

## ***Interactive comment on “Distributions of dissolved trace metals (Cd, Cu, Mn, Pb, Ag) in the southeastern Atlantic and the Southern Ocean” by M. Boye et al.***

**M. Boye et al.**

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We warmly thank the two anonymous referees for their comments. All comments have been addressed here below and in the manuscript when needed.

Anonymous Referee#2

RC : The statement footnote with Table 1 as follows: “b) in general methods based upon ICP-MS yield higher dissolved Mn concentrations than methods based upon catalytic-enhanced flow injection. Furthermore there are significant difference between UV treatment and non-UV treated samples for dissolved Mn (<http://www.geotraces.org/images/stories/documents/intercalibration/Files/ReferenceSample>)”  
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November11/SAFE Ref Mn.pdf). “is recently falsified by the excellent agreement between shipboard FI and home ICPMS at Bermuda station by Rob Middag (presentation De Baar, Middag et al. at recent Ocean Sciences meeting).

AC : The SAFE consensus values of Mn (and the statement) were based on analyses on 7 ICPMS and 3 FIA methods, employed in 10 independent lab. It is promising that an excellent agreement between Mn measurements with ICPMS and FIA was found at BATS. However it seems premature to generalise a comparison between these two methods but issued from a single analyst to a general trend. We feel that more exercises of comparison of methods are still requested, and that any discrepancy (if any) should be understood.

RC : My advice would be that definitely a complete data table should be available, either in the article itself or in the accompanying electronic supplementary material, the latter assuming that the journal Biogeosciences offers the options of such supplementary material.

AC : The database can easily be obtained on the web site of the Bonus-Goodhope project ([http://www.obs-vlfr.fr/proof/php/x\\_datalist.php?xxop=bonusgh&xxcamp=bonusgh](http://www.obs-vlfr.fr/proof/php/x_datalist.php?xxop=bonusgh&xxcamp=bonusgh)) and will be posted rather soon on the GEOTRACES datacenter (<http://www.bodc.ac.uk/geotraces/>). This is now indicated in the text.

RC : Next it would be wise to consider having at least some vertical profile graphics of individual stations in either the article itself or the supplementary material. How many and which profile to place either in the paper or in the supplement I cannot say right now, because I have not seen such plots, in other words it is up to the authors to make such plots, discuss among each other on their meaning and implications, and finally decide on which plot is shown where, if at all.

AC : To further support the vertical and meridional trends of trace metals which are discussed in the results section, we have selected some stations to show their vertical

profiles together with those of major nutrients. Thus one figure has been added (Figure 4) and is now cited in the results section when relevant.

RC : Another verification of the accuracy of the data is by a more systematic comparison with previously published datasets. However all, except one, previously published datasets in the region are from years ago in the pre-GEOTRACES era of reference samples and improved sampling methods. Nevertheless when there is good agreement then both previously published data and the new data are proven to be accurate. On the other hand when there is no agreement then perhaps the previously published data of many years ago is more doubtful. For Cu I do not see such more formal comparison, if anything it could perhaps by comparison of Cu-Si plots shed light on the reported underestimation versus the SAFe reference samples, on the other hand the old data by Loscher et al may just as well have had its problems.

AC : We did not formally compare the Cu dataset of Loscher (1999) with our dataset, but we observed a consistent trend of the Si/Cu ratios in the Polar Front region. Indeed the Cu/Si ratios were higher during spring (Loscher, 1999) than during late summer (this study). This seasonal decrease over the diatom productive season is consistent with a preferential Si uptake by diatoms, and a decrease of Cu concentrations from 1.5 nM (Loscher, 1999) to 0.9 nM (this study). Although it is possible that the lower Cu concentrations we obtained were due to low analytical recovery in absence of UV-digestion (yet Loscher did not as well), and/or to differences in the method (ID-ICPMS versus GFAAS) or contamination problems, it seems difficult to strictly compare the datasets to discuss differences in methods, when it is shown that the productive season of diatoms can have an impact on the concentrations of Cu. A comparison at crossover stations achieved simultaneously or at least during the same season would be better.

RC : The one element for which an extensive recent dataset exists is Mn, and in fact some of the here reported stations do appear to either overlap or be very close to stations of Middag et al 2011 in the about 43 to 57 degree South range, and the complete database is reportedly (Middag, top of their page 2664) available. Thus a more formal

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comparison of absolute values of Mn between the two datasets appears feasible hence is advised.

