

Biogeosciences Discuss., author comment AC3  
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## Reply on RC3

Wojciech Majewski et al.

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Author comment on "Unique benthic foraminiferal communities (stained) in diverse environments of sub-Antarctic fjords, South Georgia" by Wojciech Majewski et al.,  
Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-127-AC3>, 2022

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Dear Editor,

Together with the co-authors we prepared replies to the comments of the Reviewer 3. Thank you very much for these. They are all below. I am also attaching the pdf file of the text with track changes and corrected figures. Corrections in figure captions there are marked in yellow.

I hope all is clear.

Sincerely,

Wojtek Majewski

### **Lines 44-46: references needed.**

Sentence "Moreover, many calcareous foraminifera secrete their tests in equilibrium with ambient sea water, which makes them useful for reconstructing past water temperatures and salinities using proxies based on analyzing elemental ratios."

Is changed into

"Moreover, elemental and isotopic composition of tests of calcareous foraminiferal may be calibrated to reflect composition of ambient sea water, which makes them useful for reconstructing past environmental conditions, including water temperatures and salinities (de Nooijer et al., 2014).

de Nooijer, L.J., Spero, H.J., Erez, J. Bijma, J., Reichart, G.J. Biomineralization in perforate foraminifera, *Earth-Science Reviews*, 135, 48–58,  
<https://doi.org/10.1016/j.earscirev.2014.03.013>, 2014.

### **Line 116: from Table 1, it looks like CTD measurements are available from 19 stations (not 20).**

Table 1 is corrected. Thank you for finding this. They are 20 stations.

**Line 143: why not all van Veen Grab samples were analyzed for grain size?**

Indeed, four samples from four samples were not taken for grain size analysis due to limited material in the grab sampler. In the case of 20B and 26B, where only single grab samples were taken (due to heavy drift of the vessel), only samples from 20A and 26A were analyzed. In the case of station 22 the sediment was composed of a mixture of gravel, algae and finer sediments. The finer sediments were sampled for foraminifera, and the remaining material was not representative of the bulk sample. Sample 30 was originally taken as an extra sample for foraminifera analysis only, and no subsample for grain size was collected during the survey.

We added a short notice on it in line 133.

**Lines 161-162: "For stations SG-12, SG-13, SG-14, SG-16, and SG-28, specimens from both replicates were picked and further analyzed." Were replicates treated in the same way as the other picked samples? At line 134 the authors say: "Replicates from the remaining stations were archived.", so it might be worth clearly stating how the replicates were treated, to avoid confusion.**

Sentences "If samples yielded suspiciously few stained individuals, replicates were checked for consistency. For stations SG-12, SG-13, SG-14, SG-16, and SG-28, specimens from both replicates were picked and further analyzed."

are changed into:

"If samples yielded <300 stained individuals, specimens from replicates were also picked in the same way as the regular samples. Consequently, for stations SG-12, SG-13, SG-14, SG-16, and SG-28, specimens from both replicates were further analyzed."

I hope it is clear now.

**Line 200: Station SG-02 is not reported in Figures 1 and 2 or in Table 1.**

Yes, it should be SG-03.

**Lines 283-287: this information belong to the Discussion section.**

Its more an interpretation and it is important. I am afraid that if we place it in the discussion, in chapter "4.2.1 Inner parts of Cumberland Bay and shallow-water coves: strong glacial influence and sediment anoxia" this information will being somehow "hidden"

Thus, it is moved to the figure caption of Fig. 5, which now reads:

"Fig. 5. Total organic carbon to total sulfur ratio (TOC/TS) (a), carbon stable isotopes of bulk organic matter in the sediments (b) in relation to distance from fjord mouth, and relation between TOC and the  $d^{13}C$  values (c). Note different trends/mixing lines in (a): towards increasing TOC/TS ratios in Stromness Bay and towards lower ratios in Cumberland Bay, and in (b): towards less negative  $d^{13}C$  coves for Stromness Bay and coves and towards more negative values for the main basins of Cumberland Bay affected by tidewater glaciers. Dashed TOC/TS lines in (a) are after Berner (1983). They demarcate TOC/TS ratios suggested for anoxic (<1.5), periodically anoxic (1.5–5), and oxic conditions (ratios >5). Trends in (b) may represent the progressive mixing of different types of bulk organic matter, namely (1) material typical for open-marine conditions ( $d^{13}C \sim -24\text{‰}$ ), (2) likely petrogenic organic carbon supplied by glaciers ( $d^{13}C \sim -26\text{‰}$ ), and (3) organic matter derived from fresh terrestrial and marine sources ( $d^{13}C$

~-23‰)."

