

Interactive comment on “Size-fractionated dissolved primary production and carbohydrate composition of the coccolithophore *Emiliana huxleyi*” by C. Borchard and A. Engel

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General comments

Referee: The manuscript presents particulate and dissolved organic production in *Emiliana huxleyi* chemostat culture with interest on the composition of particulate and dissolved carbohydrates for 4 different size classes. As a general comment, the manuscript is well written and the results present a clear scientific interest, as size fractionation and composition of carbohydrates are relatively weakly studied. However, this manuscript “merit much more attention and revisions of the present version”, as well expressed by the other referee. Indeed, as mentioned by the other referee, while

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reading the M&M we discover that this data set is part of a bigger data set on which the effect of different pCO₂ treatments has been studied on several parameters (Engel et al., 2014). However, nothing is mentioned on this aspect on the introduction as the authors directly assumed that there is no effect. But, the results are interesting for: 1) knowledge's on PP, carbohydrates, size fraction, etc and 2) for the possible modification under future pCO₂ levels. The title should therefore be modified to include the pCO₂ aspect. The no OA effect should be clearly and honestly assumed by the authors. Apart this OA aspect, the interpretation of the results is, in my opinion, good and discussion related to heterotrophic compartment is interesting. As mentioned by the other referee, the presence of bacteria in the chemostat should be clearly expressed earlier in the manuscript.

Response: The response to this comment has been dealt with in the response to referee 1. See also Figures 1 and 2 in the response to referee 1.

Referee: Authors should reconsider some paragraphs of the discussion that are more related to results than discussion. Also, the author start their discussion with results from other studies on plankton communities then come to their results and other results on *E. huxleyi* culture. This should be reconsidered in the next version of the manuscript, because from their chemostats on single strain it is not realistic to compare for example PER obtained at community level. Finally some paragraphs of the discussion do not finish on a clear take home message.

Response: We will take these comments into consideration when revising the manuscript.

Specific comments:

R#2: The title should therefore be modified to include the pCO₂ aspect.

Response: As mentioned in the response to referee 1 we will include the CO₂ aspect in the revised version. However, we will keep the focus on the process of exudation

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and composition of exudates and not include the absence of a CO₂ effect in the title.

R#2: Also, why does the 180 atm chemostat not taken in consideration here?

Response: For the present study we decided to focus on present day and future ocean conditions and did not sample the chemostat aerated with 180 μ atm CO₂ (glacial conditions). Due to practical reasons we decided to choose a present day and a future ocean treatment.

R#2: The no OA effect could be simply shown with one-two Figure(s)

Response: We will show the no OA effect in revised versions of figure 1 and 2: Data obtained during the steady state period will be shown separately for "present day" and "high CO₂".

R#2: While reading the M&M we imagine that axenic conditions were maintained, but we discover in the discussion it was not the case and non-axenic conditions have to be considered.

Response: We will give information of the non-axenicity in the chemostats in the methods section.

R#2: What CCHO composition of other NSW bring to the discussion? It merit to be related to the rest of the discussion.

Response: We include the data of Aluwihare for comparison with our data and to show that the change in CCHO composition, particularly the increase in Ara has been observed for *E. huxleyi* before.

R#2: We don't need stats everywhere but there are results without stats (e.g., size fractionated DO₁₄C production), is there any reason(s)?

Response: We will check the results section and add stats wherever needed.

R#2: Does the ER expressed in % is the same as PER?

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Response: Yes.

R#2: P15291, l.21: "CO₂" is not defined before

Response: "CO₂" will be defined as carbon dioxide (CO₂) at first mention.

R#2: P15292, l. 23: "PP" is used but not defined before but after (same page, l.29).

Response: "PP" will be defined as primary production (PP) at first mention.

R#2: P15299: There is no sentence confirming that the processes and parameters measured presented no temporal dynamic (chemostat culture) and therefore that the values expressed are average SD of the process or parameter during the X days of experiment. Therefore, if I understood, the results presented are the average for the X days of experiment and of the 2 pCO₂ treatments? (except for NSW concentration and composition of carbohydrate in Figure 3).

Response: We will add an explanation to the Data treatment section stating that average values and standard deviations were derived from all samplings including the replicate samplings over time during the steady state period in both the "present day" and the "highCO₂" chemostat.

R#2: P15299, l.9-10: it is expressed that cell densities of *E. hux.* in cells mL⁻¹ while in Engel et al. (2014) *E. hux.* cell densities are in cells L⁻¹, for clarity it could be standardized?

Response: We will adapt the presented cell numbers to per liter values in accordance to Engel et al. 2014.

R#2: Table 1 is cited but do not correspond to the actual Table 1 of the manuscript, as cell abundance data are not presented.

Response: Referring to table 1 will be deleted at his point.

R#2: P15299, l.17: I would suggest to express the different pCO₂ treatments different

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way than “ 337 ± 94 (350) and 623 ± 139 (750) atm” and use like in P15300, l. 18: value SD (present day) and value SD (high CO₂).