AC : Two crossover stations were indeed achieved almost simultaneously between the Bonus-Goodhope transect and the Zero&Drake section (Polarstern cruise ANTXXIV-3) along the Greenwich Meridian during the International Polar Year. Hence we compared with the datasets of Mn (published by Middag et al., 2011) and of Cu (in prep. by Heller et al.) obtained at these crossover stations. A section (in the discussion part) and a figure have thus been added.

Minor corrections and typo's

RC : p.3580 Abstract line 19 typo: nano-flagelattes should be nano-flagellates. AC : corrected

RC : p.3583 line 20 (ultrapur HNO3 insert e : ultrapure HNO3. AC : done

RC : p.3584 section 2.3. line 5: Dissolved trace metal (Cd, Pb, Cu) concentrations .... should be: Concentrations of dissolved trace metals (Cd, Cu, Pb) ..... AC : done

RC : line 10: 0.024 M UpA HNO3 please replace UpA with a normal word, presumably ultrapure. AC : UpA was changed to ultrapure (also at line 21)

RC : p.3585 line 19-22 comprises important statement on less than adequate recovery of Cu: Dissolved Cu concentrations determined by ID-ICPMS were lower compared to the consensus values, especially in the deep samples (Table 1), possibly because the samples were not exposed to UV-irradiation prior their analyses (Milne et al., 2010). AC : we do not understand what the referee is asking us to modify since the statement is already clear.

RC : p3586 line 20 We emphasis that dry deposition insert e and z instead of s is preferable: We emphasize that dry deposition. AC : done

RC : p3588 lines 20-23: this is confusing, going from Weddell Gyre in first sentence to

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subtropical waters in second sentence implies going in northward direction and not in southward direction. Perhaps you want to say it like this, I am not sure, please verify what you want to state here and state this unambiguously: The highest Cu concentrations in surface waters were recorded in the northern branch of the Weddell Gyre (Fig. 3). In contrast in the subtropical waters, the dissolved Cu concentrations decreased in southward direction. AC : This is indeed what we meant, so we have modified the text with this sentence.

RC : p3589 lines 1-4: This is an example where separate plots for each station of vertical profiles at each station of dissolved Ag and silicate would be informative, in general the ODV plots on their own are not very informative. Vertical distributions of dissolved Ag generally showed lower concentrations in surface waters and increasing concentrations with depth (Fig. 3), similar to silicate (Le Moigne et al., 2012). AC : Some vertical profiles of Ag are now shown in Figure 4 together with Si.

RC : p3589 line 23: macro-nutrient is here and everywhere else in the text confusing for those old people that are aware of the original literature. In the original book chapter 'The Micronutrient Elements' by C.P. Spencer (Chemical Oceanography, Volume 2, Chapter 11) the micronutrients are N, P and Si as compared to macronutrient C and also conveniently in same 'Micro' as their micromolar concentrations in seawater. Recently there is a tendency for a 3 order of magnitude shift where here also the authors refer to N, P, Si as macronutrients and the bio-essential transition metals as micronutrients. This is unfortunate as causing confusion. For circumventing this problem our lab uses the words major nutrients for N,P,Si and trace nutrients for Fe, Zn, Cd, Cu etc. AC : to avoid any confusion we replaced "macro" by "major", and "micro" by "trace".

RC : p3590 line 2 and line 12: instead of SBdy please write full word Southern Boundary or better ACC Southern Boundary. It is good practice to only use abbreviations or acronyms that are commonly used by others is published literature, everyone knows the meaning of NADW or AABW but SBdy is not commonly used in the published literature. AC : we have changed SBdy to "ACC Southern Boundary" in the text, whereas

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SBdy was already defined in the caption of Figure 1.

RC : p3591 line 24: please add Ocean at the end of sentence: of trace elements to the southeastern Atlantic Ocean. AC : done

RC : p3594 line 5: replace shell with frustule, diatoms do not have shells but external frustules... incorporated into the siliceous frustule of diatoms .... also insert 'the' further in the same sentence: .. and that the ocean Ag cycle ....AC : both done

RC : line 27 insert 'to' as follows: .... (Loscher, 1999), compared to those in the .... AC : done

RC : p3595 line 14: relatively as follows: 2010). The relatively low concentrations.... AC : we do not understand the request from the referee there.

RC : p3597 line 23: again please in full AAC Southern Boundary. p3597 line 3: same. AC : done

RC : p3597 line 7: insert 'the' as follows: due to the limited .....AC : done

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