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Physiological control on carbon isotope fractionation in marine phytoplankton

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Table S1. Slopes of ε_p in response to POC production/CO_2 for the different species and studies using a linear fit. Numbers between brackets refer to the different studies (used in Fig. 3).

Reference	Group	Species	Strain	No	Slope	sd	p-value
Laws et al. 1997	Diatoms	Phaeodactylum tricornutum	CCMP 1327	[10]	-1.66	0.39	0.00
Cassar et al. 2003; 2002	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[5]	-1.36	0.34	0.01
Cassar et al. 2003	Diatoms	Phaeodactylum tricornutum	CCMP 1327	[4]	-0.99	0.16	0.00
Riebesell et al. 2000b	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[14]	-0.69	0.09	0.00
Riebesell et al. 2000b	Diatoms	Phaeodactylum tricornutum	1327	[14]	-0.61	0.02	0.00
Burkhardt et al. 1999a	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[3]	-0.48	0.11	0.00
Hinga et al. 1994	Diatoms	Skeletonema costatum	SKEL	[7]	2.57	1.25	0.05
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON15	[2]	-0.40	0.15	0.06
Van de Waal et al. 2013	Dinoflagellates	Thoracosphaera heimii	RCC1512	[17]	-0.36	0.07	0.00
Hoins et al. 2016	Dinoflagellates	Gonyaulax spinifera	409	[9]	-0.35	0.23	0.37
Wilkes et al. 2017	Dinoflagellates	Alexandrium tamarense	CCMP 1771	[18]	-0.12	0.01	0.00
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON13	[2]	-0.09	0.03	0.03
Hoins et al. 2016	Dinoflagellates	Protoceratium reticulatum	1889	[9]	-0.04	0.01	0.19
Hoins et al. 2016	Dinoflagellates	Scrippsiella trochoidea	S267	[9]	-0.02	0.02	0.35
Hoins et al. 2015	Dinoflagellates	Scrippsiella trochoidea	S267	[8]	-0.02	0.01	0.04
Hoins et al. 2015	Dinoflagellates	Gonyaulax spinifera	409	[8]	-0.01	0.01	0.08
Hoins et al. 2015	Dinoflagellates	Alexandrium tamarense	A5	[8]	-0.01	0.00	0.00
Hoins et al. 2015	Dinoflagellates	Protoceratium reticulatum	1889	[8]	-0.01	0.00	0.05
Hoins et al. 2016	Dinoflagellates	Alexandrium tamarense	A5	[9]	0.00	0.01	0.56
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON5.26	[2]	0.10	0.05	0.09
Bidigare et al. 1997; Popp et al. 1998	Haptophytes	Emiliania huxleyi	BT6	[1]	-17.03	3.29	0.01
Bidigare et al. 1997; Popp et al. 1998	Haptophytes	Emiliania huxleyi	B92/11	[1]	-11.08	2.67	0.05
Hinga et al. 1994	Haptophytes	Emiliania huxleyi	BT6	[7]	-3.66	4.56	0.46
Rost et al. 2002	Haptophytes	Emiliania huxleyi	PML B92/11	[15]	-2.18	0.57	0.00
Riebesell et al. 2000	Haptophytes	Emiliania huxleyi	PML B92/11	[13]	-1.09	0.08	0.00
McClelland et al. 2017	Haptophytes	Gephyrocapsa oceanica	RCC1211	[11]	-0.33	0.23	0.22
McClelland et al. 2017	Haptophytes	Emiliania huxleyi	RCC1256	[11]	-0.23	0.32	0.49
Rickaby et al. 2010	Haptophytes	Coccolithus braarudii	4762	[12]	-0.19	0.06	0.01
McClelland et al. 2017	Haptophytes	Gephyrocapsa oceanica	RCC1314	[11]	-0.15	0.04	0.01
McClelland et al. 2017	Haptophytes	Emiliania huxleyi	RCC1216	[11]	-0.13	0.17	0.47
Fiorini et al. 2010	Haptophytes	Syracosphaera pulchra	AC418	[6]	0.02	0.29	0.96
Rickaby et al. 2010	Haptophytes	Gephyrocapsa oceanica	PZ 3.1	[12]	0.13	0.28	0.64
Fiorini et al. 2010	Haptophytes	Calcidiscus leptoporus	AC370	[6]	0.31	0.19	0.24
Fiorini et al. 2010	Haptophytes	Emiliania huxleyi	AC472	[6]	2.33	0.30	0.02

Table S2. Model results for haptophytes.

