

Interactive comment on “Dissolved iron in the North Atlantic Ocean and Labrador Sea along the GEOVIDE section (GEOTRACES section GA01)” by Manon Tonnard et al.

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The paper submitted discusses the distribution and sources of DFe along the GA01 transect in the North Atlantic. The included DFe data looks great and is of big interest for the entire GEOTRACES community. Thus the manuscript is suitable for Biogeosciences. However, apart from the introduction and MM section, large parts of the result, discussion and conclusion section need substantial overhaul before the article can be published. I recommend major revision.

One of the biggest difficulties for me was to follow their argumentation in paragraphs. The authors did a great job to include large amounts of ideas and literature findings

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in each paragraph to explain their DFe distribution. However, in most cases the final outcome drowns by too much detail and unnecessary sentences that do not contribute to the finding.

Another problem I had, some discussions were performed superficial. When the authors discuss the aerosol distribution and DFe, for instance, they focus on elemental ratios and argue then, that not enough soluble Fe from aerosol particles was introduced. You may be able to get some insight about DFe and dust, by comparing fluxes and residence times, but not with ratios. You can use ratios to pinpoint sources, but quantitative assumptions are highly uncertain.

My recommendations are listed below!

However, I see the great potential of the paper, which will help to understand the DFe cycle in the high latitudinal ocean, between the arctic and subtropics. In addition, reduces blind spots in the GEOTRACES map (IDP). Anyway, I am happy to review a revised version of the manuscript!

With best regards,

Christian Schlosser

Abstract

Line 29ff: Air-sea interactions responsible for deep winter convection – Did you mean special cooling! Introduction

Page 2 Line 4: I would also include oxygen, the whole ventilation and redox state of the deep ocean depends on deep water formation in the North Atlantic and Weddell Sea

Page 2 Line 6: “stores” is maybe the wrong term; I would rather go with “accumulates”

MM

Page 3 Line 11: Remove “the” from “. . .aboard the N/O . . .”

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Page 3 Line 24ff: Two different filtration techniques were applied, 0.2 and 0.45 μm . Did you test that both approaches deliver the same result? I know water is restricted and sometimes sampling techniques need to be changed, however, please indicate why you did this and that swapping between both filtration techniques did not cause problems (offset, etc.)!

Page 3 Line 26: exchange “on” by “using”. By the way, did you apply pressured air to the Go-Flo’s to filter your samples. If so, please state that!

Page Line 30: You did you use 0.2% HCl to acidify your water, or? It reads like that! I assume you used concentrated HCl and the dilution with the seawater was than 0.2%.

Page 4 Line 2: The first sentence does not fit here; first you preconcentrated your sample using a SeaFAST system. Than the eluent was introduced via a PFA nebulizer and cyclonic spray chamber into your instrument (please indicate what kind of instrument you used, Element?). Please clarify!

Page 4 Line 11: gravimetrically is perhaps not the right word, you used a balance, right!

Page 4 Line 13ff: please include “..in-house standard seawater..”, was this seawater acidified in the same way? And how many samples did you run normally and how much samples were between each calibration curve?

Page 4 Line 16ff: Please include the analytical precision, the blank, detection limit of the analytical method. Please also include, how you calculated your errors, standard deviation of the three slopes? Or just the s.d. of the Element?

Page 4 Line 21: The CTD sensors were deployed on a stainless steel rosette. Correct? Please indicate and correct throw-out the rest of the text.

Page 4 Line 28: Name the parameter $\Delta\sigma_t$

Page 4 Line 30: What do you mean with perturbation, at which depth, please indicate in Table 1, for which station this was the case.

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Page 5 Line 2ff: Please indicate for which data you applied statistics on?

Page 5 Line 3: You did not measure the p-value, you maybe determined or calculated the value.

Page 5 Line 15: Include “. . .540 data points. . .

Page 5 Line 19: Exchange “The complete relational database. . .” by “ The complete data set. . .” Results

Page 5 Line 27: I would swap the two sentences “For a schematic of water masses, currents and pathways, see Danialt et al. (2016).” and “Hereafter we summarise the main features (Fig. 1 and 2).”

Page 6 Line 1: Give a depth range of the “Upper waters (0 – 800 m)” or so! Please also include this to the Intermediate and Deep waters.

Page 6 Line 5: Did you mean with central water the Subarctic intermediate water (SAIW). Please clarify! Please also increase the letter size in Fig. 2. It is really hard to see on a normal A4 print out! There are no currents in Fig. 2, either you somehow include them or remove the caption.

Page 6 Line 18: Please rewrite “..Labrador Sea Water (LSW).

Page 6 Line 29ff: I do not understand the sentence, starting with “During GA01, . . .”

Page 6 Line 30ff, I am not sure about, explaining the different flow paths, It is really hard to follow without any drawing. Other question, is it really important, since you are just interested in water masses and their DFe signal, and not about currents! I would remove that!

Page 7 Line 8: I do not see any silicic acid and nitrate data, please indicate concentrations and where they can be found.