**Section 3.2.1 The authors should refer to the dataset they compiled and that they are planning to submit to Pangaea after the paper has been accepted for publication (although I recommend starting the process early rather than later because it might take a while for the dataset to be published in the repository).**

Yes, all Supplementary materials will be submitted to PANGEA. However, due to the long waiting time we are not able to provide the reference number to the dataset yet.

**Lines 310-311. I recommend adding a reference to the photos of these species in Supp. Figure S1-S6.**

References added.

**Line 369. Can the authors provide an estimate/opinion about how much the reduced staining time could have biased their results? They already provide a nice discussion on how they think that the modification they made to the FOBIMO protocol did not affect their results, but something similar is missing with respect to the substantial decrease in incubation time with Rose Bengal.**

A sentence was added:

"We believe it was a reasonable precaution, especially since 24–48 hours of staining can already provide satisfactory results (Bernhard et al. 2006).

Bernhard, J.M., Ostermann, D.R. Williams, D.S., and Blanks J.K. Comparison of two methods to identify live benthic foraminifera: A test between Rose Bengal and CellTracker Green with implications for stable isotope paleoreconstructions, *Paleoceanography*, 21, PA4210, doi:10.1029/2006PA001290, 2006.

**I would be nice if the authors were to add a (small) section regarding the applicability of their results, possibly to fossil data, as well as suggestions for future research directions.**

This section may be added at the beginning of the final chapter 5. Concluding remarks:

"As already indicated, benthic foraminifera can serve as valuable proxies for marine environmental conditions recorded in the geological record. It is therefore somewhat surprisingly that no attempts have been made to use them in order to reconstruct coastal environments around sub-Antarctic islands during past climatic oscillations, such as those associated with Quaternary glacial/interglacial cycles. Our results demonstrate that these microfossils have considerable potential in this regard. They seem especially suitable for studying paleoenvironmental changes in the most restricted settings proximal to tidewater glacial fronts in shallow-water settings that are strongly affected by processes taking place on land. These may be rich in organic matter, which is believed to exert a strong control on foraminiferal assemblage composition and diversity.

The sensitivity of foraminifera to environmental changes linked to current and likely future climatic changes are of more immediate interest...'

Addition future direction of studies, i.e., monitoring of faunal changes in reaction to rapid warming of the Drake Passage sector of the Southern Ocean is stated at the end of the final chapter.

**Table 1 – header 'Date' – please specify the year. Station SG-13, please revise**

**date format. Also, can the authors add additional columns to specify which samples were analyzed for grain size, TC, TOC, TS, and  $d^{13}C$  of bulk organic matter?**

Corrected, additional column "Sedimentary indices" added.

**Legend Figures 3, 4, 5, 6, and 9. "outer Cumberland Bay" – it should be Cumberland.**

Done. Thank you.

**Figure 2. I wonder if this figure would be more helpful if the data were grouped by sampling position with respect to the fjord (i.e., near shore, mid-fjord, outer fjord) rather than sampling area (i.e., Antarctic, Fortuna, Cumberland, Stromness bays). In case, Section 3.1.1 should be revised accordingly.**

We found easier to group and describe the CTD results as they differ between different fjords, that is why they are shown this way in Fig. 2. The difference between long, glaciated fjords of Cumberland Bay and short, unglaciated Stromness is very large and inner sites at these two locations are very different. The profiles from outer fjord setting are marked in yellow in all cases, on the same scales, so comparison between those on the present figure is also possible.

**Figure 5b. Can the authors include TOC data on this figure to better show the relationship between TOC and organic matter  $d^{13}C$ ?**

The additional graph (c) is added to Fig. 5. Revised caption goes as the answer for the comment for Lines 283-287...

**Figure 6. I am having a bit of a hard time deciphering the maps (?) on the y-axis of the plots. If the authors think that these are important, then I suggest adding them to the site of the plots, making them bigger, and explaining their meaning in the figure caption.**

If I understand correctly, these are not maps, but schematic images of glacier fronts. The sentences "Schematic profiles of the Nordenskjöld and Neumayer glaciers marked in bright and dark grey, respectively." Is added to the captions of Figs. 6 and 9.

**Caption Figure 8. FA should be defined.**

Done. It now goes "Important species for each foraminiferal assemblage (FA), encircled, defined by the Q-mode PC analysis (Table S2) are in bold, the dominant species are underlined

**Table S3 is not cited anywhere in the text.**

Added in chapter "3.2.4 Relation between FAs and environmental and sediment properties" and "3.1.1 Water temperature and salinity" consequently it became Table S1 and the remaining tables from supplementary materials are now re-numbered.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2022-127/bg-2022-127-AC3-supplement.pdf>