Model	**AIC**	**BIC**
Limitation	764	791
CO_2 manipulation	757	784
Culturing Approach	775	803
Light dark cycle	**711**	**738**

Table S3. Model results for diatoms.

Model	**AIC**	**BIC**
Limitation	609	639
CO_2 manipulation	**600**	625
Culturing Approach	604	**623**
Light dark cycle	633	657

Table S4. Model results for dinoflagellates.

Model	**AIC**	**BIC**
Limitation	551	575
CO_2 manipulation	531	555
Culturing Approach	**490**	**520**
Light dark cycle	527	546

Table S5. Slopes of ε_p in response to μ_i/CO_2 for the different species and studies using a linear fit. Numbers between brackets refer to the different studies (used in Fig. S1).

Reference	Group	Species	Strain	No	Slope	sd	*p*-value
Popp et al. 1998	Diatoms	Prorosira glacialis	CCMP980	[13]	-1019	365	0.04
Hinga et al. 1994	Diatoms	Skeletonema costatum	SKEL	[8]	-25	7	0.00
Cassar et al. 2003; 2002	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[6]	-10	3	0.01
Riebesell et al. 2000b	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[16]	-10	1	0.00
Laws et al. 1997	Diatoms	Phaeodactylum tricornutum	CCMP 1327	[11]	-8	2	0.00
Riebesell et al. 2000b	Diatoms	Phaeodactylum tricornutum	1327	[16]	-8	0	0.00
Cassar et al. 2003	Diatoms	Phaeodactylum tricornutum	CCMP 1327	[5]	-8	1	0.00
Burkhardt et al. 1999b	Diatoms	Thalassiosira weissflogii		[4]	-4	1	0.05
Burkhardt et al. 1999a	Diatoms	Phaeodactylum tricornutum	CCAP 1052/1A	[3]	-4	1	0.00
Burkhardt et al. 1999b	Diatoms	Skeletonema costatum		[4]	-3	4	0.50
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON5.26	[2]	-903	316	0.05
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON15	[2]	-831	456	0.14
Hoins et al. 2016	Dinoflagellates	Gonyaulax spinifera	409	[10]	-583	9	0.01
Wilkes et al. 2017	Dinoflagellates	Alexandrium tamarense	CCMP 1771	[20]	-539	68	0.00
Brandenburg et al. 2020	Dinoflagellates	Alexandrium ostenfeldii	AON13	[2]	-265	78	0.03
Hoins et al. 2016	Dinoflagellates	Protoceratium reticulatum	1889	[10]	-133	33	0.16
Van de Waal et al. 2013	Dinoflagellates	Thoracosphaera heimii	RCC1512	[19]	-102	21	0.00
Hoins et al. 2016	Dinoflagellates	Scrippsiella trochoidea	S267	[10]	-73	68	0.35
Hoins et al. 2015	Dinoflagellates	Alexandrium tamarense	A5	[9]	-34	4	0.00
Hoins et al. 2015	Dinoflagellates	Scrippsiella trochoidea	S267	[9]	-34	14	0.03
Hoins et al. 2015	Dinoflagellates	Gonyaulax spinifera	409	[9]	-30	25	0.26
Hoins et al. 2015	Dinoflagellates	Protoceratium reticulatum	1889	[9]	-20	22	0.37
Hoins et al. 2016	Dinoflagellates	Alexandrium tamarense	A5	[10]	18	26	0.53
Bidigare et al. 1997; Popp et al. 1998	Haptophytes	Emiliania huxleyi	BT6	[1]	-141	27	0.01
Hinga et al. 1994	Haptophytes	Emiliania huxleyi	BT6	[8]	-109	37	0.03
Bidigare et al. 1997; Popp et al. 1998	Haptophytes	Emiliania huxleyi	B92/11	[1]	-92	22	0.05
Rickaby et al. 2010	Haptophytes	Coccolithus braarudii	4762	[14]	-42	12	0.00
Fiorini et al. 2010	Haptophytes	Syracosphaera pulchra	AC418	[7]	-19	82	0.84
Rost et al. 2002	Haptophytes	Emiliania huxleyi	PML B92/11	[17]	-19	5	0.00
McClelland et al. 2017	Haptophytes	Coccolithus pelagicus	cp	[12]	-14	5	0.03
McClelland et al. 2017	Haptophytes	Gephyrocapsa oceanica	RCC1314	[12]	-7	2	0.01
McClelland et al. 2017	Haptophytes	Gephyrocapsa oceanica	RCC1211	[12]	-7	3	0.11
Riebesell et al. 2000	Haptophytes	Emiliania huxleyi	PML B92/11	[15]	-6	1	0.00

