BG-2014-494 Carbon export in the naturally iron-fertilized Kerguelen area of the Southern Ocean based on the 234Th approach

F. Planchon, D. Ballas, A.-J. Cavagna, A.R. Bowie, D. Davies, T. Trull, E. Laurenceau, P. Van Der Merwe, and F. Dehairs

General comment

The manuscript aims to describe the 234Th and derived POC export variability in the Kerguelen plateau submitted to natural iron fertilization. The idea here is to estimate how iron fertilization could affect the carbon export in high productivity sites over and off plateau in early stages of the bloom. It appears that higher export was observed in the permanent PF meander and lower over and off the plateau. In the same way, higher export efficiency has been found in PF meander and lower in others stations. This indicates, as we expected, that phytoplankton biomass stage is crucial to determine the carbon export and that export efficiency is balanced between phytoplankton species, grazing pressure and bacterial degradation. The relation between iron fertilization and carbon export is less obvious as export is firstly and mainly linked to biomass structure and particle settling velocity.

The manuscript presents new results regarding POC export in the Southern Ocean in early bloom stage period using the 234Th approach. The results and protocols are well described. The discussion is consistent. However, in this section, some explanations appear unclear and have to be more detailed. Consequently, **I recommend the paper for publication with minor corrections.**

Manuscript Evaluation Criteria

Scientific Significance:

Does the manuscript represent a substantial contribution to scientific progress within the scope of Biogeosciences (substantial new concepts, ideas, methods, or data) ? **Good**

The manuscript presents new 234Th and carbon export data in the Southern Ocean. The 234Th approach is not new but it's a powerful proxy to determine the magnitude of the carbon export in addition to the classical sediment trap method. The idea to follow the carbon export variability in natural iron fertilization region is not new but the concept here was to conduct a cruise in early bloom stage.

Scientific Quality:

Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references) ? **Good**

The scientific methods are clear and robust. Discussions are relevant but some clarifications are necessary (see below).

Presentation Quality:

Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language) ? **Excellent**

The structure of the manuscript and the quality of figures are correct.

Access Review (Quick Report), Peer-Review & Interactive Public Discussion (BGD)

Manuscripts submitted to BG at first undergo a rapid access review (initial manuscript evaluation), which is not meant to be a full scientific review but to identify and sort out manuscripts with obvious major deficiencies in view of the above principal evaluation criteria.

Manuscripts rated 4 (poor) in any of the principal criteria are normally rejected without further review and discussion. Manuscripts rated 1-3 (excellent-fair) in all criteria are normally published on the Biogeosciences. Discussions (BGD) website, the discussion forum of BG, where they are subject to full peer-review and Interactive Public Discussion.

In the full review and interactive discussion the referees and other interested members of the scientific community are asked to take into account all of the following aspects:

1. Does the paper address relevant scientific questions within the scope of BG? Yes

2. Does the paper present novel concepts, ideas, tools, or data? Yes

3. Are substantial conclusions reached? Yes

4. Are the scientific methods and assumptions valid and clearly outlined? Yes

5. Are the results sufficient to support the interpretations and conclusions? Yes

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes

8. Does the title clearly reflect the contents of the paper? Yes

9. Does the abstract provide a concise and complete summary? Yes

10. Is the overall presentation well structured and clear? Yes

11. Is the language fluent and precise? Yes

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? No

14. Are the number and quality of references appropriate? Yes

15. Is the amount and quality of supplementary material appropriate? Yes

Details comments

The overall manuscript is clear but some clarifications/explanations are required in the discussion section.

Paragraph 4.1:

The station R2 is dominated by small phytoplankton and slow grazing. The reasons to explain a high ThE ratio is not clear. In line 453: What is the relation between iron limitation and a high ThE ? Explain more.

Paragraph 4.2:

The stations F-L are characterized by a massive bloom with diatoms in fast growing phase. In lines 496/497, authors suggest that the phytoplankton community was composed by a broad spectrum of size and taxa (mix between small and large species). What is exactly the structure of the biomass community ? How diatoms can be associated to an accumulation scenario as they are usually associated to higher export efficiency (ballast effect) ? Perhaps authors should consider the new production as directly linked to carbon export instead of primary production ?

Paragraph 4.4:

In this site (E1 and E3), the export was high in the beginning while the production was low. Both are going in opposite trend explaining the decoupling between production and export. In this case again, authors should consider maybe the new production instead of the primary production ?

Conclusion:

There is a misunderstanding in line 696. The highest carbon export was observed in station E (PF meander) and not in station A3 (see figure 6). Do authors consider the average of carbon export (100m, 200m and trap@200m) or just the maxima ? This should be clarified.