Clim. Past Discuss., 9, C3194–C3197, 2014
www.clim-past-discuss.net/9/C3194/2014/

Climate of the Past Discussions

Interactive comment on "Pulses of enhanced North Pacific Intermediate Water ventilation from the Okhotsk Sea and Bering Sea during the last deglaciation" *by* L. Max et al.

Anonymous Referee #1

Received and published: 22 January 2014

Lars Max and colleagues present new convincing evidence documenting large changes in North Pacific Intermediate Water (NPIW) formation rates across the last glacial termination. The authors follow a multi-proxy approach combining benthic-planktic foraminifera radiocarbon age differences (i.e. ventilation ages) and benthic foraminifera d13C measurements on a series of sedimentary archives retrieved from the (relatively) shallow Bering Sea and Sea of Okhotsk.

Their observations corroborate (and further document) enhanced ventilation at intermediate depths in the North Pacific at times where the Atlantic meridional overturning circulation (AMOC) was severely altered. Furthermore, the rich array of data presented in the manuscript does clearly not support enhanced "deep" water production during

HS1 and the YD as previously inferred based on model results. To me, the opposite trend shown by "intermediate" and "deep" d13C records combined with the ventilation ages is particularly convincing.

In essence, I support publication of the submitted manuscript provided the authors can address the following comments. The manuscript will undoubtedly contribute to the ongoing debate regarding the evolution of North Pacific subsurface ventilation in the past.

I hope the authors will find my comments helpful and constructive. Please do not hesitate to come back to me (via the editor) if my comments were unclear.

l. 46 – briefly outline why no deep water is forming today in the North Pacific to better orient the non-specialized reader

l. 52 – if I'm not mistaken, most of the models see deep convection induced in the NE Pacific under salinity perturbation experiments

l. 67 – please clearly define your definition of the term "ventilation". It has been misused again and again inducing some unnecessary controversy.

l. 69 – "... differences in radiocarbon ages between COEVAL planktic and benthic foraminifers"

l. 88 and throughout the manuscript – d13C does not allow to make inferences about past changes in ventilation. d13C is merely a proxy indicating the extent a water mass has been affected by carbon remineralization, overprinted by air-sea gas exchange kinetics. It is however helpful to trace changes in water mass characteristic (as correctly stated a few lines below – l. 118-122). This is certainly a semantic question, but using a very precise, sensu stricto definition will help dissipate misunderstandings.

l. 162 – reservoir ages. The authors apply a constant 500-900 yr reservoir correction for Okhotsk and Bering sea planktic foraminifers, respectively. While this correction seems entirely adequate, one could refine this reservoir age correction by comparing

the raw 14C ages derived from planktic foraminifers with the age model derived using magnetostratigraphy and benthic d18O stratigraphy (Riethdorf et al., 13). Alternatively, one could use the comparison between the SO201-2-12KL SST and the NGRIP temperature records to derive an independent age model, allowing to (roughly) address changes in surface reservoir ages.

l. 195 & Fig. 3 – please clearly indicate the different depths stations on the water-column profiles depicted in Fig. 3.

l. 203 – where are these poorly ventilated water masses originating?

l. 243 – ". . . these water massES. . ."

l. 255 – Galbraith et al., 07 as well as deVries and Primeau, 10 suggested quite significant changes in ventilation in the deep subarctic North Pacific across the last glacial termination. Well, I wouldn't define them as "minor", but maybe this is a question of appreciation.

l. 272-273 – maybe introduce the defining concept separating "intermediate" from "deep" water masses much earlier in the manuscript.

l. 278 – can the temporal evolution of the 13C gradient be shown in Fig. 5?

l. 310 – what is meant by "thermodynamic"? air-sea gas exchange?

l. 325 – this is also consistent with proxy data (Crusius et al., 04; Jaccard and Galbraith, 12)

l. 333-336 – not all the models show a warming during HS1 under enhanced PMOC. To my understanding this is largely model-dependent. In Okumura et al., 09, the AMOC shutdown during HS1 intensifies the Aleutian Low, which in turn induces a cooling tendency in the western North Pacific. So, in essence, I'm not sure whether an absence of warming in the SST proxy records is an absolute criterion to dismiss deep ventilation. But I agree that the cold SSTs during both HS1 and the YD as inferred in Max et al., 12

and Harada et al., 12 are at odds with the LOVECLIM simulations presented in Okazaki et al., 10 and Menviel et al., 12, which were used as prime arguments to drive deep convection in the North Pacific.

Interactive comment on Clim. Past Discuss., 9, 6221, 2013.