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Climate of the Past Discussions

Interactive comment on "Synchronous variations of precipitation and temperature at Lake Qinghai, NE Tibetan Plateau during the past 800 years and their relations to solar activity: evidence from Li/Ca ratios and δ^{18}O values of ostracod shells" *by* Z. Zhu et al.

Z. Zhengjie

zhuzhjie@163.com

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Interactive comment on "Synchronous variations of precipitation and temperature at Lake Qinghai, NE Tibetan Plateau during the past 800 years and their relations to solar activity: evidence from Li/Ca ratios and δ18O values of ostracod shells" by Z. Zhu et al. Z. Zhu et al. First, I sincerely think the reviewers for their comments. It is obvious that the manuscript has been given constructive suggestions and interesting discus-

sions by many reviewers, and we address them as follows: Referee 1: Dr. Blaauw's comment "Dr Blaauw pointed out that the date of QH2 is problematic by using the 137Cs and 210Pb of the alignmented core" Actually, due to the selection of enough ostracod shells by wet-sieving, we can not date the QH2 by the method of 14C, 137Cs and 210Pb. Thus, in the process of sampling, we have attendedly chosen the sampling site neighboured to QH0407-C-2 (Xu et al., 2006a), and the similar lithostratigraphy of core QH2 and core QH0407-C-2 supports the conclusion that core QH2 is neighboured to QH0407-C-2. QH0407-C-2 was dated by 137Cs and 210Pb, and the precipitation-controlled indices based on the chronology data derived from mass accumulation rate are similar in trends to the precipitation reconstructed from tree rings in adjacent region during the past 600 years, which further verifies the reliability of the geochronology data (Xu et al., 2006a, 2006b). This data was also supported by the AMS 14C of QH2000, whose age is 2400 yr BP at 120cm, indicating that core QH2 accumulated linearly during the past 800 years. In addition, Henderson et al. (2009) have reviewed a number of dates of Lake Qinghai sediment core by 14C method. Results show that most of the depth sedimentation rates are 0.05cm/yr on the basis of 14C dating.

Holmes J "All of the discussion that relies on such correlations should be cut from the MS, and the author……" We agree with you. Due to the scarcity of high resolution temperature records, temperature variations at Lake Qinghai and NE Tibet has seldom reconstructed during the past millenium, and the only is in tree rings. However, many variables can affect the tree ring widths, such as temperature and precpitation. So, the temperature variations reconstructed by tree rings is also uncertain. In the revised paper, we will compare the meterological records with the Li/Ca ratios and oxygen isotope of ostracod shells, which will further verify the data of this paper. "On page 1500, the authors maintain that changes in effective precipitation are mainly responsible for shifts……" Based on our investigation and other studies, it is obvious that P-E is the main factor to control the oxygen isotope composition of ostracod shells. Although oxygen isotope composition of precipitation has the potential effect on δ18O of lake water, an inverse relationship between the amount and δ18O value of precipitation in

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monsoon dominated regions suggests that precipitation is the main factor to affect the δ18O of lake water, and also δ18O of carbonate. In addition, a number of researchers have used δ18O of ostracod shells at Lake Qinghai to deduce monsoon variations, thus precipitation variations (Lister et al., 1991; Zhang et al., 1994; Yu and Kelts, 2002; Henderson et al., 2003, 2009;. Li et al., 2007; Liu et al., 2007) In other places, such as Sugan Lake (Holmes et al., 2007), since the ice melting water is the main source of lake water, δ18O of ice core may affect the δ18O lake water. The other reason is that this place is not the monsoon dominated region (e.g. westerly jet stream), and the δ18O of precipitation may not follow "the amount" rule. "On page 1502. I have a number of concerns about some of the assertions made here. Ostracod shell formation is a complex biomineralization process and it is dangerous to assume that because temperature dependence of Li partitioning is apparent for other carbonates, the same should be true for ostracod shells. For example, oxygen-isotope fractionation into ostracod shells is very different in sign to that for other carbonates and it may be that Li partitioning is similarly affected. The correlation between oxygen isotopes and Li/Ca for the Qinghai ostracods is convincing, but the possible existence of compounding variables is an issue that should not be overlooked. I therefore believe that it is premature to suggest that a causation exists." Since both field and laboratory studies have showed that that Li/Ca ratios of carbonate are chiefly dependent on temperature variations (Marriott et al., 2004a, 2004b; Montagna et al, 2006), we have drawn the conclusion that Li/Ca ratio of ostracod shells is a reliable temperature indicator. In this paper, we have also considered the Li/Ca ratios of lake water, which have in detail described in the manuscript. The good correlation between meterological record and Li/Ca ratios of ostracod shells also supprted our conclusion (Fig.1).

