

Reply to Reviewer #2

Dear Reviewer,

First, on behalf of all the authors, I would like to thank you for your precious suggestions that contributed for the overall improvement of the manuscript. Please find attached the new version. We would like to point out that in the first version there was a mistake in the calculation of the Fe and nssCa fluxes for the NEEM ice core. We repeated the calculations and the mistake is now fixed. However, this correction does not affect the interpretation of the dataset. We also included in Table 1, the nssCa concentration and fluxes since we referred to them several times in the main text.

We also introduced in the method sections more details about the analytical performances for Ca and Na and more indications on how nssCa was calculated. This info was missing in the first version of the manuscript (L122-131).

Best regards,

Andrea Spolaor

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We introduced a more detailed definition for “leachable Fe”. On this purpose, we decided to re-name it as “Total Dissolvable Fe”, following the terminology used by Edwards et al., 2006. More details are now reported at L75-78, L97-106 and L167-L171. Previous studies showed a significant correlation between TDFe and DFe (i.e. likely more available for the phytoplankton), indicating that when TDFe increases, DFe increases as well.

DU, Zhiheng, et al. Relationship between the 2014–2015 Holuhraun eruption and the iron record in the East GRIP snow pit. Arctic, Antarctic, and Alpine Research, 2019, 51.1: 290-298.

Xiao, Cunde, et al. "Iron in the NEEM ice core relative to Asian loess records over the last glacial-interglacial cycle." National Science Review (2020).

At L167-171 we state that a direct comparison between the NEEM record and TD and EDC cannot be done because of the different acidification times. However, the main features and general trends can be comparable. We also introduced a more detailed description of dust sources both regarding the NEEM ice core (L275-L285) and the Antarctic cores (L172-199).

Long-term productivity records in the North Pacific are sparse. We focused on two regions (the eastern and western side of the North Pacific) from where we retrieved both high-resolution productivity records for the last 27kyrs (Meheust et al., 2018) and long-term productivity records (McDonald et al., 1999; Haug et al., 1995).

We changed “transition zone” with “mid-latitude North Pacific” throughout the entire manuscript to be consistent with what reported in Amo and Minagawa, 2003.

L243-244: I would also hesitate to make statements as strong as the ones on lines 243-244 saying that “the transition zone of the North Pacific was sensitive to atmospheric Fe supply” and that “a direct link

between Fe transport and ocean productivity holds only in the transition zone of the North Pacific (L254-255) solely based on comparisons to one marine sediment record and without a better understanding of how much of the ice core Fe is bioavailable.

We totally agree with your suggestions. We changed the sentence accordingly at L378 (“MPP in the mid-latitude North Pacific might have been more sensitive to the atmospheric Fe supply”) and at L391 (“Merging our record with marine productivity data, we found that a link between Fe transport and ocean productivity holds in the mid-latitude North Pacific, suggesting that this area is sensitive to the atmospheric Fe supply”). For these reasons, at L397-399 we concluded that future investigations that aim to better quantify the more labile and bioavailable Fe fractions are needed to constrain realistic Fe supply and response of the marine ecosystem.

Regarding the Xiao et al., 2020 paper, we added a section in the manuscript at L229-240 where we discussed the differences between our record and their findings. We found that the different analytical procedures used might have led to different results. This highlights the need for a standardization of the trace element analysis among different laboratories to achieve reproducible and more comparable records.

L77-78: “what is meant by a “low-resolution sampling apparatus”? Is this just manual collection?

Yes. We changed at L88-89.

L88-89: is there a citation to support dissolution of particles after 30 days?

Yes, we reported the most relevant citation about acidification experiments: Koffman et al., 2014.

L105-L106: were any replicate samples run to assess reproducibility?

Reproducibility was tested both using the TM-RAIN04 reference material reading it every 50 samples (as well as for accuracy determination). We also read six selected samples (3 from the interglacial and 3 from the glacial period) 5 times during the analytical run and we found an average RSD% of 5% (7% for samples from the interglacial periods, 4% for samples from the glacial period). Details are reported from L122-129.

L169-170: provide some more context for these statements. Is this during modern times or from paleo studies?

It is referred to modern times (L253)

L213: what is the “transition zone”

As stated above, we changed the term to “mid-latitude Pacific Ocean” accordingly with the terminology used by Amo and Minagawa in their paper.