

Interactive comment on “Neoglacial trends in diatom dynamics from a small alpine lake in the Qinling Mountains of central China” by Bo Cheng et al.

Bo Cheng et al.

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We would like to take the opportunity to thank the three reviewers for highlighting some very important generalisations in our interpretations of changing diatoms, guilds and beta-diversity. We have taken on board all their comments, but this has necessitated some substantial changes to the manuscript. 1. We have moved away from discussing beta-diversity and resources in general because (i) beta-diversity has so many different meanings to different disciplines, and (ii) the reviewers were right to point out that talking about resources in general in a palaeo paper was too vague. 2. We have restructured the discussion somewhat, where we now (i) interpret the major changes to species in

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an environmental context; (ii) discuss what changes to the diatom guilds might mean, before (iii) finally using this information to inform changes in compositional turnover (which is one form of beta-diversity). 3. In the original version of the manuscript we had undertaken PCA of the genera, but barely talked about these in the results. We have decided to remove the PCA of the genera from the revised version. 4. However, we have included TOC as an extra proxy (as all reviewers made a comment on only looking at diatoms), and this has been very useful in interpreting carbon sequestration in the lake during the neoglacial.

Other general changes:

• Aifeng Zhou is now a co-corresponding author along with Anson Mackay
• Keywords are more reflective of the revised manuscript

Reviewer 3 comments

Reviewer 3 wanted more information on the lake and its environmental context (see main comments to reviewer 2 above; what little information we do have, we have now included), and greater interpretation of the diatom changes themselves rather than relying on other papers. Given the responses to Reviewers 1 and 2 above, our interpretation of diatom changes is much tighter throughout the manuscript.

Specific comments:

Line 48: “Here we take...” Response: This is still grammatically correct, so no need to change

Line 49: “Multidecadal variability” on what data is this based? Response - this phrase has been deleted

Line 49: The dating seems to have a hard water effect (which has not been clearly addressed) and only five AMS dates. Please clarify how you have come up with this multidecadal (55 years) variability Response: the reservoir effect in bulk organic dating is common in the lake sediments (Zhou et al., 2015). The Yuhuangchi lake is

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located in a high altitude area, where organic matter mainly comes from terrigenous organic matter input and the lake's authigenic algae. Terrigenous organic matter often contains the old soil carbon input through to the lake. We also found that has obvious reservoir effect in 10cm dating result. A common way to judge radiocarbon reservoir effect is by using a linear or quadratic regression, and interpret the extrapolated surface of age as a radiocarbon reservoir effect (Hou 2012 QSR). Extra text and reference to Hou et al. 2012 have been provided in Section 2.1, P7, Lines 164-165

Line 55: "Important": :what does this mean here? Important compared to what? We have removed this word

Line 61: Consider to add "productivity" to keywords Done

Line 77. Is there a word missing after "sensitive" e.g. "area" or "environment"? No – the word sensitive here refers to the regions themselves

Lines 82-83. ".but their habitats to many: : " I don't really understand this sentence? Is this needed? Sentence has been corrected to "they provide habitats to many. . ." which is clearer; P2, Line 73-74

Lines 140 and 145: Is the elevation of the lake 3370m asl or 3365m asl? Good spot – the elevation has been corrected in the Figure legend to 3370m asl

Line 152. What kind of piston corer did you use? Please specify We actually used a homemade piston drill, similar to UWITEC's piston corer, which a plastic core tube with a piston inside and can be hammered into the sediment. So I think we can leave text as is

Line 153. ": :from the central region of Lake Yuhuang Chi". Why from the central area, was it the deepest part of the lake? or the main sedimentation area? or had it the longest sediment sequence? Please clarify Response: Yes, this was the deepest part of lake and also with flat lake floor

Line 154. Why did you use bulk organic sediment for dating? Where there no terrestrial

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plant macrofossil in the sediment? Response: Yes, that is correct; no macrofossils were found in the sediments. We have made this clear in the text – Lines 159-160

Line 158. Its rather unclear how you came up with the 1340 year reservoir age effect. Please clarify this in sufficient detail and add the number of dates to line 156 Response – both things done – see P6, lines 160-161

Lines 163-164. What does this sentence mean? How did you came up with a resolution of 55 years considering the uncertainties of the datings? What is the frequency of the diatom samples, 2mm, 5 mm, 1 cm: :? Response: We have added in that diatom analyse were performed on alternate 1cm-thick samples (P7, line 174). The 55 year resolution is got from the age model but seeing as we are still in the methods section we have taken this clause out.