Fig.1 The correlation between temperature and Li/Ca ratios of ostracod shells "The correlation with the Dulan tree-ring record as evidence for temperature control rests on a chronology that is possibly unreliable, as discussed above. Moreover, I am not convinced that the Dulan tree-ring record is necessarily a good proxy for the temperature at which the Qinghai ostracods formed anyway, not least because the ostracod

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shells would have been secreted at 20 m depth in the lake (they are benthic), and the relationship between deepwater and surface temperature in Qinghai is complex. At the very least, this needs to be discussed." As mentioned above, Dulan tree-ring itself is not a reliable temperature proxy, due to its variable factors. Therefore, we will compare the meterological records with the Li/Ca ratios and oxygen isotope of ostracod shells to testify our results. If Lake Qinghai water mixed homogeneously, we can believe that the temperature difference between surface and deep is constant, as the oxygen isotope difference between authigenic carbonate (surface) and ostracod shells (deepwater) (Henderson et al., 2003). So the temperature variations of deepwater can denote the surface. "technical correction Please not correct spelling of family name of von Grafenstein – it is incorrectly given as Grafenstein in the text and references." I have modified this in the revised paper.

Annoymous Referee 2 "The sedimentation rate derived from 210Pb radioactivity correlates quite well with that from 137Cs" From the 210Pb and 137Cs data, the average mass sediment accumulation rate derivd from 210Pb is 0.018 gïČŮcm-2ïČŮa-1, and the mass sedimentation rate calculated from 137Cs is 0.018 gïČŮcm-2ïČŮa-1. So, we believe that the the sedimentation rate derived from 210Pb radioactivity correlates quite well with that from 137Cs. "The jump in the sedimentation rate around 5 cm is not well explained. Why is this jump so abrupt and how well is it defined?" The jump in the sedimentation rate around 5 cm is calculated from the difference from mass sedimentation rate and depth sedimentation rate. As we know, the reliable dating method is using the mass sedimentation rate due to the compaction of surface sediments during early diagenesis. The jump so abrupt may be also ascribed to the compaction of surface sediments (Xu et al., 2007 for details). "It seems unlikely that the depth-age relationship is linear below 5cm considering the precipitation changes as suggested in the paper" The dating of bottom sediments has been used the extrapolation, and this data are verified by comparison to the AMS 14C data (Liu et al., 2002). Due to variable factors including precipitation, we should use the average depth sedimentation rate. Zhu et al. discuss the connection between d18O and precipitation. However,

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to me the most interesting figure in this context is missing: A comparison of d18O of the ostracod shells and measured precipitation values (or a proxy for past changes in precipitation in the region). Zhu et al. refer to a paper in preparation by Zhu et al. that, in my opinion, should be published before ongoing discussions about the data are made (the present paper). The same is true for the Li/Ca ratios. One would wish that the claim of a "temperature-controlled proxy" is somehow justified by comparison with recent instrumental data or proxy data from nearby records. The good correlation between temperature and Li/Ca ratios of ostracod shells suggests Li/Ca ratio is a reliable temperature indicator (Fig.1). The same is for δ18O values of ostracod shells.

Fig.2 The correlation between precipitation and δ18O values of ostracod shells Figure 7. I am not really convinced that precipitation and temperature agree so well during the last 40 years at Lake Qinghai. The authors should use objective methods to justify this conclusion. From looking at this figure I would conclude that temperatures show an increasing trend but that the precipitation is rather stable. Only some of the shorter-term features seem to agree. In addition, it is not clear if the data are smoothed or if they represent annual values? We agree with you. We have added the correlation coefficient in the Fig.7. The data in this paper represent annual values. The comparison of climate proxy data and solar proxies should again be done in an objective way. Looking at figure 8 I am not convinced that there is indeed a good agreement between climate and solar activity. A correlation analysis could help.Figure 8b shows a record inferred from 14C data. However, the reference (Stuiver et al., 1998) refers to the original 14C data. As the reviewer said, we also want to give a correlation analysis. However, we have not obtained the 14C data. In the revised paper, we have added original data inferred from Stuiver (1998). We suggest that solar activity may be the main driving force of temperature and precipitation variations at Lake Qinghai on decadal scales during the past 800 years in the manuscript, but do not exclude impact other factors. Although temperature and precipitation record and solar activity record are not exactly corresponding with each other in phases and details, they correlated with each other on decadal scales, if considering the different resolution between the three series. The

