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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.

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General comments This paper is concerned with an 800-year long lake-sediment record from Qinghai Hu (Lake Qinghai), which lies on the NE Tibetan Plateau. The record is based on oxygen-isotope and Li/Ca ratios in shells of the benthic ostracod Eucypris inflata and the sediments dated using short-lived radio-isotopes.

A number of authors have used oxygen-isotope ratios of carbonates (ostracod shells,

'authigenic' carbonate) from Lake Qinghai sediments to reconstruct past climate over the past millennium, the whole Holocene and the last glacial-late glacial interval, and have shown convincingly that these ratios are controlled primarily by the oxygen-isotope ratio of lake water. Interpreting changes in the water isotope composition is, in my view, still open to debate, although it seems likely that the ratio of precipitation to evaporation (P-E, or effective precipitation) is probably one important control, as suggested in the present MS. The second main proxy discussed in this paper, Li/Ca, has not to my knowledge been applied to lacustrine ostracods, although previous work on marine carbonates suggests a negative correlation between Li/Ca and carbonate. Using this reasoning, and correlations with the carbonate oxygen-isotope data from Qinghai and other palaeoclimate data from the NE Tibetan Plateau, the present authors argue that Li/Ca in Lake Qinghai ostracods is also a water temperature proxy. They then go on to examine temporal relationships between Lake Qinghai temperature (from Li/Ca) and effective moisture (from oxygen isotopes) and their palaeoclimatic implications.

If the authors' reasoning and conclusions are correct, they make some very important findings about Li content of non-marine ostracod shells and its palaeolimnological significance, and about the climate of the NE part of the Tibetan Plateau over the past 1000 years. However I have a number of concerns about the data and their interpretation that raise questions about the conclusions drawn. These concerns are detailed below

Specific comments The age model for the core is, in my view, inadequate because it involves unwarranted extrapolation from the 210Pb-137Cs dates. So, whereas the period back to about the mid-19th century is well dated, the uncertainties for the earlier part of the sequence are both large and unquantified. Moreover, they are never discussed. So, although the temporal relationship between Li/Ca and oxygen isotopes in ostracods is not age-model dependent (because both sets of analyses were performed on the same material), those relationships that are established by correlation between

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the Qinghai material and other sequences, such as tree rings, are much less certain. In my view, all of the discussion that relies on such correlations should be cut from the MS, and the authors should only base their discussions on analyses that have been undertaken on the same core material, which are of course unaffected by dating uncertainties, or correlations with other sequences for the past ∼150 years, for which the 210Pb-137Cs age model is applicable.

On page 1500, the authors maintain that changes in effective precipitation are mainly responsible for shifts in the oxygen-isotope composition of Qinghai lake water, and that the amount of rainfall is the main driver of P-E variations. The authors base the latter argument on the fact that there appears to be a good correlation between annual precipitation near Qinghai and a drought/flood index for Xining (∼150 km from Qinghai) for the period 1960 to 2000 AD. Although I do not doubt that precipitation amount is a significant control on effective moisture, other factors may be important on centennial and millennial timescales. In particular, the oxygen-isotope composition of rainfall has the potential to change on longer timescales, as shown by, for example, Tibetan Plateau ice cores, and such changes may affect the composition of Qinghai lake water (see Holmes et al. 2007, for an example from a different Tibetan Plateau lake).

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. 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

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tree-ring record is necessarily a good proxy for the temperature at which the Qinghai ostracods formed anyway, not least because the ostracod 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.

Sections 4.4 and 4.5. In light of my concerns about chronology, I would argue that much of what is written in these sections is premature and speculative: in the absence of a more robust chronology, I suggest it is removed from the paper.

technical correction Please not correct spelling of family name of von Grafenstein – it is incorrectly given as Grafenstein in the text and references.

References Holmes, J. A., J. Zhang, F. Chen, and M. Qiang (2007), Paleoclimatic implications of an 850-year oxygen-isotope record from the northern Tibetan Plateau, Geophys. Res. Lett., 34, L23403, doi:10.1029/2007GL032228.

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