Page 7 Line 9ff: It is hard to understand what you mean with “PIW is in contact with the

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atmosphere once a year (?) during the time of winter convection..” All together there is a lot of water mass information, that can be found elsewhere in the special issue, I would rather shorten that part of the result section.

Page 7 Line 30: Cannot check if this is correct! No nitrate data available.

Page 8 Line 11-12: This is school book knowledge, that is why we are using sensors! Remove the two sentences! However this entire section 3.2.2 needs an overhaul.

Page 8 Line 20ff: You can delete the first three sentences, they do not contain any important data!

Page 8 Line 29: Also station 61 and 78 are high, at least this is shown by your plot! And replace “. . .were around. . .” by “. . .ranged from. . .”

Generally, I would merge section 3.3, 3.3.1 and 3.3.2. Figure 4: Are you sure that single elevated values at site 40 (1500m) and at site 44 (500m) are correct. They just seem like outliers to me! Do we really need Fig.5 and 6, we see everything already in Fig. 4.

Page 9 Line 1ff: rewrite sentence, hard to read!

Page 9 Line 6ff: Please provide numbers for surface waters.

Page Line 9ff: But also at station 21 the DFe value is high. I do not think they are significantly different from the others, s.d. is $\pm 20\%$ and higher.

Page 9 Line 17: NEADW was very similar to the median GEOVIDE voyage but compared to test of deep waters lower, please rewrite! But the DSOW in the Labrador Sea was similar.

I am not sure Fig. 7 is really required. It just comprises what we already see in Fig. 4. And apart from some outliers (hydrothermal? Any Mn data), surface waters, NADW and waters from the Labrador Sea, concentrations are around 1nM. And as numerous times shown, it is impossible to fingerprint water masses with DFe.

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Page 10 Line 9: Others showed also elevated concentrations, for instance, station 44. However I understand why the authors decided to explain both station! For myself station 1 is not a problem, it is very close to the continental margin and influenced by lateral water mass transport than the other stations farther off-shore. However, site 17 is a bit more tricky. Did you reanalyze that station, that would confirm that the analysis was alright and you do not face just a strange offset. Anyway, I would discuss station 17, but please rephrase some sentences, it was really hard to grasp the issue you wanted to bring across. From the first sentence it should be clear what the issue is, than explain (eg. Concentrations are irregularly high).

Page 10 Line 23ff: Please provide the numbers from the other studies. Would it be possible to plot the surface DFe concentration and put the graph in the sup material. Than you can relate to that!

Page 10 Line 29: Please include an opening sentence, what you think is the reason (something similar to the last sentence). It is quite a step from Fe distribution to the origin of water mass mixing.

Page 11 Line 5: Explain what tip jets are!

Page 11 Line 10ff: This process is called winter entrainment (Tagliabue et al. 2014). Rephrase sentence and delete the last one (You just repeat yourself).

Page 11 Line 16: Also contaminated waters are introduced!

Page 11 Line 18: What is a stratification period? Be precise!

Page 11 Line 218ff: You can not compare the Mediterranean surface waters with MOW. Rewrite! DAI and DFe behave entirely different in the water column (residence time, organic complexation, concentrations, etc.), but both of them are likely to be scavenged from particles. So when a dust storm hits, both elements should decrease, do they actually do this in the water column of the Mediterranean sea. However, I am not too much surprised to see no DFe signal in the MOW. However, I suggest you have a

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look for DFe literature values from deep Mediterranean waters (GA04 is not available, a pity).

Page 12 Line 1: The entire section 4.1.3 is highly speculative. I agree elevated DFe in the Irminger Basin needs to come from somewhere, however, just looking at your Chl a data it is a very productive site, so presumably PFe concentrations are elevated as well, if so you should mention that, than it is just elevated remineralization and intense deep mixing during winter time that is responsible. However, you need to rewrite that section, to make it less speculative, look for existing data!

Page 12 Line 25: the elevated concentration on station 44, is not this just a single point?

Page 12 Line 26ff: Replace "above" by "at", and what are i) sediment inputs (these are particles), and ii) intrusion of an Fe-rich water mass, please be more specific!

Page 12 Line 33: How often have you analyzed the samples below 2.500 m at site 44. For me this is just one outlier, the two other samples from cast 44 in Fig 8A are not that out of the range.

Page 13 Line 10ff: Your argument is based on four data points, I could also put a straight line through, with a similar R2. However this entire paragraph is highly speculative! In an earlier paragraph you mention that DFe do not fingerprint different water masses, and now they do? You should remove this section!

Page 13 Line 22: unpublished sources? You need to explain that! Did you look through your Mn and Pb data, when they are also high, we talk about a hydrothermal input of trace metals.

Page 14 Line 3ff: There are no elevated DFe values farther east from the ridge! Where is the CGFC and BFC. Questions over questions!

Page 14 Line 13ff: I am confused. Do we talk about station 40 and 1.75nM at 1500 m, this is a single high value for me, and not located in ISOW waters.

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Page 14 Line 26ff: The DFe/DAI ratio in seawater can not be compared with the Fe/Al ratio of dust particles. Both elements have different fractional solubility's. So the ratio is always different! Remove!

