

Supplement of: Can morphological features of coccolithophores serve as a reliable proxy to reconstruct environmental conditions of the past?

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1 Growth rate

10 Samples for cell abundance were taken at the end of the experiment with the exception of the nutrient experiments where samples were taken every second day. Incubation bottles were turned to resuspend all cells and to obtain a homogenous suspension of the cells before sampling. Cell numbers were immediately measured three times without addition of preservatives using a Beckman coulter Multisizer. Specific daily growth rates (μ) were calculated as (Eq. 1):

$$\mu = \frac{\ln c_1 - \ln c_0}{t_1 - t_0} \quad (1)$$

15 where c_0 and c_1 are the cell concentrations at the beginning (t_0) and at the end of the incubation period (t_1), respectively. Growth rate data were used to check the growth phase of the species.

1.1 Light

E. huxleyi growth rates followed an optimum curve response pattern along the light gradient and the optimum growth rate was recorded at 450 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ (Fig. S1; Tab. 3.1). *G. oceanica*, *C. braarudii* and *P. carterae* growth weren't influenced
20 by light intensity. *P. carterae* displayed increasing growth rates at higher light intensities. All data are reported in Table 1 and shown in Fig. S1.

1.2 Mg/Ca

E. huxleyi, *G. oceanica* and *C. braarudii* growth rates were negatively influenced by increasing $[\text{Ca}^{2+}]$ while no effect was observed on *P. carterae* growth (Fig. S2; Table 2).

25 1.3 Nutrient

In the N and P limited treatments, *E. huxleyi* growth rate was 58% and 71% lower than in the (nutrient replete) control treatment (Fig. S3; Table 3). *G. oceanica* growth rate in N and P limited treatments was 76% and 43% lower (Fig. S3). *C. braarudii*

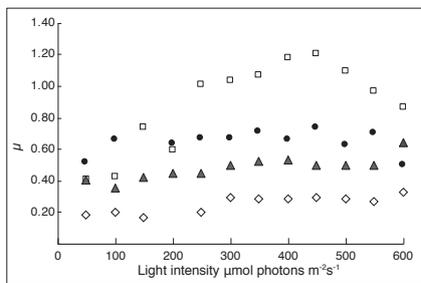
growth rate was 82% and 69% lower. *P. carterae* did not grow in the P limited conditions. N-limitation reduced growth rate compared to the control by 50%.

30 1.4 Temperature

Elevated temperature, accelerated growth rates in *E. huxleyi* and *G. oceanica* by 50 and 75%, respectively. *P. carterae* growth rates declined by about 30% at 22.5°C relative to 15°C. *C. braarudii* did not grow at 22.5°C (Fig. S4; Table 4).

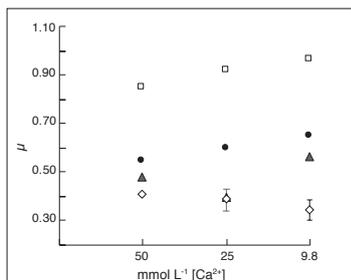
1.5 Carbonate chemistry

E. huxleyi growth rate was significantly lower in the OA and CS2 treatments compared to the control and the CS1 treatment. (Fig. S5, Table 5). *G. oceanica* growth rate was reduced in the OA, CS1 and CS2 treatment compared to the control with the lowest rate observed in the CS2 treatment. *C. braarudii* growth was reduced in the OA, CS1 and CS2 treatments compared to the control. *P. carterae* growth rate was unaffected by changing carbonate chemistry.

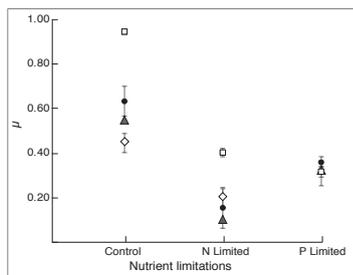


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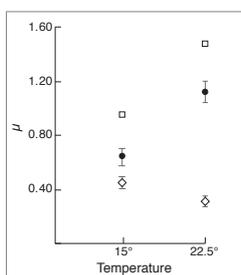
Figure S1: Average growth rate under different irradiances. Square: *E. huxleyi*; dot: *G. oceanica*; triangle: *C. braarudii* ; diamond: *P. carterae*.