Line 165. Please add a reference(s) after ": :standard procedures" Done: we have added in the reference to Battarbee et al. 2001

Lines 169-170. ": :such that suitable concentrations could be calculated". What does this mean, please clarify Response: we have taken this phrase out; it is not necessary

Line 207. Please add a reference after "C2 Data Analysis Version 1.7.2" Response: we have added Juggins (2014)

Line 214-> this is a bit odd paragraph as it contains only Table 1 and no written results? Response: good point; we have added in text to describe the lithology and introduce Table 1 (P9, Lines 226-230)

In Table 1 all +- ages are 30 years, is this correct? Yes

Lines 239-240. This sentence could be combined with the previous one as the information is almost the same Response: it is not clear what is being meant here so we have chosen to leave sets of info separate

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Lines 256-257. The first two sentences of the Figure caption could be e.g. "Diatoms with a relative abundance >3% in more than one sample are shown" – Response: the figure legend has been edited

Line 263. Please add "Relative abundance (%)" below the diatom stratigraphy figure – Response: rather than doing this, we have added in (%) to the Figure legend, making clear what relative abundance refers to

Line 272. Please add "Relative abundance (%)" below Figure 4 – Response: rather than doing this, we have added in (%) to the Figure legend, making clear what relative abundance refers to

Line 282. The beta-diversity value of 1.033 SD units is rather low and indicates relative subtle changes in the core (compare e.g. to values in Smol et al. (2005, PNAS)) – Response: I don't think that we need to respond to this just here, as it is a comment. But note from comments above re. beta-diversity, we have moved away from this concept to one that characterizes compositional change

Line 303. Fragilariaceae are also very common in high latitude lakes: : you may add a reference after this statement – Response: this is made explicit in the statement: "Fragilarioids are often opportunistic, dominating assemblages in alpine and arctic lakes with a short growing season and long periods of ice cover (Lotter and Bigler 2000)" (P14, Lines 322-324)

Line 329. *H. Schmassmannii* is not really replacing *S. exiguiformis* as its relative abundance varies between ca. 10- 15% during this period and *S. exiguiformis* decreases from ca. 50 to 40%...this does not really seem as a replacement, or? This is a too strong interpretation, please rephrase – Response: this paragraph has been reinterpreted according to other reviewers comments as well; we no longer have one species replacing another as such, but that changes in species are likely linked to changes in lake dystrophy (see P14, Lines 329-338)

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Lines 337-338. "...resources stabilised or even increased slightly: : ." How can this be seen in the results? Which species or index is confirming or suggesting this interpretation? At least not the relative abundances of Figs 3 & 4 – Response: we have changed this from "resources stabilized" to "compositional turnover stabilised" - this is now data led rather than an interpretation of resources, which we acknowledge above may have been over-interpreting what these scores can tell us (17, Line 389)

Line 343. High profile G2-diatoms dominate the whole zones 1 & 2 with an relative occurrence around 60% (see Fig. 4)...so there are no real changes here unlike is suggested – Response: we agree, and the text here has been modified substantially (P16, lines 348-371)

Lines 337-344. This whole paragraph consists of rather vague speculation without much of supporting data from the study. I would suggest you to re-evaluate your results and rewrite this accordingly – Response: we agree, and the Discussion has been rewritten, moving away from focus on interpretation of resources, which was not clear from the data

Lines 348-353. Please change the numbers of sub-figures to be 6b, 6c, 6d etc – Response: done

Line 358. Please add "Winter" before "temperature" – Winter-temperature anomaly graph has now been removed