Page 15 Line 1: Remove most of them does not add to the story!

Page 15 Line 5: What do you mean with "...below ground biomass.." In general I do not understand, why you excluded sediments, that could be an additional source.

Page 15 Line 14ff: Fronts refer to temperature and salinity changes in surface waters, such as the Polar Front, not in the water column. Call it different; just use the term "fresh water lens". Why multi-year-sea ice?

Page 15 Line 18ff: But glacial sources and land ice sheet is the same, just call, it "...freshwater induced by meteoric water and sea-ice melt." Then all is clear.

Page 15 Line 27: Where do you get the sea-ice fractions from, and explain how it works, include references! And what have brines to do with it, either ice forms or not! Brines are not part of your story, so far I can tell. Brines always form when sea-ice is formed, or in the desert by evaporation. And in line 31 you switch back to sea-ice formation, please stay with that term.

Page 15 Line 33: But brines usually sink, because they are heavier than the surrounding water!!! It is really hard to follow your argumentation here.

Page 16 Line 11: You have to explain how you produced these numbers, a citation in an earlier paragraph is not enough!

Page 16 Line 15: How do you lose a sample! Generally first you talk about the contribution of MW and then you switch to biological uptake of DFe, that in the same paragraph? You lose the reader here; this entire section needs an overhaul.

Page 16 Line 32: "... decreasing from surface to depth." Which depth, down to the bottom in 400 m depth? Be precise

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Page 16 Line 15-25: What has the tropical and subtropical North Atlantic to do with your work! I assume very little, please delete or at least reduce the text.

Page 17 Line 30: I would rather suggest to say: "Shelley et al. concluded that..." because without any trajectories here I can check, and more or less all this work was already published.

Page 18 Line 13: Do you mean DOM? Or organic material OM. However, you talk about DOM for 7 lines, and then you don't have the data. Once sentence should be enough to point out the importance of DOM.

Page 18 Line 16: This entire paragraph is very poor! It is interesting to compare elemental ratios of seawater with the soluble fraction of dust. But the reasoning here "...whether there was enough atmospheric input to sustain the SML DFe concentrations..." without any flux numbers, residence times is unscientific. Even more strange, at the end of the paragraph you don't even say, whether there is enough or not. Similar to the above, this needs serious work to make it worthwhile reading. There is too much hand waving, and too few data, sorry! I suggest you look up the actual flux numbers and then compare them with your data.

Page 19 Line 5ff: replace "on" by "in". And which similar pattern followed the station. Be precise! Sentence stating in Line 6 makes no sense, please rewrite!

Page 19 Line 11: What has the composition of sediments to do with your PFe value? Nothing...

Page 19 Line 15: "Intermediate behavior" of what? And then Chla? This paragraph is very hard to follow, what is the message you want to bring across, I can't tell!

Page 19 Line 26: "respect"? I respect you as a person, but samples usually don't respect anything?

Page 19 Line 30ff: How do you know its manganese oxide, just use particulate Mn. And why you do not include the transmissometer data. That is what you wanted to

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show, or not that resuspended sediments control you particulate fraction.

Page 20 Line 3ff: You did not do a PCA for dFe, so how can you be sure that the dim1 controls DFe? I cannot follow.

Page 20 Line 24: You did not show any evident information that would suggest that DFe is controlled by OM (you did not even show any data) and PMn. Like the others this paragraph needs more work!

Page 20 Line 27ff: Include "some" in front of "maxima, Please tell me the difference between "the relationship between DFe and biological uptake" and "Did DFe concentrations potentially limit phytoplankton growth?" This sounds to me very connected with each other! Why not discussing that in the follow up paper?

Page 20 Line 31: Include mean or average Plus standard deviation

Page 21 Line 4: Please include numbers! Following the text in the paragraph, it is very hard to follow, you jump between F:N ratios, water masses and Chl a. Try to keep it short and weed out unnecessary details. Otherwise you will lose the reader!

Page 21 Line 20ff: Can you explain to me why you calculate Fe* for the entire water body (Fig. 13) and explain DFe limitation of the phytoplankton community. They live in the first 100-200 m. Same fro Fig.14. Reading the last sentence of the section on page 22 "However, atmospheric loading (and especially Fe) was higher within the subtropical gyre than elsewhere in the GEOVIDE section mainly due to the proximity to mineral dust source (i.e. the Sahara Desert)." I feel I am still stuck in the Atmospheric chapter. Please shorten the paragraph and just say what you can prove with data.

Page 22 Line 14ff: The entire conclusion needs an overhaul!

Figures: Figure 1: great;

Figure 2: increase letter size, it is hard to read;

Figure 3: I am not sure that white contour lines for DFe help to understand Chl a. I

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would remove DFe and include this figure in the supplementary material.

Figure 4, 5 and 6(?): great

Figure 7, 8, 9, 10: can go in the supplementary material, maybe Fig. 9 you can keep

Figure 11 -14: in the sup mat., Maybe Figure 13 for the first 200 m can stay!

Table 3 and 4: belongs into the sup. material

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