DTU Library

Reply to the comments by Madsen & Liu on “Late quaternary OSL chronologies from the Qinghai Lake (NE Tibetan Plateau): Inter-comparison of quartz and K-feldspar ages to assess the pre-depositional bleaching”

Long, Hao; Tsukamoto, Sumiko; Buylaert, Jan-Pieter; Murray, Andrew Sean; Jain, Mayank; Frechen, Manfred

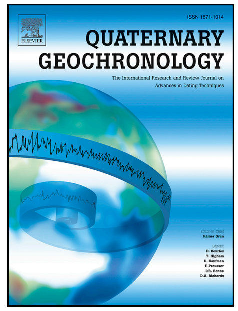
Published in:
Quaternary Geochronology

Link to article, DOI:
10.1016/j.quageo.2018.11.003

Publication date:
2019

Document Version
Peer reviewed version

Citation (APA):
Long, H., Tsukamoto, S., Buylaert, J-P., Murray, A. S., Jain, M., & Frechen, M. (2019). Reply to the comments by Madsen & Liu on “Late quaternary OSL chronologies from the Qinghai Lake (NE Tibetan Plateau): Inter-comparison of quartz and K-feldspar ages to assess the pre-depositional bleaching”. *Quaternary Geochronology*, *50*, 14-15. https://doi.org/10.1016/j.quageo.2018.11.003



Reply to the comments by Madsen & Liu on “Late quaternary OSL chronologies from the Qinghai Lake (NE Tibetan Plateau): Inter-comparison of quartz and K-feldspar ages to assess the pre-depositional bleaching”

Hao Long, Sumiko Tsukamoto, Jan-Pieter Buylaert, Andrew Sean Murray, Mayank Jain, Manfred Frechen

PII: S1871-1014(18)30121-3

DOI: https://doi.org/10.1016/j.quageo.2018.11.003

Reference: QUAGEO 974

To appear in: *Quaternary Geochronology*

Received Date: 23 October 2018

Accepted Date: 16 November 2018

Reply to the comments by Madsen & Liu on "Late Quaternary OSL chronologies from the Qinghai Lake (NE Tibetan Plateau): Inter-comparison of quartz and K-feldspar ages to assess the pre-depositional bleaching"

Hao Long[a], Sumiko Tsukamoto[b], Jan-Pieter Buylaert[c,d], Andrew Sean Murray[d], Mayank Jain[c], Manfred Frechen[b]

[a] State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (NIGLAS), 210008 Nanjing, China

[b] Section 3: Geochronology, Leibniz Institute for Applied Geophysics (LIAG), D-30655 Hannover, Germany

[c] Center for Nuclear Technologies, Technical University of Denmark, DTU Risø Campus, DK-4000 Roskilde, Denmark

[d] Nordic Laboratory for Luminescence Dating, Department of Geoscience, Arhus University, DK-4000 Roskilde, Denmark

Abstract: In response to the comment of Madsen and Liu (2018), we explain why our quartz optically stimulated luminescence (OSL) ages showing the early MIS 3 lake highstand are robust. We also demonstrate that the difference in the age estimates between ours (Long et al., 2018) and other studies should be attributed to contrasting equivalent dose (D_e) values, rather than water contents (hence the dose rate) which was claimed by Madsen and Liu (2018).

Keywords: Qinghai Lake; quartz OSL age; K-feldspar age; Lake highstand

1. Introduction

Based on the combined quartz optically stimulated luminescence (OSL) and K-feldspar post-infrared IRSL (pIRIR) dating of the shoreline features from Lake Qinghai, we reported a very early MIS 3 lake highstand (~60 ka; Long et al., 2018). Madsen and Liu (2018) commented that our age estimates contradict previous studies (e.g. Madsen et al., 2008; Rhode et al., 2011; Liu, 2011), which indicate a synchronous highstand during MIS 5 at different lake systems fed by the Qilian Mountains. They suggested that the age discrepancy originated from the different water content, 10 ± 10 % (Long et al., 2018) and 20 ± 5 % (Li et al., 2015), in the dose rate calculation. Here we respond to their suggestions.