McClelland et al. 2017	Haptophytes	Emiliania huxleyi	RCC1256	[12]	-5	3	0.21
McClelland et al. 2017	Haptophytes	Emiliania huxleyi	RCC1216	[12]	-2	2	0.46
Fiorini et al. 2010	Haptophytes	Calcidiscus leptoporus	AC370	[7]	3	11	0.83
Rickaby et al. 2010	Haptophytes	Gephyrocapsa oceanica	PZ 3.1	[14]	15	10	0.15
Fiorini et al. 2010	Haptophytes	Emiliania huxleyi	AC472	[7]	53	15	0.07

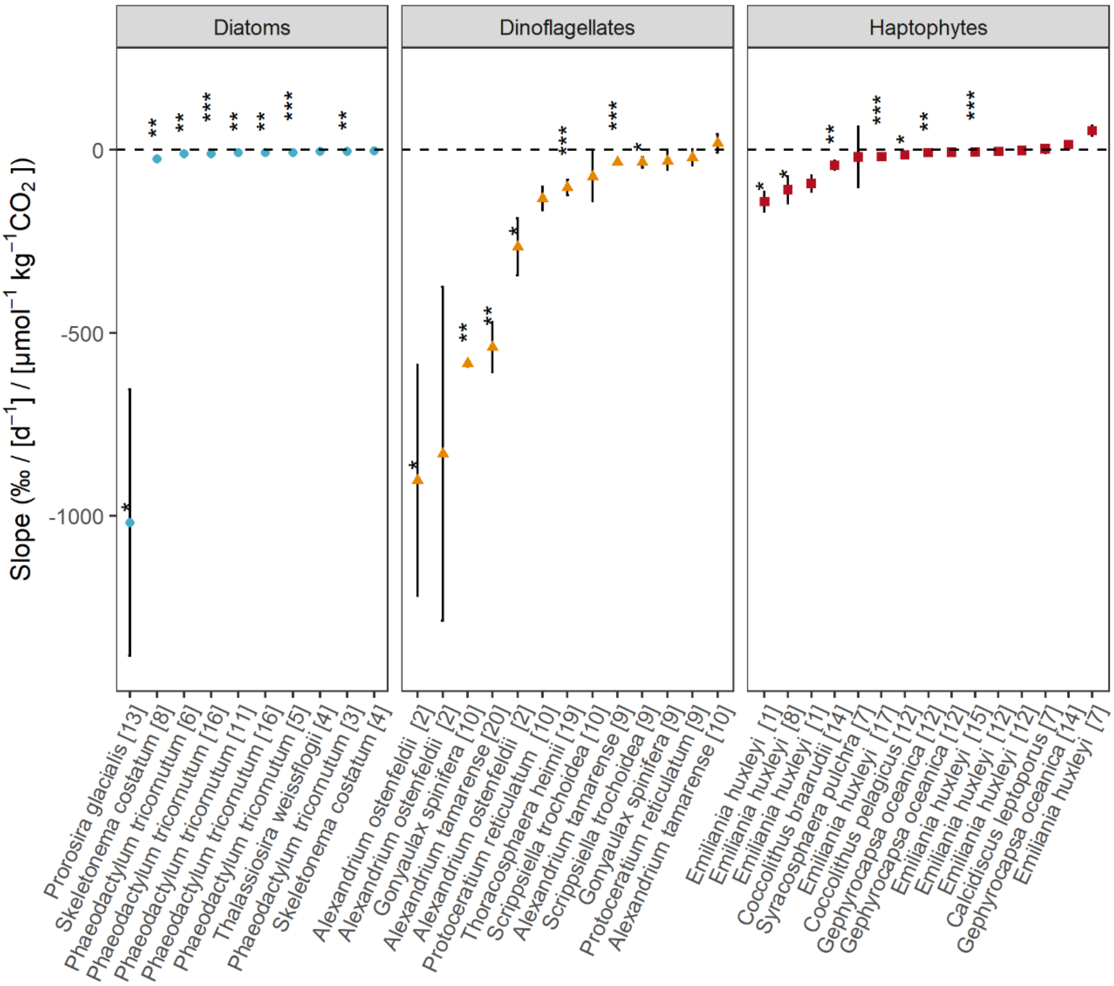

Figure S1. Slopes of ε_p in response to $\mu_i/[CO_2]$ for the different species and studies using a linear fit. Numbers