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Interactive Comment

# *Interactive comment on* "Influence of the Atlantic thermohaline circulation on neodymium isotopic composition at the Last Glacial Maximum – a modelling sensitivity study" *by* T. Arsouze et al.

**D. Vance (Referee)**

d.vance@bristol.ac.uk

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This paper presents results of model simulations of water column $\epsilon_{Nd}$ in the Atlantic for both the modern and the LGM. I am pleased to see this work, which represents an initial attempt to advance our theoretical understanding of this potentially important circulation tracer. But I have one major problem with the paper. There are a couple of pleas for more data here, but the problem for me is that none of the simulations presented reproduce the data we *do* have very well. So:

1) While the pattern of $\epsilon_{Nd}$ variation in the modern simulation looks good, the absolute values do not. It is stated here that NADW is slightly too radiogenic in the simulations.

The figure given for this disagreement here is 2 epsilon units. It looks to me that in places it is more like 3, and actually that is what a poster by these authors that I have just seen at EGU also states. Whatever the exact value, the problem surely is that this difference between model and reality is about the size of the LGM-Holocene change seen in South Atlantic records for example, e.g. Piotrowski et al. Surely this is a major problem. Indeed, I would go so far as to suggest that this problem means that it is time not to publish a paper but to first try to find out why the model is doing this.

2) We have a small amount of data for the deep North Atlantic in the past. For the North Atlantic the paper of van der Flierdt et al. on deep sea corals is referenced and discussed. While it is true that that paper contains no data on the LGM itself, it does suggest a remarkably homogenous deep North Atlantic through the deglacial, both with depth and through time. In addition, it also suggests no difference from the modern situation at 50 and 90 kyr. The authors do not reference a paper of our own (Foster et al. 2007, Geology 35, 37-40) which provides another robust constraint. The record is lower resolution than we would all like, but it is high enough to distinguish glacials and interglacials. We show that $\epsilon_{Nd}$ at around 2000m, between 20°N and 40°N, has changed hardly at all in the last 450 kyr.

We would all like more data but the fairly robust conclusion of the above two papers is surely that there has been no change in deep North Atlantic Nd isotopes through the last few climatic cycles, at least at depths between 1000 and 3000m. So the fact that the simulations presented here for the LGM seem to be suggesting changes to more radiogenic values of up to 3 epsilon units (I think, the colours are sometimes hard to read) is surely a problem.

3) Then we come to the Piotrowski record in the South Atlantic. This suggests a 3 epsilon unit shift to more radiogenic values at the LGM. All the simulations presented here suggest a change of 0.5-1 units.

One of the problems of the paper, I feel, is that the data we have is discussed in a not



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very straightforward fashion. So, for example, the first statement about the Piotrowski data in the discussion is that the model reproduces their value for the LGM. But this misses the point. Their next statement is that the model fails to reproduce the LGM-Holocene gradient. OK the statement *is* there but the main point is presented after a subsidiary one.

I also question the emphasis here on mean basin $\epsilon_{Nd}$ values. The explicit aim of the paper, stated as early as the abstract, is to examine the impact of changes in circulation on $\epsilon_{Nd}$ in the Atlantic. The main impact will surely be, and to some extent the existing data backs this up, changes in how Nd isotopes are distributed. So the abstract, for a start, definitely focuses too much on the basin mean changes. Though a lack of change in the basin mean is important, I don't understand the weight given to it here. I also really think that the abstract needs to state what for me is the main finding of this paper, that the model cannot reproduce the unradiogenic signature in modern NADW.

Page 313, line 9: more care with wording here. These same authors have demonstrated that Nd (or at least the isotopes) is not conservative at the margins. Also, while it is true that Nd is not directly involved in biological cycling, concentrations of Nd generally increase from surface to depth, implying a clear role for some sort of scavenging process that must involve biologically-generated particulate material to some extent.

Page 314, lines 16-17: there are real data constraints on this now and there is really little need for these kinds of statements. I agree that one might *expect* changes in the Nd end-members, I expected to find it, but these statements here are superseded by the recent van der Flierdt et al. and Foster et al. papers (see above) which just don't find it.

Page 318, around line 10: I don't agree with these statements that suggest that the model reproduces the data for the modern ocean well. See above. A 2-3 epsilon unit mismatch between modern data and simulation is the same as the LGM-Holocene change in the South Atlantic. These differences between the modern simulation and



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the modern data are much more significant than the authors suggest.

Figures: the sections showing differences in $\epsilon_{Nd}$ between the modern and LGM simulations are useful. But I also want to know when looking at, for example, Figure 3, is what the model predicts the $\epsilon_{Nd}$ of the deep North Atlantic to be at the LGM. To do this I first have to covert the colour scheme in the lower panels to a number that gives the difference with the modern and I then have to go to the top panel, again convert the colour scheme to a number and then subtract the two numbers. This is too hard! Could we at least have another set of panels on Figures 3 and 4 giving the absolute $\epsilon_{Nd}$ as well as the differences from the modern?

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Interactive comment on Clim. Past Discuss., 4, 309, 2008.