2. Are our quartz OSL or feldspar pIRIR ages to be preferred?

In Long et al. (2018) we have chosen to use the quartz OSL ages for the interpretation and discussion on the lake levels, after confirming that the OSL signal was well bleached by a comparison of the quartz OSL and the K-feldspar $pIRIR_{290}$ ages (following Murray et al., 2012). Madsen and Liu (2018), however, misused our data and only discussed the chronology by the feldspar $pIRIR_{290}$ ages, which could be overestimated due to partial resetting, because they believed that "quartz OSL dating beyond 60–70 ka has proven to be problematic (e.g., Li et al., 2015)". It is true that there is a tendency for older quartz OSL ages to underestimate. Nevertheless, in our view, Madsen and Liu (2018) misrepresent the literature on the subject. As far as it is known any tendency to underestimate is a function of equivalent dose (D_e) rather than age and various authors have suggested that this tendency can start to be of significance in the range 150-200 Gy (e.g. Wintle and Murray, 2006; Chapot et al., 2012). Of the nine beach samples of relevance here, five have doses of <150 Gy and the largest value is 215 Gy. Fig. 1 shows the ratio of quartz to feldspar ages plotted against quartz D_e. If quartz was to systematically underestimate the age at larger doses one would expect that these data would be best represented by a decreasing trend at higher quartz doses. This cannot be seen in these data; all ratios are consistent with the average of 0.94±0.04 (n=9) and if anything there is a weak (but not statistically significant) increasing trend in these data, rather than decreasing. The two samples (LUM-3467, LUM-3472) which give pIRIR ages in the range preferred by Madsen and Liu (2018) (75±6 ka and 76±6 ka) give two of the smallest quartz D_e values (126±8 Gy and 118±7 Gy) and there is no evidence in the literature that quartz underestimates at these doses. Thus, we completely stand by our conclusion that the quartz OSL ages are to be preferred and that the feldspar ages in this study are most appropriately used to test the completeness of bleaching if quartz.

Nevertheless, our feldspar ages only overestimate on average our quartz ages by 8 ± 5 %, or 5 ± 3 ka. This suggests that other studies that rely only on pIRIR dating of similar depositional environments may not be significantly in error, at least from this point of view.

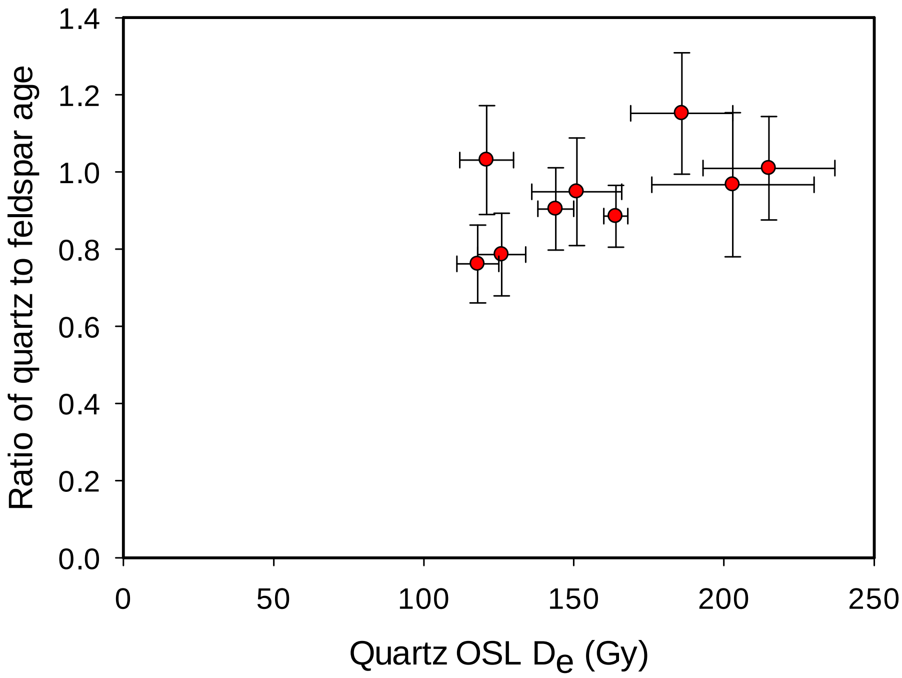


Fig. 1 Quartz to feldspar age ratio as a function of quartz D_e for the nine beach samples in Long et al. (2018)