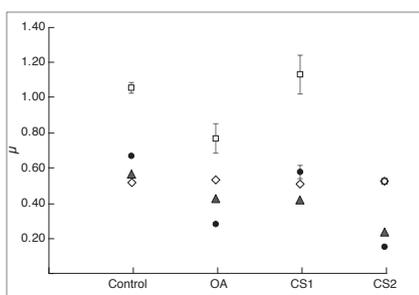
45 **Figure S2: Average growth rate under different Mg/Ca conditions; all measurements were done in triplicates; error bars denote standard deviation. If not visible, error bars are smaller than symbols. Symbols: square: *E. huxleyi*; dot: *G. oceanica*; triangle: *C. braarudii* ; diamond: *P. carterae*.**



50 **Figure S3: Average growth rate under different nutrient conditions; all measurements were done in triplicates; error bars denote standard deviation. If not visible, error bars are smaller than symbols. Symbols: square: *E. huxleyi*; dot: *G. oceanica*; triangle: *C. braarudii*; diamond: *P. carterae*; *P. carterae* didn't grow under P limited regime.**



55 **Figure S4: Average growth rate under different temperature conditions; all measurements were done in triplicates; error bars denote standard deviation. If not visible, error bars are smaller than symbols. Symbols: square: *E. huxleyi*; dot: *G. oceanica*; diamond: *P. carterae*.**



60 **Figure S5: Average growth rate under different carbonate chemistry conditions; all measurements were done in triplicates; error bars denote standard deviation. If not visible, error bars are smaller than symbols. Symbols: square: *E. huxleyi*; dot: *G. oceanica*; triangle: *C. braarudii*; diamond: *P. carterae*.**

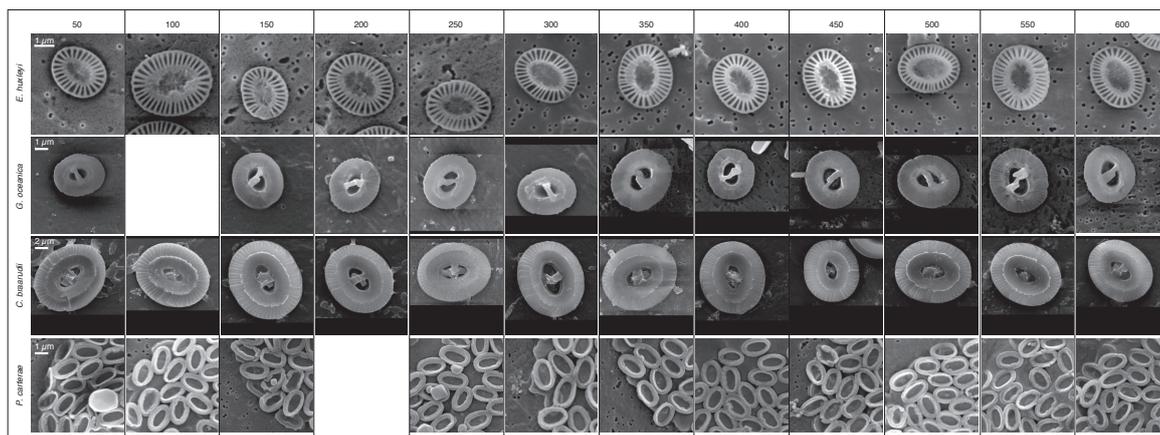
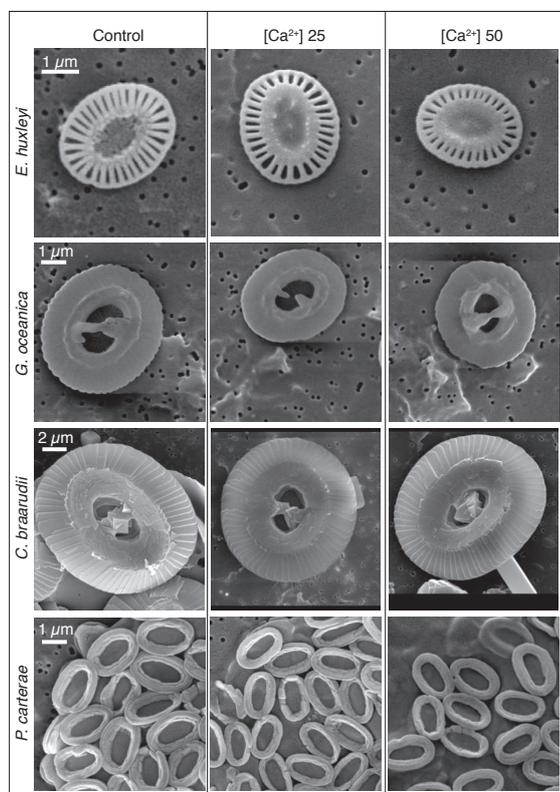
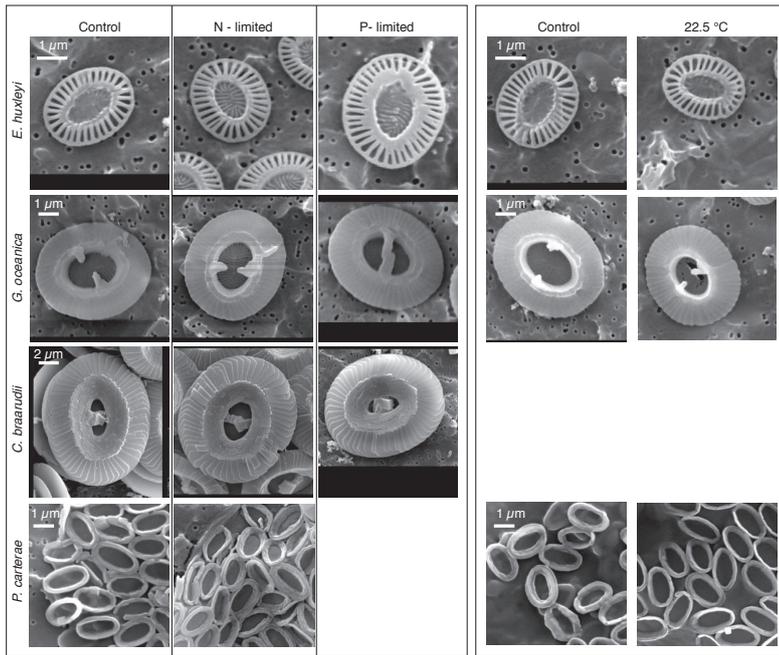


