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***Interactive comment on “Effects of iron on the elemental stoichiometry during EIFEX and in the diatoms *Fragilariopsis kerguelensis* and *Chaetoceros dicaeta*” by L. J. Hoffmann et al.***

**L. J. Hoffmann et al.**

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Authors reply to the review # 2 on the manuscript “Effects of iron on the elemental stoichiometry during EIFEX and in the diatoms *Fragilariopsis kerguelensis* and *Chaetoceros dicaeta*” by L. J. Hoffmann et al.

Reviewers comment # 1: Abstract, Line 18: I would rephrase the sentence to read “These results indicate that iron limitation does not always increase silicification in diatoms a E” I would recommend eliminating the last sentence of the Abstract. The variable effect of Fe on cellular Si in diatoms has been demonstrated several times going back to the work by Takeda in 1998 and the field work of Frank et al. So we have know for years that these relationships are more complicated than implied by Ed

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Boyle's statement that pumping iron makes thinner diatoms. So the statement that the issue "is more complex than hitherto assumed" is not entirely accurate. Assumed by who? Certainly not me, and likely not by many others who have read the literature that has emerged since 2000. I am not trying to undermine the significance of the work presented here, but I believe that the abstract would read just fine without the last sentence.

Authors reply: We changed the first sentence as suggested by the reviewer and rewrote the last sentence of the abstract as follows: "Our results therefore imply that simple cause-and-effect relationships are not always applicable for modeling of elemental ratios."

Reviewers comment # 2: Page 251, line 10: This paragraph is a bit inconsistent in its treatment of Fe effects. The physiological basis for an effect on N assimilation is presented, but the physiological basis for Fe effect on C quotas is not presented. I would recommend a brief treatment of both Fe effects on N and C metabolism.

Authors reply: We added the following paragraphs to the introduction: "For the synthesis of amino acids nitrate has to be reduced to ammonium. This occurs in a two step reduction, where the energy is derived from Fe-dependent photosynthetic redox reactions. Both enzymes involved, nitrate and nitrite reductase, have a high iron content. Additionally nitrite reductase uses reduced ferredoxin, an iron-sulfur redox protein, or the non-iron-containing flavodoxin to reduce nitrite to ammonium. Therefore, iron limitation leads to reduced nitrate uptake rates (Price et al., 1994) and lowers nitrate reductase activity (Timmermans et al., 1994). However, it is not known if the latter is due to a direct reduction in the enzyme activity or indirectly via a reduced supply of the reductant from photosynthesis. Besides nitrate, phytoplankton cells can directly take up ammonium and incorporate it into amino acids without the use of iron containing enzymes. Therefore the iron demand of phytoplankton cells is higher when growing on nitrate compared to ammonium as N source (Maldonado and Price, 1996; Raven, 1988). This implies that in low Fe waters like the SO ammonium uptake is preferred

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and new production is suppressed (Maldonado and Price, 1996) despite the surplus of nitrate. To fulfill the higher iron requirements for nitrate uptake, phytoplankton cells have higher iron uptake rates when growing on nitrate compared to ammonium (Wang and Dei, 2001).” “Besides nitrate uptake, iron affects the efficiency of the photosynthetic apparatus and thus probably carbon uptake. Iron is an essential part of the iron-sulfur proteins and ferredoxin of the photosystems and the heme and iron-sulfur proteins of the cytochrome b6/f complex. It therefore plays an important role in the photosynthetic electron transfer and is essential for photosynthetic energy supply (Greene et al., 1991; Greene et al., 1992; Greene et al., 1994). Under iron limitation a visible decrease in chlorophyll concentration (chlorosis) as well as a decrease in the photosynthetic efficiency ( $F_v/F_m$ ) is generally observed.”

Reviewers comment # 3: Page 251, line 30: This paragraph would benefit from a brief description of the current hypotheses concerning how Fe affects the Si content of diatoms to match the treatment for N and C mentioned above.

Authors reply: We added the following paragraph to the introduction: “It is generally assumed that higher silicification is caused by a reduction in growth rate and an increased duration of the cell in the G2 + M phase of the cell cycle during which Si uptake occurs (Martin-Jézéquel et al., 2000). Therefore, the effect of iron on the BSi : POC, BSi : PON, and BSi : POP ratios is an indirect one and the same effect is observed for other factors influencing growth such as temperature, light intensity, photoperiod, and macronutrient limitation (reviewed by Ragueneau et al., 2000).”

Reviewers comment # 4: Page 251, Line 23: I disagree that “It has generally been assumed” that shifts in diatom Si:N and Si:C ratios under iron stress is due to increases in cellular Si levels. This may be a simple language issue. Takeda (1998) showed a variable response of cellular Si to Fe stress and Franck et al (2003) come to the conclusion that increases in Si:N ratios under low Fe is mainly driven by declines in cellular N rather than increases in cellular Si. I suggest this modification: “While this can be caused by decreased cellular Si levels upon release from iron stress (Takeda

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1998, Hutchins & Bruland 1998) other studies show the effect to be driven mainly by increase in cellular nitrogen and carbon with little or nor change in cellular Si (Takeda 1998, Franck et al. 2003).”

Authors reply: We changed this sentence as suggested by the reviewer.

Reviewers comment # 5: Page 252, Line 20: change “compared” to “completed”

Authors reply: We changed this.

Reviewers comment # 6: Section 4.1: I am very glad to see that POP was measured. This is a nice addition as there is very little data on this topic.

Reviewers comment # 7: Page 260, Line 25-29. How about: ” This shift in the diatom assemblage towards more heavily silicified species may have overwhelmed any reduction in the Si content of individual cells.”

Authors reply: We changed this sentence as suggested by the reviewer.

Reviewers comment # 8: Page 262, line 8: change “it is generally accepted” to “it has been hypothesized”

Authors reply: We changed this.

Reviewers comment # 9: Page 262: Change “As in situ iron fertilization experiments are performed with the aim a E” to “One of the common goals of in situ iron fertilization experiments is to evaluate the effect of iron limitation on carbon export to the deep sea”. I don’t think the motivation for most iron fertilization studies was geoengineering.

Authors reply: We changed this sentence as suggested by the reviewer.

Reviewers comment # 10: Page 262, line 28: Change “stability” to “strength”

Authors reply: We changed this.

Reviewers comment # 11: Page 264, first paragraph. The results have another implication that may be worth reiterating here. I would add that changes in the implication

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for these changing elemental ratios for the elemental composition of diatoms must also be examined with caution.

Authors reply: We agree that this aspect should be mentioned and included the following sentence: "In conclusion we suggest that changes in the implication of these changing elemental ratios for the cellular elemental composition of diatoms should be examined with caution."

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