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Climate of the Past Discussions

# *Interactive comment on* "Reconstructing past atmospheric circulation changes using oxygen isotopes in lake sediments from Sweden" *by* C. E. Jonsson et al.

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General Comments

This manuscript is a synthesis of a number of published oxygen isotope records derived from calcium carbonate, diatom silica and cellulose deposited in Holocene lake sediments in Sweden. The authors review the mechanisms by which these isotope signals record past climate, and distinguish two typical scenarios: a) hydrologically open lakes, whereby the d18O of lake waters represent meteoric water, and thus their sedimentary signal is considered a function of changing d18O of precipitation; and b) hydrologically closed lakes, whereby the d18O of lake water is primarily a function of the



relative amount of evaporation/precipitation. They conclude that Holocene d18O signals from Swedish lake sediments provide a regionally coherent climate record which largely agrees with published glacial and biological evidence. They argue (following previous publications by these and other authors) that climate change in Fennoscandia during the Holocene was characterised by atmospheric circulation shifts, from zonal circulation associated with cool, wet climate to meriodional circulation bringing warmer and dryer conditions. To this extent they are successful. The text is clearly written and arranged and the figures are of a high standard. Their review of the mechanisms through which lake sediment d18O reflects climate change is thorough and accurate to my knowledge. The discussion of Holocene climate changes is largely convincing, however it could be argued that some of the conclusions are somewhat speculative, considering the relative paucity of available data. In this respect, the authors may consider plotting more non-isotopic data from the region to support their argument. The significance of these data with respect to the wider North Atlantic region is touched upon, but with limited depth. Ice rafted debris data (Bond et al. 1997; 2001) is presented, but the authors might consider whether there are more appropriate datasets for comparison – e.g. more up-to-date IRD records, ice core data or other palaeoceanographic data. However, generally speaking this is a high quality manuscript and there are few issues of major concern.

Technical corrections and specific comments

1611, line 12 –change determine to determining

1613, line 5 – specify temporal resolution of data when discussing d18O-T correlations (daily, monthly, annual?).

1614, lines 7-8 – "around plant organics" – reword this, maybe "during assimilation of carbon to form organic compounds... or something.. Maybe chop to simply "during photosynthesis". Also mention increase in pH as result of CO2 uptake – increases saturation of CaCO3.

1615, line 15 – species related fractionation: There is evidence that diatom species might affect fractionation (George Swann's marine core). You might not agree with this interpretation, but should cite it.

1615, line 24 – is 2.5 difference +ve or –ve? The absence of evidence of digenetic effects in high altitude lakes doesn't mean it doesn't or shouldn't exist. More discussion/defense required here.

1616, line 2 – isotopic composition ofÂň cellulose

1616, line 3 – how do you determine aquatic nature of cellulose? How do terrestrial sources differ isotopically and what are their typical fluxes to lake sediments?

1617, line 15 – snowmelt affects lake water d18O. Should therefore discuss differences between snow and rain d18O in previous section. Can snow be considered as simply cold rain, or are there other processes?

1618, line 20 – change to: "in lakes affected by evaporation, dry periods result in.."

1621, line 19 – early Holocene orbital forcing. It would be helpful to plot the insolation curve for comparison with the lake d18O data to support this discussion.

1624, line 7. Achieved not archived. Actually, reached or occurred would be better.

1624, line 16. Why not plot the glacial data for comparison?

1624, line 18. Amount not amounts.

1624, line 27. Occurred, not occurs.

1625, line 6. "Below normal precipitations.." replace with "reduced precipitation" or "lower precipitation".

1625, line 7. "The fact that d18O changed over Fennoscandia at the same periods as the IRD changes reveal a significant terrestrial response to changes in the North Atlantic". This sentence is unclear in it's meaning, but has some fundamental problems



too:

Firstly, is it a 'fact' that d18O changes in Sweden and IRD fluxes to the North Atlantic were simultaneous? The IRD record is much lower resolution than most of the lake records, and the dating is much more uncertain. That the amount of IRD within the sediment changes downcore also suggests changing sediment accumulation rate in this core. What are the dating errors for these records? For a rigorous assessment of whether or not these changes were simultaneous (within dating error), horizontal error bars representing dating error should also be plotted. I imagine it's possible that the two points with high IRD around 3 ka could coincide with periods of high or low d18O in the Vuolep Allakasjaure core.

Secondly, what constitutes a 'significant' terrestrial response? And what exactly do you mean by this? Are you alluding to the glacial/terrestrial response at the source of the IRD (which should be detailed more clearly – see below)? Or do you mean in the atmospheric changes over Fennoscandia as represented by the d18O in lake waters/sediments? Or do you allude to the glacial/ecological changes reported by others? Anyway – more clarity required here.

1625, line 23. "Wet conditions is related", change to "are related".

1625, line 29. Delete "preliminary" (repeated)

1626, line 3. Change "retrieve" to "achieve".

Figures and Captions

Figure 2. Not easy to solve, but the labels on the weather data figures are very small and may not be legible when printed.

Figure 5b. Lake Tibetanus. Is this simply higher resolution analysis of the same core as in Fig 4, or a different core? Do the data overlap? In any case, it might be useful to plot the lower resolution data too – i.e. completing the 5 ka timespan for this plot. It also looks like there are some similarities between the Tibetanus d18O and the speleothem

record in Fig 4 – is it worth also plotting the speleothem data in Figure 5?

Figure 5c. IRD – are these haematite stained grain concentrations? Please give more information re. what these data represent – i.e. types of mineral counted and likely provenance.

Figure 5d. Vuolep Allakasjaure – following a large gap, there are some extra, higher resolution data for most recent sediments. Is this correct, or an error in the plotting? Extra explanation in caption may help.

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Interactive comment on Clim. Past Discuss., 5, 1609, 2009.