

Interactive comment on “Whole water column distribution and carbon isotopic composition of bulk particulate organic carbon, cholesterol and brassicasterol from the Cape Basin to the northern Weddell Gyre in the Southern Ocean” by A.-J. Cavagna et al.

Anonymous Referee #1

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The manuscript “Whole water column distribution and carbon isotopic composition of bulk particulate organic carbon, cholesterol and brassicasterol from the Cape Basin to the northern Weddell Gyre in the Southern Ocean” by Cavagna et al presents particulate organic carbon (POC), cholesterol and brassicasterol concentrations and their stable carbon isotope composition. The aim of the study is to unravel particle fluxes in the Southern Ocean (Weddell Gyre) which is within the scope of BG. The concept is not new but applied for the first time to the study area. Based on their data, the authors

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conclude that zooplankton fecal aggregates play a key role in carbon export for their study area. They also hypothesize that the release of sea-ice algae influences the isotopic signature of sterols in the open ocean.

In my view, the authors particularly present interesting depth-related changes of the ratio of brassicasterol vs cholesterol. However, the major conclusions regarding the contribution of heterotrophs and autotrophs are not substantiated by respective biological data and, therefore, quite speculative. I also have the impression that the analytical aspects of this work could be improved (see detailed comments below). For an improved representation of the data it would be helpful to present the analytical thresholds:

- What are the limits of detection and quantification for the biomarkers and POC? - How much POC would you need to reliably evaluate the stable carbon isotope composition (see also comments below)? - A reproducibility study based on ≥ 3 runs of the complete analytical procedure applied to one sample would improve the technical quality of the paper and would help the reader to assess the impact of the analytical variability

I also think the manuscript would benefit from professional editing to improve language (detailed comments below). The title could be shortened (e.g. “Carbon isotopic composition of bulk particulate organic carbon, cholesterol and brassicasterol from the Cape Basin to the northern Weddell Gyre in the Southern Ocean”). The conclusions chapter contains some discussion and summary.

Font sizes of axis labels should be increased. Also, there is some redundancy between figures and tables (e.g. Table 1 and Figure 4). In my view, some relevant literature is not considered (e.g. Fischer, 1991 Marine Chemistry 35, 581-596).

In summary, the manuscript still needs substantial revision in technical aspects, discussion and style.

Detailed comments:

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P1669 L16 “could be applied as proxies” L21 full stop missing

P1670 L21 comma missing after O’Leary et al. (2001) L23 “All three studies”?

P1673 L9/10 unclear, rewrite L14 delete “but” L15 “before being advected” L18 delete “occupation” L21 in table 1 a maximum of only 11 samples are displayed L25 replace “in situ large volume infiltration systems” by “HVFS” L29 “Prior to use,”

P1674 L3 replace “during” by “for” L10 I would suggest using “1-53 μm ” throughout the ms L21 replace “during” by “for” L17 important statement – any published references?

P1675 L9 “assume that the isotopic” L10 Is there any way of measuring the residue. This would add another level of analytical quality L12 Is this paragraph based on the methods of Boschker as well? -> reference

P1676 L6 “, and (ii) gas chromatography-mass spectrometry (GC-MS)” L14 replace “possible” by “potential” L22 “trimethylsilyl” throughout the ms and captions

P1677 L1 is there a reference for this procedure?

P1678 L1 what are the values for the detection limit? L5 “for that purpose” L18 turbidity sensor attached to CTD? Any signs of a nepheloid layer? L22 “due to the analytical method”; the heterogeneity of the natural system is of course hard to assess. However, the analytical errors could be easily checked by a complete triplicate run of a given sample. L25 “brassicasterol at depths below 750 m was below the detection”; what is the detection limit? This is also important for the validity of the biomarker ratios.

P1679 L17 “similar to S1” L23 “towards the seafloor”

P1680 L18 “systematically and reached a value” L22 delete “very”

P1681 L1 “limit in the deeper” L7 “converged” L8 what do you mean by “eastern route” L12 Hedges et al. (2000) might be a good reference here as well (Organic Geochemistry 31 (2000) 945–958) L19 “Taking into account the time lag” L26 delete “rather” L29 delete “rather”

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P1682 L5 Delete “since” L7 “. The discussion is focused on” L13 and L15 “barium” lower case L23 I wouldn’t term high variability a “trend”

P1683 L3 delete “As already highlighted in the Results section” and begin with “The general . . .” L6 “the decrease of bra:cho ratios reflects [. . .] its stabilization around 1 in the deep water” doesn’t make sense – rewrite L8 “reaching a maximum between 500” L9 Of course the bra:cho of 1 reflects similar concentrations of both compounds. However, as there is no systematic or kinetic relationship between both compounds I wouldn’t call it an “equilibrium” here. L21 replace “becomes” by “is” L25 this belongs to conclusions

P1684 L13 “estimating an” L19 “throughout the entire water”

P1685 Could you give epsilon values here as well for comparison? Generally I would suggest combining the following very short chapters.

P1686 L24 unify spelling of “fecal” in the ms

P1687 L8 “increase of 1-2” L11 delete “then” L13 delete “they studied” L25 “somehow” sounds vague

P1688 L3 “of the cell membrane” Do you mean “ ^{13}C - ^{12}C ” covalent bond here? “ ^{13}C - ^{13}C ” would be very rare L15 delete “all dataset”? “($\delta^{13}\text{C}$ SP–cholesterol = $(0.7 \times \delta^{13}\text{C}$ SP–cholesterol)”: one of these should be brassicasterol, correct? L20 unify “ CO_2 (aq)” throughout the ms L25 “when focus”? rewrite

P1689 L3 “in the cold” L14 “all dataset”? delete?; “mainly controls the isotopic”

P1690 L2 are these epsilon values? L18 “to the contribution of larger cells (diatoms).” L20 with only three slopes to compare your statement is quite weak. . . L25 reference?

P1698

How do you explain a 5.7 per mille change within a 10 m depth interval (S2)? Are the concentrations too low for correct isotope ratios? If yes, you might have to eliminate

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other values as well. 0.0 μg POC/L would imply that there are also no stable carbon isotopes. I didn't quite understand why the values in this table are different from the previous tables.

P1699 Caption: there is no "ND" in the table

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