between brackets refer to the different studies (Table S5). Blue dots represent diatoms, orange triangles dinoflagellates, and red squares haptophytes. Significance is indicated by the asterisks (*** P<0.001, ** P<0.01, * P<0.05).

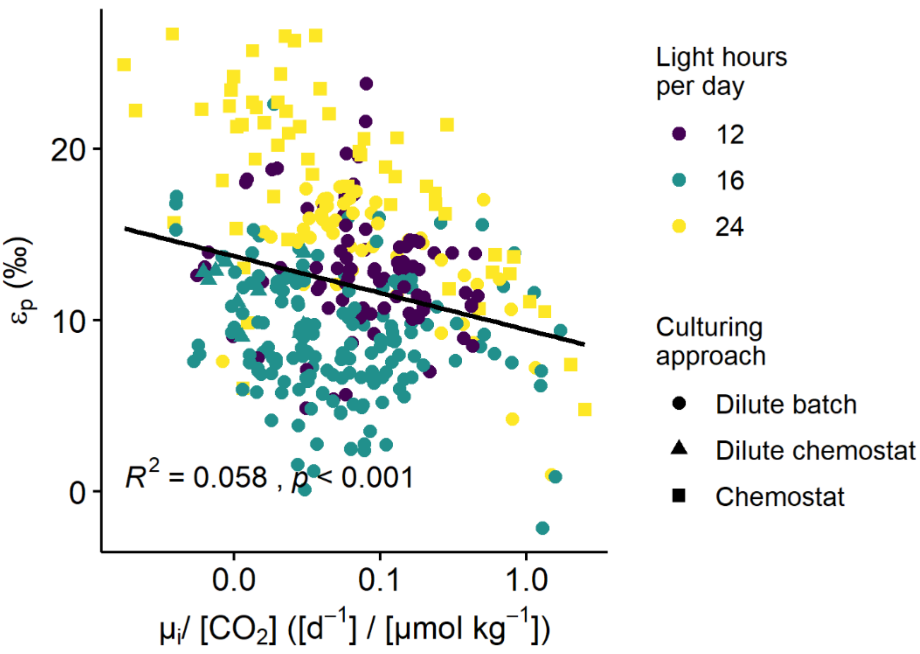

Figure S2: ε_p against μ_i/[CO_2] (log-transformed) across all phytoplankton groups. Colors indicate the light-dark cycle; marker shapes indicate the culturing approach. Black line illustrates the log-linear relationship (R^2 and P indicated in the panel).

