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Biogeosciences Discussions

Interactive comment on "Co-limitation by iron, silicate, and light of three Southern Ocean diatom species" *by* L. J. Hoffmann et al.

Anonymous Referee #1

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Comments on the manuscript : " Co-limitation by iron, silicate, and light of three Southern Ocean diatom species" by L.J. Hoffmann, I. Peeken, and K. Lochte.

Reviewer : B. Quéguiner

The manuscript gives results on the effects of iron/light/silicic acid (not " silicate ") colimitation of three Southern Ocean diatoms. I think there are too many protocol problems to make the results coherent with what can occur in the natural environment. Silicic acid concentrations used are too high, Fe concentrations have not been measured, there are problems of sample storage for countings and morophological study. I think it will be difficult to get something serious from these data and it is certainly not possible to deduce something as to the effects of Fe fertilization in natural PFZ waters. There-

fore I do not recommend the publication of the paper which does nto deserve the high scientific standard expected for Biogeosciences.

Abstract 1) Replace " The effect of combined iron, silicate, and light co-limitation was investigated in two Southern Ocean diatom species, Chaetoceros dichaeta and Actinocyclus, sp. and one cosmopolitan species, Chaetoceros debilis, all isolated in the Southern Ocean (SO). " by " The effect of combined iron, silicate, and light co-limitation was investigated in three diatom species, Chaetoceros dichaeta, Actinocyclus sp., and Chaetoceros debilis, isolated from the Southern Ocean (SO). " Ch. dichaeta is cosmopolitan and Actinocyclus " sp. " refers to a genus which is not endemic from Southern Ocean. Also do not use " endemic species " when refering to Ch. dichaeta and Actinocyclus sp.

Introduction 2) " Diatoms can build up enormous blooms and, since there is only little frustule dissolution during the transport to the deep sea (Tréguer et al., 1989), they are responsible for almost all of the silica sedimentation in the SO (Abelmann and Gersonde, 1991). " Although I agree that the antarctic sediments are dominated by diatom frustules, the reasons are not unique and it does not only reflect slow dissolution. This is a controversial point as recent measurements have indicated high dissolution rates (which I personally don't trust) while other papers explain the biogenic silica accumulation by focusing processes.

3) " The extremely deep mixing and the resulting low light intensities are discussed as a third main factor influencing algal growth in the SO (Mitchell et al., 1991; Timmermans et al., 2001; van Oijen et al., 2004). " Please add the classical paper by Nelson and Smith (1991).

4) " Here we present the first study examining the effect of iron, light, and silicate colimitation on two Antarctic diatom species Actinocyclus sp. and Chaetoceros dichaeta limitation and one cosmopolitan species Chaetoceros debilis, all isolated in the SO, in laboratory experiments. " - same as comment #1.

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Material and methods 5) The notation of the different treatments by letters A to H is not easy for the reader. It would be better characterized as LFe/Llight/LSi to HFe/Hlight/HSi with " L " standing for Low and " H " standing for High. 6) " In these treatments free iron concentration were 1.55nM Fe' (all inorganic Fe species) estimated after Timmermans et al. (2001). " Without any Fe chemical measurements how can you take fro sure that no contamination could have occurred ? 7) " The iron, silicate, and light conditions of the different treatments are shown in Table 1. The high silicate treatments were grown in 200 μM Si, which is the concentration commonly recommended in f/2 media for diatoms. The 10 times lower Si concentrations n the low Si treatments (20 μM Si) resulted in a NO3- Si(OH)4 ratio of 44, which is close to the ratio that can be found in low Si regions of the Southern Ocean, where Si concentrations are depleted to $<$1 μM (Brzezinski et al., 2005; Coale et al., 2004; Franck et al., 2000; Sigmon et al., 2002). " This is a major problem with the experiment. The " low " silicic acid concentration is probably 20 times as high as the real low in situ concentration north of the PF while the high silicic acid concentration is 3 to 5 times higher thant the high in situ concentration south of the PF. Given the commonly reported high KS values of Fe-limited Southern Ocean diatoms, such a discrepancy between culture and natural concentrations makes any extrapolation to the natural ecosystem totally speculative. 8) " Therefore Fv/Fm and cell counts of the treatments A, B, and F are also only shown until day 46 (Figs. 1 and 2). " I don't understant the reference to the figures 1 and 2 which are photographs of the cultures. References should be respectively 5 and 4. 9) " For determination of cell numbers 2 ml samples were fixed with 40 μl Lugol's Solution (iodine - potassium iodide solution 1%, MERCK) and stored at 3°C in the dark until analysis. " How long did the storage last ? Did you use acidic Lugol ? 10) " Fixation with Lugol's Solution broke cell chains after some months of storage, which was not expected by the authors. " How can you rely on chain length estiùmation with such a problem ? 11) " Assuming a cylindrical shape of the cells, Ě " Chaetoceros cells are flatened and the section is not circular but elliptic ; so your estimation of cell volume is wrong.

Discussion 12) " The nutrient concentrations in culture media are usually much higher

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compared to natural conditions. This is necessary to reach sufficient biomass in a relatively small volume so that there is enough material for analysis. Nutrient concentrations that would be considered high in the field, such as the 20 μM silicate, were suitable for our low Si treatments due to the much higher biomass and showed to reduce algal growth in our experiments. " This is purely speculative !

Interactive comment on Biogeosciences Discuss., 4, 209, 2007.