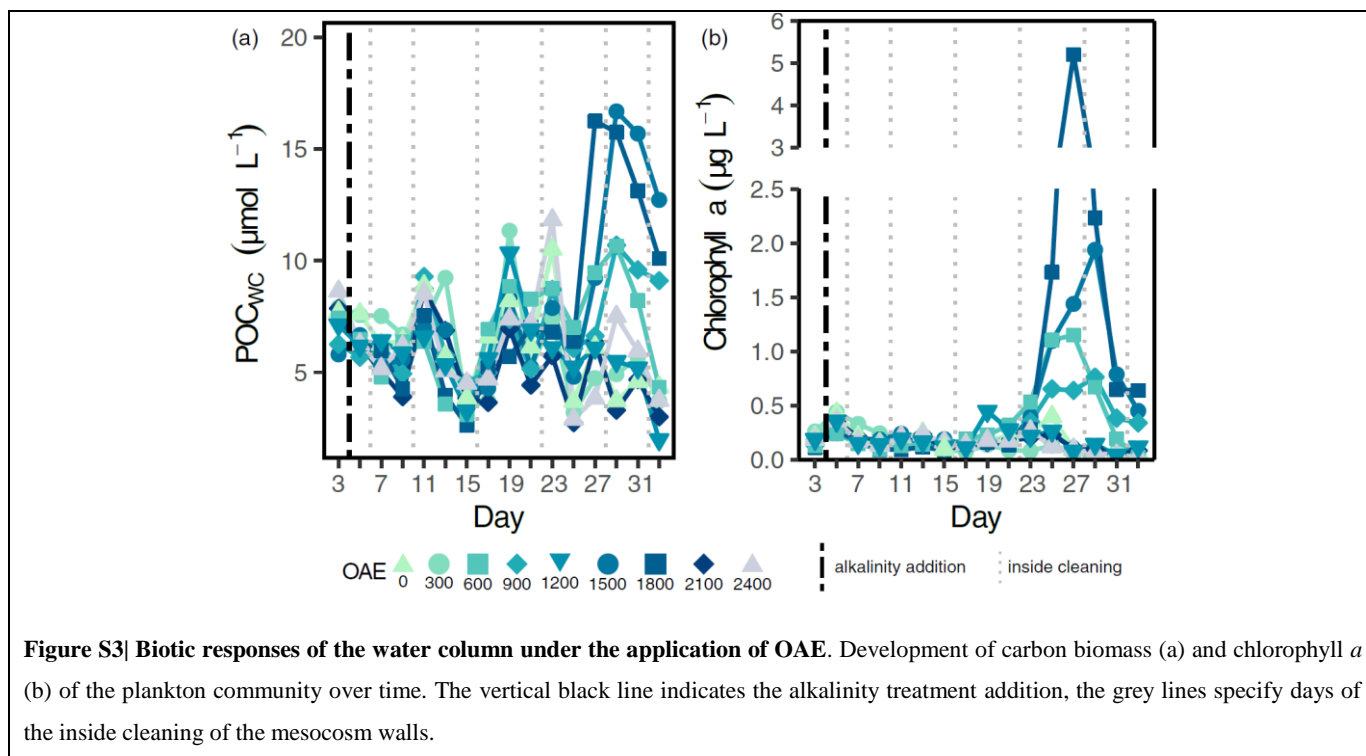
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**Figure S1 | Exemplary weighted bio-volume distribution (WVD) of sediment trap particles of all mesocosm on Day 9.** The cumulative biovolume of all particles within a given size class is plotted against the respective size class mean equivalent spherical diameter (ESD)



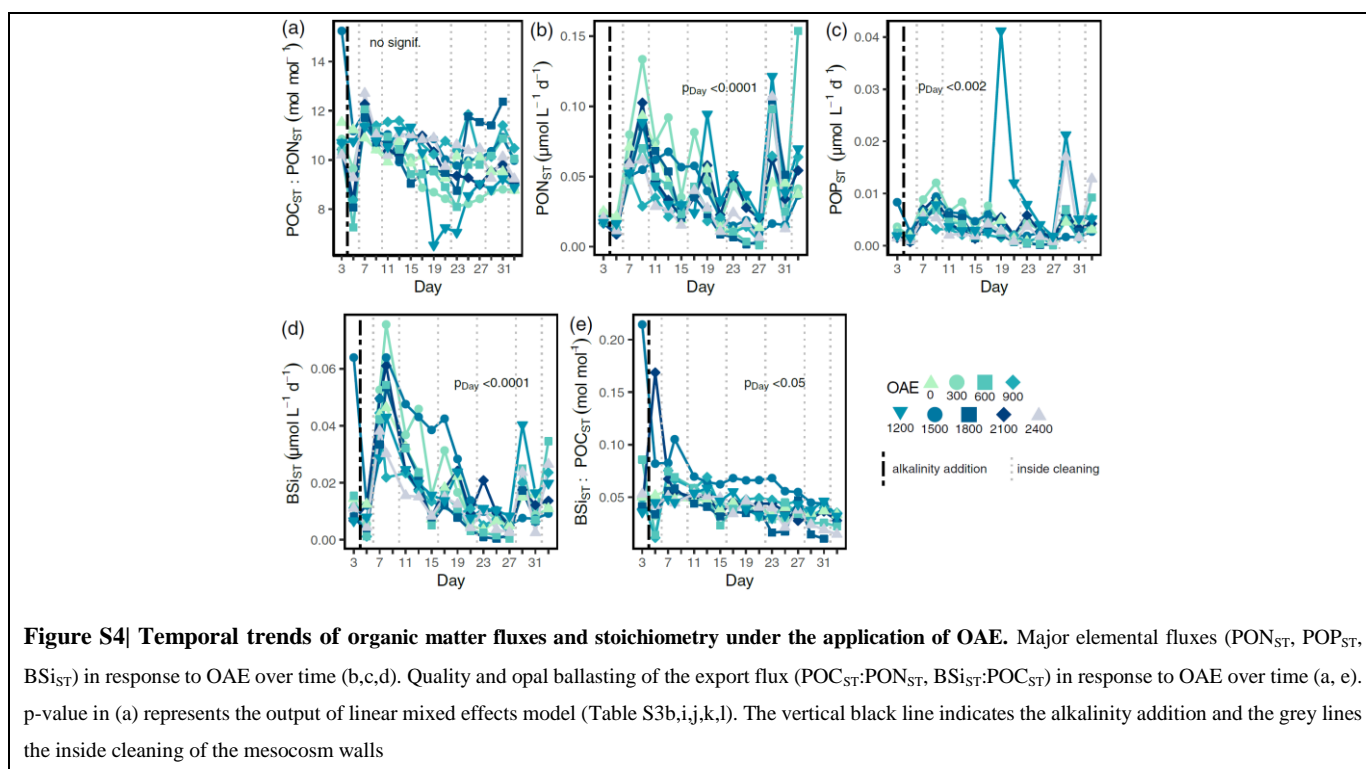
25 **Figure S2| Dissolved Inorganic Nutrients.** Concentration of inorganic nitrate (a), nitrite (b) phosphate (c) and silicate (d) over time. Note the negative values for nitrate, nitrite and phosphate, indicating that measured concentrations were low and below the detection limit of the spectrophotometrically determination method. The vertical black line indicates the alkalinity addition and the grey lines the inside cleaning of the mesocosm walls.