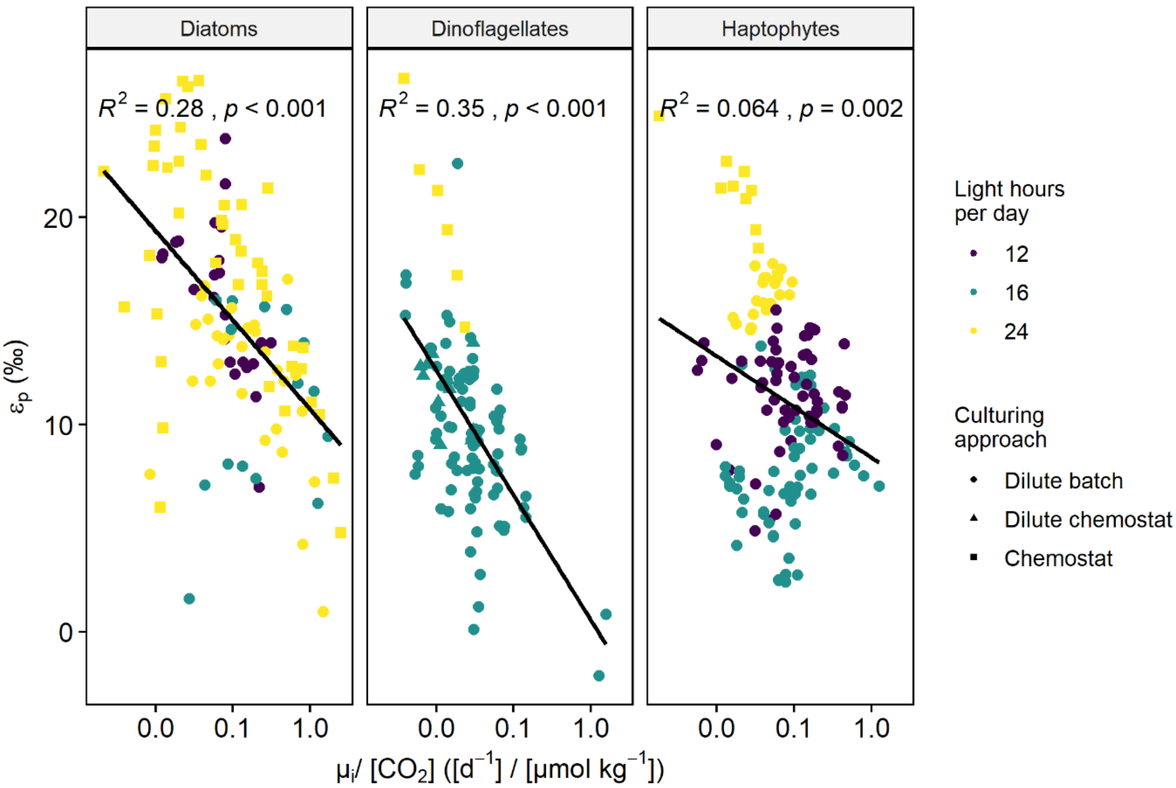

Figure S3: μ_i/[CO_2] (log-transformed) against ε_p for the different phytoplankton groups, where the colored points indicate the respective light-dark cycle, and the shape of the points indicates the culturing approach. Black line illustrates the linear relationship (R^2 and *p*-values indicated in the panels).