Response: We will adopt the referee's suggestion.

R#2: P15299, l.22: a sentence confirming that PP (PO14C, DO14C) productions were constant during the time of the sampling in stationary phase would be required (see above also).

Response: We will add a sentence confirming the steady state in the chemostat cultures.

R#2: P15300, l.7: “Table 1” should be “Table 2”?

Response: Reference to figures and tables will be thoroughly checked and corrected in the next version.

R#2: P15300, l. 14: “nutrient seawater (NSW)” should be modified to “natural seawater”?

Response: Yes. We will change “nutrient” to “natural”.

R#2: P15300, l. 16: Fig. 3a is cited before Fig. 2 has been cited. Response: Will be adapted.

R#2: P15301, l.12: “significant variation in monomeric” is used but no statistics are provided to confirm the “significant”.

Response: We will add the p value.

R#2: P15301, l.17: Fig. 4 is also the average of present and high CO₂? Could be precised here as “(Table 3 and Figure 3 and 4)”.

Response: We will provide more specific information in the figure caption.

R#2: P15301, l.19 and 20: should be “Fig. 3b, right panel” instead of “left”?

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Response: In this case referring to the left panel is correct. However, references to figures and tables will be corrected and thoroughly checked in the next version.

R#2: P15301, l.20: it should be choose between *Emiliana huxleyi* or *E. huxleyi*; there is a “and” that should be removed.

Response: We will use “*Emiliana huxleyi*” only once for the first time mentioned in each paragraph and use “*E. huxleyi*” afterwards. The “and” will be deleted.

R#2: P15302, l.24: a new result is provided and there is no information on how the cell abundance were converted to carbon (conversion factor used?).

Response: We wrote ‘cell normalized production of PO14C’ which implicates that the PO14C data were normalized to (divided by) the cell abundance. We will introduce the cell normalized values in the results section.

R#2: P15303, l.11: Marañón et al. (2005) have also shown relative constant PER over different ecosystem from eutrophic and oligotrophic with field samples.

Response: True. We will add a sentence to specify this important finding by Marañón et al. (2005) and cite the respective paper at this point.

R#2: P15303, l.15: What do you mean by culture? Laboratory cultures? Because I don't read that Marañón et al. (2005) or López-Sandoval et al. (2010, 2011) or Engel et al. (2013) are related to culture but to natural samples samples in field or in mesocosm conditions.

Response: We will change “cultures” to “natural phytoplankton communities”.

R#2: P15304, l.10: what is “LMW-DOC”? (not defined before) Response: We will add the definition as “low molecular weight (<1 kDa, LMW)”

R#2: P15395, l.9: should be “(Fig. 3 b, left and right panels)”?

Response: Reference to figures and tables will be corrected and thoroughly checked

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in the next version.

R#2: P15395, l.29: should it be “may be related to physiological and ecological functions”?

Response: Yes. We will add a “to” to the sentence.

R#2: P15307, l.23: I don't see that large and small fractions have different contributions.

Response: We wrote 'slightly higher (DO14C) proportions in the very large and small fraction'. Since it is more apparent for the very large fraction than for the small fraction we will revise the sentences to 'slightly higher (DO14C) proportions in the very large fraction'.

R#2: Figure 2: is this Figure 2 the same as Figure 3a (right panel) with the NSW concentration removed to have the freshly produced component? This figure is cited in the text but not very used, the values could be provided in the text and the Figure 2 could be replaced by a figure showing that there is no effect of increase pCO₂ on some of the parameters and processes measured.

Response: Showing the whole and the background corrected data for combined carbohydrates is on our opinion reasonable for an easier comparison with other studies. Therefore we rather change figure 1 and 2 by showing the data for present day and high CO₂ individually to visualize the no CO₂ effect and keep figure 3a (right panel) as is.

R#2: Figure 3: cited before Fig. 2 (see above). The a) and b) should be more visible.

Response: Will be adapted and a) and b) will be shifted to a more visible position.

R#2: Figure 4: the text on the right y-axis should be oriented inside

Response: We will change the text on the axis in accordance to the referee's suggestion.

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R#2: like Figures 1 and 2. All: as mentioned by the other referee for each Figures and Table headings, it should be define tCCHO, pCCHO, as well as results represent average between the two pCO₂ treatments over the experimental period. In the present version Figures and Tables are not self-sufficient (reading text is required).

Response: We will change the figure captions and table headings in accordance to the referee's suggestion.

References Engel, A., Cisternas Novoa, C., Wurst, M., Endres, S., Tang, T., Schartau, M. und Lee, C. (2014): No detectable effect of CO₂ on elemental stoichiometry of *Emiliana huxleyi* in nutrient-limited, acclimated continuous cultures; *Marine Ecology Progress Series*, 507 . pp. 15-30

Marañón,E., Pedro Cermeño, P., Valesca Pérez, V.: Continuity in the photosynthetic production of dissolved organic carbon from eutrophic to oligotrophic waters. *Mar. Ecol. Prog. Ser.*, 299, 7-17, 2005

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