Lines 368-369. This is not clear in Figure 6c – Winter-temperature anomaly graph has now been removed

Line 379. "Increasing diatom flux: : ."the relative abundance data does not really support this: : :could there be some problems in counting the diatom flux as the dating results are not very convincing and the sedimentation rate has a large impact on the flux values? Line 380-381. "Driven mainly by increasing *P. bodanica*": : :that is not clear when looking at Figure 3: : :*P. bodanica* seems to have a relative abundance

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around 20% before and after this period. Please check and re-think – Response: we have removed the clause “including planktonic species”, as reviewer is right, relative abundance data do not show major changes in the planktic guild at this time. Flux rates are of course tied to sedimentation rates, so we’re not clear of the point being made. We think the dating is rather robust, with all errors and uncertainty given in the manuscript.

Line 382. Beta-diversity does not increase between 1500-800 cal yrs BP. Please rephrase – Response: this has been amended

Line 398. How come beta-diversity is almost zero although in Fig. 3 a relatively diverse diatom population still remains? – Response: this is because beta-diversity means the change in species composition, not numbers of species per se. But as highlighted above, we have shifted our interpretation away from beta-diversity to compositional turnover which describes the data more accurately.

Lines 421-422. “: : planktonic diatoms show a distinct decline during the LIA”. Where can this be seen? In Fig 3. the P:L ratio does not decrease nor does the abundance of *P. bodanica* and also the planktonic guild is high in Fig 4? Please clarify – Response: This statement has been removed from our re-write of the discussion

Lines 425-426. I doubt that the appearance of *H. Schmassmannii* is due to low water temperature? Do you have any data when this species blooms? Or what its temperature optima is? This species can be found also in high latitude lakes – Response: the paper by Buczkó et al. 2015 reviews a number of different papers which state that this species is thermophilic, but also mentions at least one at the end which suggests that the species has been found during the younger Dryas at Krakenes, Norway. On balance, it is likely that this species does decline during cooler temperatures – so we have left this statement as it is, but we have augmented by bringing in possibility of other factors such as siltation also being important (P21, Line 463-464)

Line 429. “: : the lake becoming more shallow due to increased aridity”: : The

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planktonic species *P. bodanica* still occurs with a relative abundance of ca. 20%, which could indicate deeper water as it needs turbulence to sustain in the water column. Could one explanation be that the water became clearer due to the frozen ground and less inwash of e.g. DOC/humic substances? – Response: we suggest the lake become more shallow due to the appearance of *Denticula subtilis* which usually occurs in shallow lakes with high conductivity. (P21, Lines 463-465)

Lines 456-472. This whole paragraph is rather general based on other publications instead of your own results. I think this whole paragraph should be re-written so that it reflects the results of this study – Response: we have made greater reference to our own data in the conclusions

Line 548. Please add the reference for the program C2 here: – Response: this has been done – Juggins 2014

Lines 659-664. Please switch the alphabetical order of these two references – Response: done

Line 448. “: : around the time of the did: :” please re-phrase – Response: done

References used

Battarbee, R.W., Jones, V.J., Flower, R.J., Cameron, N.G., Bennion, H., Carvalho, L., Juggins, S., 2001. Diatoms. In: Smol, J.P., Birks, H.J.B., Last, W.M. (Eds.), *Tracking Environmental Change Using Lake Sediments*. Kluwer Academic Publishers, Dordrecht, pp. 155e201.

Hou, J., D’Andrea, W.J. and Liu, Z., 2012. The influence of ^{14}C reservoir age on interpretation of paleolimnological records from the Tibetan Plateau. *Quaternary Science Reviews*, 48, pp.67-79.

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Zhou, A.-F.* , He, Y.-X., Wu, D., Zhang, X.-N., Zhang, C., Liu, Z.-H., Yu, J.-Q., 2015. Changes in the Radiocarbon Reservoir Age in Lake Xingyun, Southwestern China during the Holocene. PLoS ONE 10(3): e0121532.

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