

Interactive
Comment

Interactive comment on “North Pacific-wide spreading of isotopically heavy nitrogen from intensified denitrification during the Bølling/Allerød and post-younger dryas periods: evidence from the Western Pacific” by S. J. Kao et al.

S. J. Kao et al.

Received and published: 17 September 2008

3-A. General comments This paper presents sedimentary nitrogen isotopic data from intermediate depths collected at the Okinawa Trough in the western North Pacific. The sedimentary record spans the last 30 kyr and shows interesting millennial-scale oscillations during the last deglaciation that the authors interpret as representing a widespread signal of denitrification occurring in the eastern Tropical North Pacific. In my opinion, the paper is still at a rather initial stage, more like a draft, but the data

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



deserves publication. There are many pieces of information that need to be included and a substantial revision of the manuscript and its English is necessary. At this stage I will not comment on all the specific aspects that should be addressed by the authors, rather I will give some general suggestions that, in my opinion, could help to improve each section.

Thanks for reviewer's comments. We revised our manuscript thoroughly by adding more materials and discussion and making corrections according to reviewer's suggestions.

3-B. Specific comments Introduction: 3-B-1. I think that what the authors mean by "unsettled issues of denitrification in the past" is not the intensity of water column denitrification in the North Pacific during the LGM, which is known to be reduced, but the net effect of this reduction on the global ocean N inventory and the d15N signal in oceanic NO₃. I would suggest revising the introduction and discussing in more detail why the selection of the Okinawa Trough coring site is pertinent to that particular "unsettled issue". Also, I would discuss here what would be the consequences of "settling" the issue.

The reviewer is correct about our intention, but we may have over-stated what can be settled by our new observations. However, we do believe that our data can contribute to better constrain the oceanic nitrogen budget.

Materials and Methods: 3-B-2. The age model construction for MD012404 is critical because they are comparing far distant records in a common time scale. I find the age model section too brief to say the least. Since the age model is based mostly on results obtained for this paper, the authors need to show all the information about the new radiocarbon ages, calibration method, other age constraints (presence of the volcanic eruption), etc.

In old version, we described the age model very briefly in Material and Methods, because the age model was based on an older version published by Chang et al. (2005).

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

However, as mentioned in the original paper, our results were based on a fine-tuned age model with 14 additional ^{14}C age dating samples. The new version has been published by Chang et al. (2008) who gives detailed descriptions. We refer to that paper in the revised manuscript.

Results and discussion: 3-B-3. Here the authors embark in a lengthy description/discussion on the study area and some potential influences on the sedimentary archive. I would suggest to write a separate "study area" section with a detailed oceanographic and biogeochemical description. In particular, given the inferred connection with the eastern North Pacific, I would like to see a review of the effect of NPIW on the local water column properties. Mapped sections could help here.

We provided a new section (as suggested also by Reviewer #4) for study area. More descriptions regarding the NPIW and its correlations with the water properties in the Okinawa Trough were introduced. We have combined the circulation scheme in the North Pacific with the distribution of N^* to illustrate the possible dispersion of ^{15}N -enriched nitrate originating from the eastern North Pacific.

3-B-4. Given the broad implications of a "North pacific-wide" denitrification signal, the interpretation of the sedimentary nitrogen isotopes as a "proxy of what" should be more carefully considered. How can we be certain that the millennial oscillations are not due to changes in local N fixation rates, as the authors recognize is a factor affecting their d^{15}N data throughout the record (may be through climate-driven changes in Fe input)?...(this is just one example!) As noted before, the discussion is embedded with the results and it is in general, very weak and vague. The authors seem to be content with just naming different scenarios for the observed variability but they failed to try to favor/discard one or another using their or other's data. Presenting more records to support their conclusions is one way to go.

We have separated the Results and Discussion in the revised manuscript. In Discussion, we have discussed various mechanisms that may cause changes in d^{15}N . Our

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

discussion demonstrated the consistency between our data and the model simulation of Deutsch et al. (2004).

3-B-5. In general terms, I miss a more detailed oceanographic discussion, i.e. implications of their data its interpretation for the ventilation history of the whole North pacific. What about connections with the Southern Hemisphere? Indian Ocean? Monsoons?... etc. One example: The authors argue that the causes of an increased denitrification in the North Pacific during warm interstadials are still debatable (ventilation vs. export productivity). Surprisingly, they have overlooked the fact that by "seeing" the signal in their distant site might provide something important to say about that debate! I am sure that the results of this study could add many interesting pieces to the ever growing N-cycle jigsaw puzzle.

We elaborate various mechanisms including regional N₂-fixation, local denitrification, denitrification signal from ETNP and even the abyssal release of isotopically heavy NO₃ in new Discussion.

Summary: 3-B-6. I think that this article could be considered for publication in Biogeosciences once a substantial revision is made. The data is certainly of interest but it is not ready for publication in its present form.

We made substantial modification in this version.

Interactive comment on Biogeosciences Discuss., 5, 1017, 2008.

BGD

5, S1714–S1717, 2008

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