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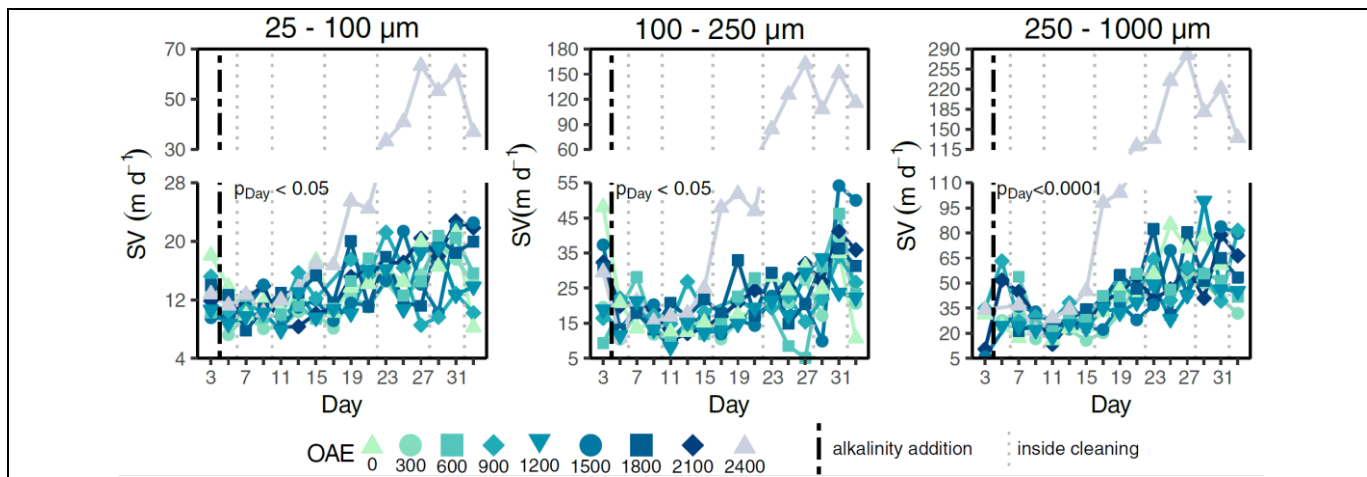
**Figure S3| Biotic responses of the water column under the application of OAE.** Development of carbon biomass (a) and chlorophyll *a* (b) of the plankton community over time. The vertical black line indicates the alkalinity treatment addition, the grey lines specify days of the inside cleaning of the mesocosm walls.

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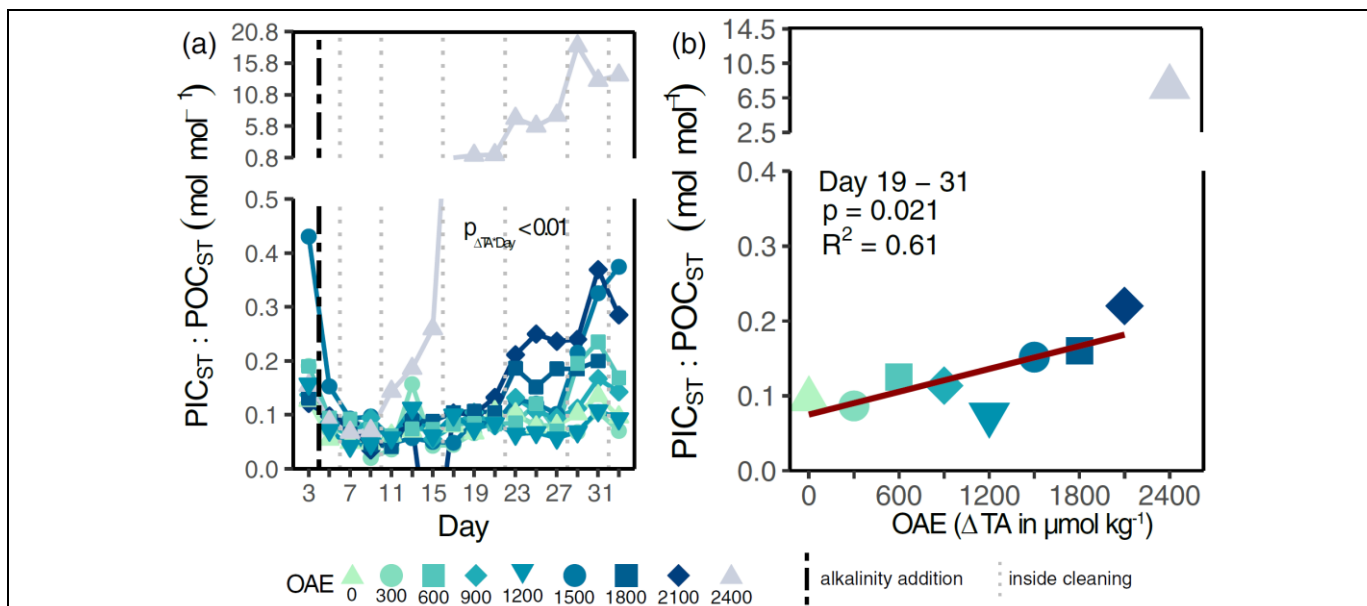
**Figure S4| Temporal trends of organic matter fluxes and stoichiometry under the application of OAE.** Major elemental fluxes (PON<sub>ST</sub>, POP<sub>ST</sub>, BSi<sub>ST</sub>) in response to OAE over time (b,c,d). Quality and opal ballasting of the export flux (POC<sub>ST</sub>:PON<sub>ST</sub>, BSi<sub>ST</sub>:POC<sub>ST</sub>) in response to OAE over time (a, e). p-value in (a) represents the output of linear mixed effects model (Table S3b,i,j,k,l). The vertical black line indicates the alkalinity addition and the grey lines the inside cleaning of the mesocosm walls

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**Figure S5| Particle sinking velocities in response to OAE.** Development of average particle sinking velocities of different size classes over the application period of OAE. p-value in (a) represents the output of linear mixed effects model (Table S3c,d,e). The vertical black line indicates the alkalinity addition and the grey lines the inside cleaning of the mesocosm walls.