Plate 1: Example of the coccoliths of the four species tested under different light intensities

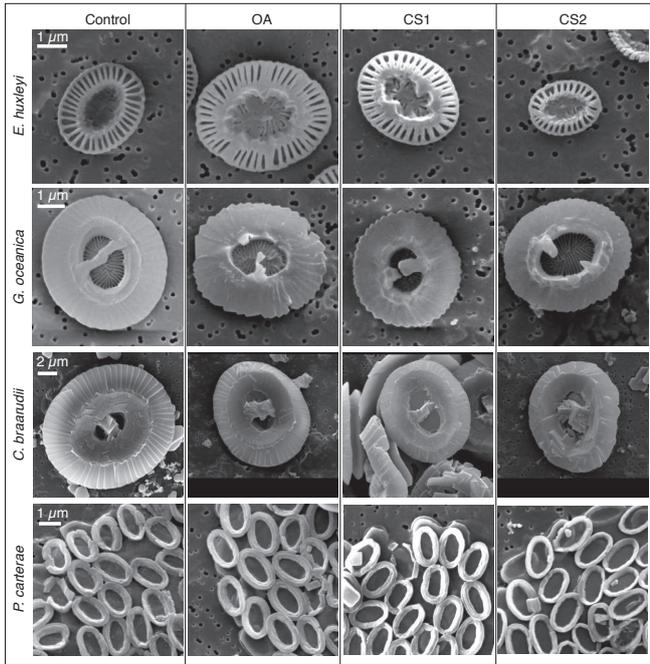


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Plate 2: Example of the coccoliths of the four species tested under different Ca concentrations



70 Plate 3: Example of the coccoliths of the four species tested under different nutrient conditions and temperature values.



75 Plate 4: Example of the coccoliths of the four species tested under different CO₂ concentrations