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Biogeosciences Discussions

Interactive comment on "Factors influencing the stable carbon isotopic composition of suspended and sinking organic matter in the coastal Antarctic sea ice environment" *by* S. F. Henley et al.

Anonymous Referee #2

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The authors report a systematic set of observations on temporal changes in the d13C of organic matter formed in seawater and sea ice and sinking to the seafloor at a coastal site in the Western Antarctic Peninsula to further elucidate the factors that control d13C-POC variability and to strengthen our interpretation of organic matter d13C recorded in marine sediments.

The authors provide a clear overview of the main factors known to affect the d13C of phytoplankton biomass. To verify the importance of these factors in controlling the observed variations in d13C-POC, they determined concurrently seawater [CO2] (derived from alkalinity and pH measurements), d13C of DIC, and diatom species composition.

They found that variation in [CO2]aq cannot account for the observations and ruled out the possibility that their signal can be controlled by changes in growth rate. On the other hand, they find strong correlation between d13C-POC and the abundance of a specific diatom (P. inermis). From their observations, the authors conclude that, at this site, species assemblage is the main factor driving the observed variation in d13C. Interestingly, the frustules of the species responsible for the shift in d13C is not preserved in the sediment traps, even though the d13C signal they produced is recorded in the d13C of the sinking particles..

The paper is informative and well written. I only recommend a few, relatively minor, changes before publication.

1 – While the authors provide much detail on many of their sampling and analytical methods, they do not provide any information on how they measured pH. Yet, this is one of their most crucial measurements since they use alkalinity and pH to calculate [CO2] and assess the importance of the latter in controlling d13C-POM. pH must be measured precisely for this purpose and this is not a trivial task. I recommend that the authors provide details on how they measured pH and at what level of precision. Error bars should also be provided for their estimates of [CO2].

2 – Paragraphs between 11059/line 6 and 11060/line3

Here the authors are speculating on why d13C is so much lower in P. inermis. I find this discussion difficult to follow.

First we are told that CCM could be important. But then we are told that CCM produces heavy d13C and therefore P. inermis is not using CCM. Instead, the mixed assemblages that came before did use CCM accounting for their higher d13C. OK so far, although I am not sure on what basis the latter suggestion was made. But then we are told that any of the known CCM cannot explain the d13C of these mixed assemblages.

The following paragraph seems to say that we don't know why P. inermis is so different,

which is fair enough and I would leave it at that. I think the two previous paragraphs should be removed or clarified.

2 – Last conclusion (11067 line 15-16): “This study [. . .] highlights the need for parallel analysis of diatoms assemblages to reliably interpret sedimentary d13C POC records”

I disagree.

I think that the fundamental observation of this study for paleoceanographers is not just that shifts in diatom assemblages can have a profound effect on d13C-POC, but also that d13C-POC can be changed by diatom species whose frustules are not preserved in sediment. Therefore, combining d13C-POC with diatom assemblages will not help. The conclusion, which I think should be highlighted in this paper, is that the only way to stand a chance at interpreting correctly the d13C-OM record is to look at diatom-bound OM. Then, we would know what diatom species we are dealing with for a more accurate interpretation of the d13C record.

Minor points:

11043 line 24: I don’t understand why Kienast et al. (2001) is the reference of choice for ice core record of pCO2.

11045 line 13: what is a BOD bottle?

11049 line 11: which method was used to remove the swimmers?

11058 line 14: I don’t understand the meaning of “generic effect” of changes in diatom species composition

11060 line 21: Show how the contribution of ice algae was calculated (I guess two end members mixing, but how do they establish the end-members?)

Interactive comment on Biogeosciences Discuss., 8, 11041, 2011.