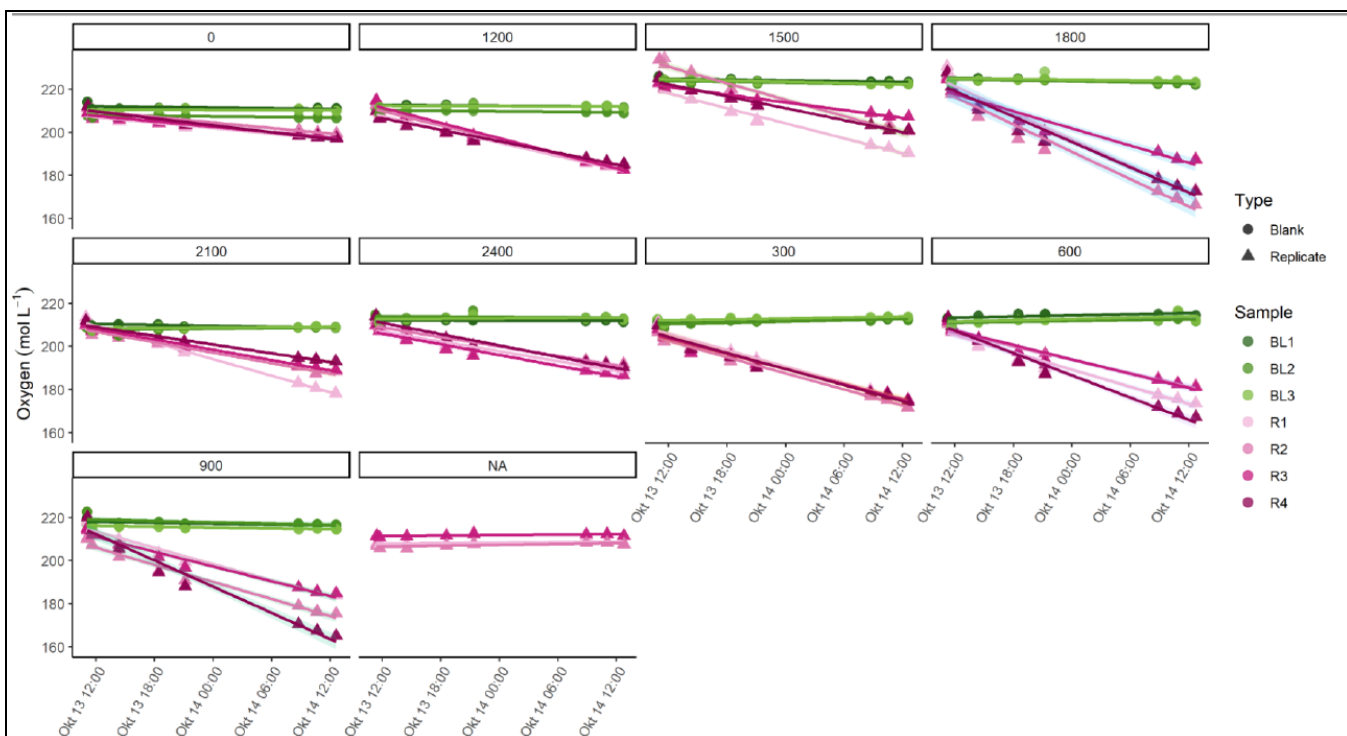
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**Figure S6| Response of carbonate ballasting to OAE.** Carbonate ballasting and its response to OAE over time (a) and averaged over the treatment period (b). p-value in (a) represents the output of linear mixed effects model (Table S3h). The vertical black line indicates the alkalinity addition and the grey lines the inside cleaning of the mesocosm walls.