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curve of Fig.8 C represents the 5-point running means. The 14C and 10Be data derived from Stuiver (1998) and Muscheler et al. (2007) have revised after removal of linear trend (Tan et al., 2008) “The use of references should be improved.” We have modified the citation of references in the revised paper. “778$\times$108 km3 seems to be too large compared to the surface area of 4340 km2. The same for Mono Lake. I guess there is a confusion between m3 and km3” Sorry, I have a confusion between m3 and km3, and I have modified it in the revised manuscript. “Temperature variations... are these daily mean temperatures or maximum temperatures... please provide the details.” It is mean temperature. “The precisions was less than... do the authors mean that the deviations between the 3 duplicate samples were smaller than the measurement accuracy?” Yes. “The reference list does not fit to the claims in the sentence. For example, Hodell et al. do not discuss the Asian summer monsoon” I have in detail revised the reference listed in the paper. “beacause-> because” I have modified it in the revised paper.

Interactive comment on Clim. Past Discuss., 5, 1493, 2009.

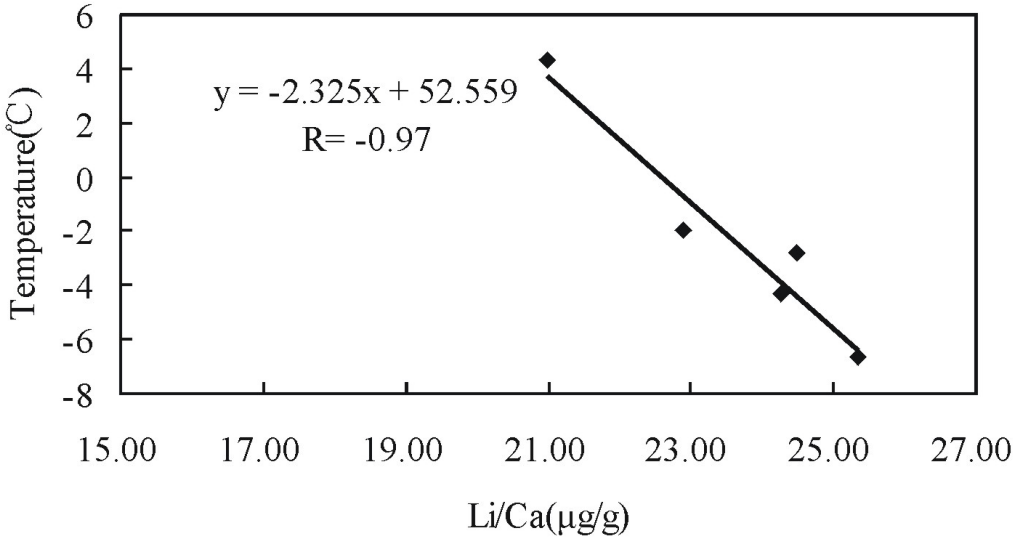
y = -2.325x + 52.559
R= -0.97
Temperature(℃)
6
4
2
0
-2
-4
-6
-8
15.00
17.00
19.00
21.00
23.00
25.00
27.00
Li/Ca(μg/g)

Fig. 1.

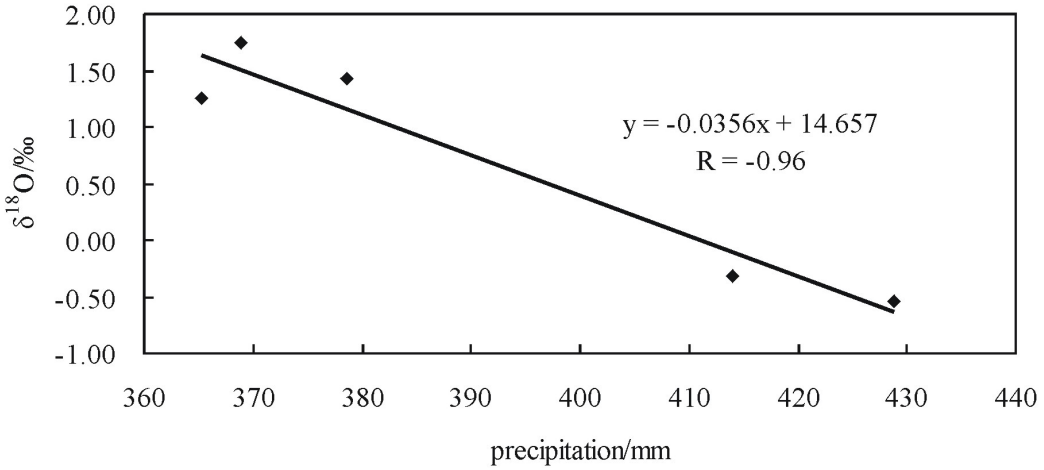

Fig. 2.

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