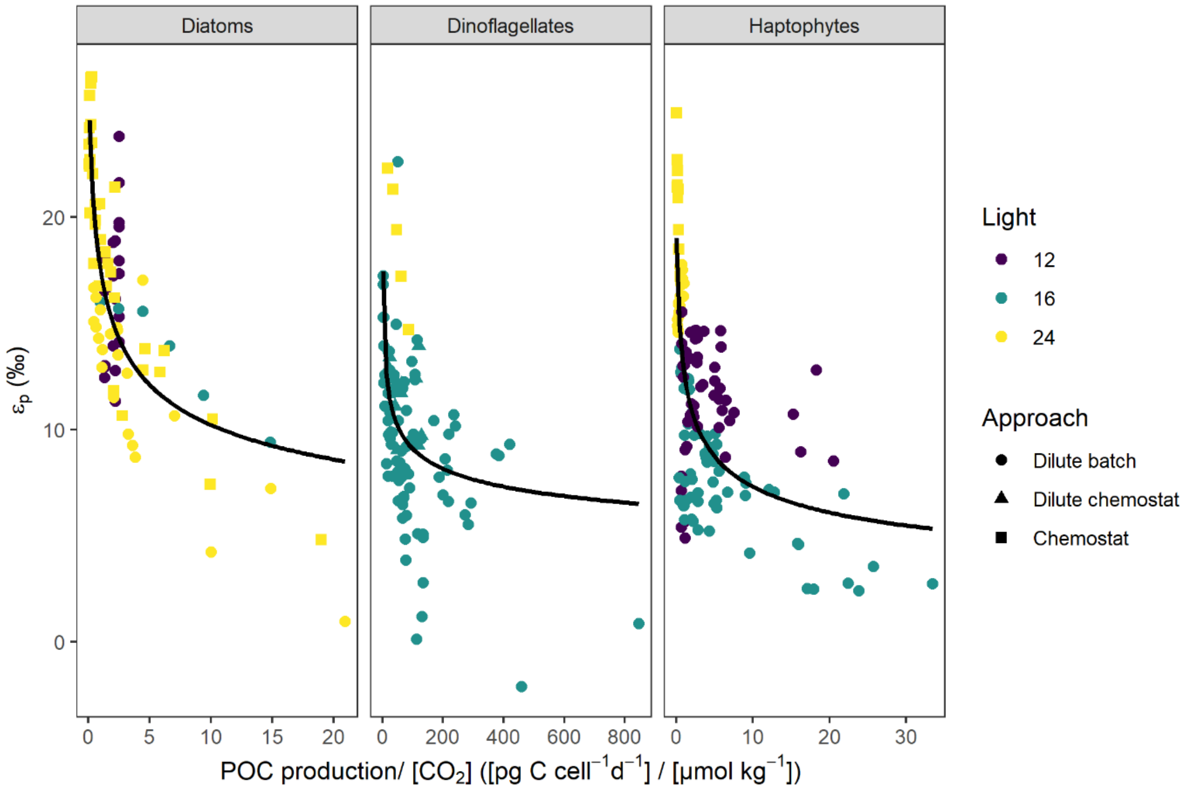

Figure S4. ε_p against POC production/[CO_2] (C-demand/C-supply) for the different phytoplankton groups, where the colored points indicate the differences in light hours per day, and the shape of the points indicates the respective culturing approach. Black line illustrates the decaying relationship.

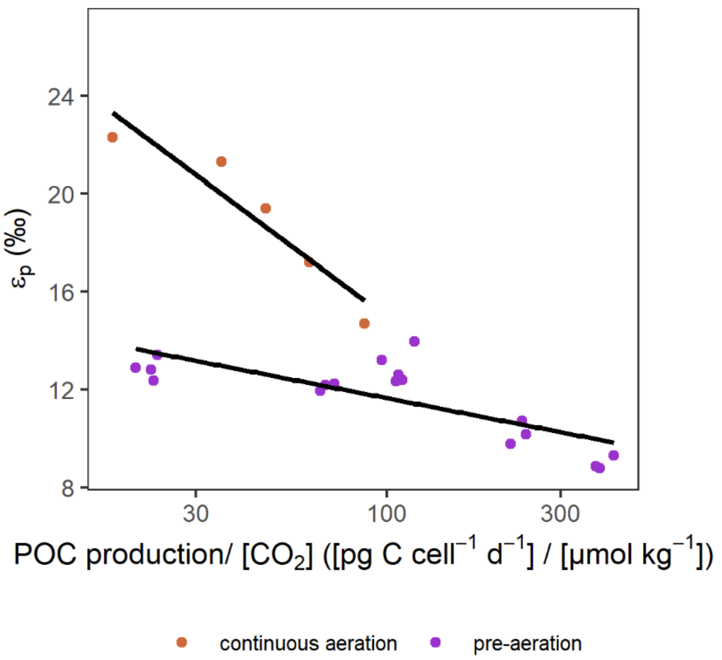

Figure S5. POC production/[CO_2] (C-demand/C-supply; log-transformed) against ε_p for *Alexandrium tamarense* under different carbonate chemistry manipulation methods.