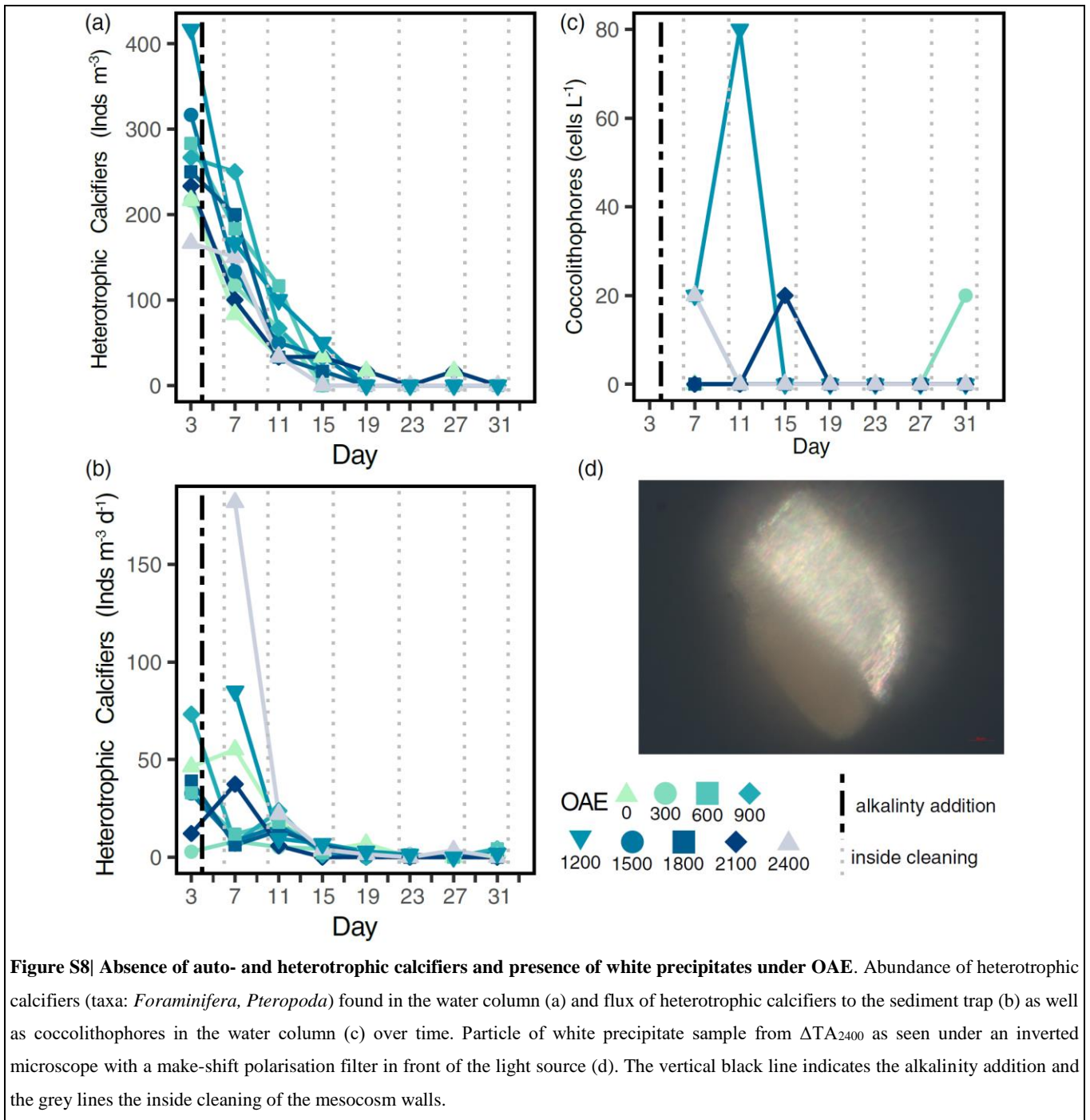
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**Figure S7| Example of O<sub>2</sub> consumption rates on Day 33.** O<sub>2</sub> consumption rates within incubation bottles on the plankton wheel measured with the Fibox 4 on Day 33. Pink dots and regressions represent sediment incubated bottles, while green dots and regressions represent the blank bottle O<sub>2</sub> consumptions. Single data points represent averages of n > 3 measurements and have been corrected for temperature and salinity. Note, that there is no discernible difference in regression lines of  $\Delta TA_{2400}$  compared to other treatment levels.

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