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Comment on bg-2021-312

Anonymous Referee #4

Referee comment on "Investigating the effect of nickel concentration on phytoplankton growth to assess potential side-effects of ocean alkalinity enhancement" by Jiaying Abby Guo et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-312-RC2, 2022

Review of "Investigating the effect of nickel concentration on phytoplankton growth to inform the assessment of ocean alkalinity enhancement"

Guo et al.

This paper studies the influence of changing dissolved Ni concentration on the growth and fitness (photo-physiological response) of a wide range of phytoplankton species. This topic is under-studied and, therefore, this report is an important addition to our knowledge of Ni biogeochemistry in the ocean. Interestingly, the authors found that most of the species are either insensitive or show a limited response to the applied Ni gradient.
Observed sensitivity for cyanobacteria and diatom species are in agreement with previous reports. Based on their results, the authors discuss the implementation strategy for the OAE and EW (utilizing olivine) to mitigate the increase in atmospheric CO2 and minimize the impact of associated excess Ni supply on marine ecology. Overall, the manuscript is well-written and structured. However, the manuscript needs to be revised before publication. I hope the comments below can help the authors improve their manuscript.

1) Discussion on the observed sensitivity of photo-physiological parameters (Fv/Fm and σ_{PSII}) to the applied Ni gradient seems limited. As shown, some species exhibit significant change in Fv/Fm or σ_{PSII} (e.g., Geitlerinema, Prymnesium parvum, Synechococcus). Also, Fv/Fm trends are very different for different species, for example, Synechococcus and Geitlerinema. It is less clear how Ni-replete or depleted conditions affect these parameters for different species. Do the authors suggest any causal relationship between changes in Ni and these parameters?

2) Based on their results or references to literature (lines 377-386), the authors suggest that total dissolved Ni ('free' plus ligand-bound) may influence the physiology of phytoplankton. As the experiments using Southern Ocean water (i.e., with high 'free' Ni)

were not performed with all the species, it remains uncertain in this study if organic complexation could have a significant influence on the Ni bioavailability for a wide range of species. In this context, the authors' conclusion (lines 440-442) on utilizing organic ligand-rich regions for OAE application, presumably due to reduced Ni bioavailability, seems non-aligned to the above-mentioned discussion in the paper.

Overall, I would recommend publication of the manuscript pending consideration to the issues mentioned above and other minor comments mentioned below.

Other comments

Line 50: What do you mean by 'quality'?

Line 53: Interested to know if, similarly, Mn would also be released. Mn is one such element which could be enriched in olivine, and rivers are one of the important external sources of Mn to the oceans. Mn is also a micro-nutrient for marine phytoplankton.

Line 60: Also, in the Atlantic (Middag et al., 2020) and the Indian Ocean (Thi Dieu Vu and Sohrin, 2013).

Line 63: 'bioactive element for phytoplankton in some areas' – appropriate reference(s) required.

Lines 139-141: Some insights are required on how the 'free' Ni concentration is estimated using the software visual MINTEQ 3.1. Either it could be included in the main text or else in the appendix.

Lines 149-151 (also 220-222): 'assumed the organic ligand…… in Aquil medium.' – some comparison (in numbers) and reference(s) are required.

Lines 196-198: "Typically, cells …. phase.' I did not understand this statement. Please explain and rephrase, if possible.

Line 213: What does "over- or under-fitting" imply?

Line 240 and 292: How small?

Line 306: It should be shown statistically.

Line 422: ‘A potential dependency …… ligands’ Is this established in the study?

Figures 2, 3 and 4: It is very difficult to read data from these figures. Optimal scales for y-axes of sub-figures should be used to so that trends discussed in the text are more apparent. If possible, results (sub-figures) can be divided according to different phytoplankton groups for better understanding.