3. Is a higher water content more appropriate, and would it change our conclusion?

Madsen and Liu (2018) also comment on our use of 10 ± 10 % water content in our dose rate calculation. We measured in-situ water contents of a series of beach samples, which were less than 10% for the sands/gravel sands in the study area. To cover any systematic error arising from water content change, a total uncertainty of 10% was adopted. Although we did not measure the saturated water content of our samples, 20 ± 5 % recommended by Li et al. (2015) and Madsen and Liu (2018) should be close to the saturated water content for such sand and gravel samples. That is, they are advocating a life-time water content close to saturation. In our view this is unrealistic given that the beach ridge samples are located well above lake level for most of the burial period. Nevertheless, if we use 20 % water content for our quartz samples, the mean age of ~60 ka will increase to ~66 ka, which is not enough to be consistent with MIS 5.

It is also interesting to note that if the water content is increased the effect is greater on the quartz ages than on the feldspar ages. Whereas the quartz ages do indeed get older by ~1% for a 1% increase in water content, feldspar ages only increase by 0.7-0.8%. This increasing the water contents from 10 to 20% reduces the average discrepancy between quartz and feldspar to ~6 %. In conclusion, using an increased water content does not weaken our argument that quartz is the most appropriate dosimeter and nor does it place our beach sediments in MIS 5.

4. Where does the difference in age between our work and other publications originate?

We think that the difference in the age estimates between Madsen and Liu (2018) and ours should be attributed to the difference in D_e values, not to the dose rate. For instance, the K-feldspar $pIRIR_{290}$ D_e of two samples from QH-13 (~310 and ~330 Gy; Madsen and Liu, 2018, in their table listed as QH-14), are much larger than that we obtained (190-250 Gy); another sample QGHE2 collected near by the QH2 site, yielded a $pIRIR_{290}$ D_e of ~260 Gy which is obviously larger than that of our two samples from QH2 (~190 Gy and ~210 Gy). Additionally, in their earlier works, using a MAR-protocol Madsen et al. (2008) and Rhode et al. (2011) determined quartz D_e of up to ~400 Gy (well above the 200 Gy usually regarded as unreliable) for similar shoreline features around Lake Qinghai; our quartz D_e values range from ~120 to ~210 Gy. Nevertheless, in our view it remains unclear whether there were multiple highstands in late MIS 5 and/or early MIS 3 or whether different laboratories obtained different D_e for the same lake level high stand.

We remain confident of our estimates of quartz D_e. We have participated in an international laboratory intercomparison in which quartz dose estimates undertaken in our laboratory were within 3% of the global average (Murray et al., 2015). However, such intercomparisons have not yet taken place for feldspar and we would be happy to exchange samples with Madsen and Liu as a first attempt at resolving this apparent discrepancy.

References

Chapot, M.S., Roberts, H.M., Duller, G.A.T., 2012. A comparison of natural- and laboratory-generated dose response curves for quartz optically stimulated luminescence signals from Chinese loess. Radiat. Meas. 47, 1045-1052.

Li, G.Q., Jin, M., Duan, Y.W., Madsen, D., Li, F.L., Yang, L.P., Wei, H.T., Chen, F.H., 2015.Quartz and K-feldspar luminescence dating of a Marine Isotope Stage 5 megalake in the Juyanze basin, central Gobi Desert, China. Palaeogeogr. Palaeoclimatol. Palaeoecol. 440, 96–109.

Liu, X., 2011. The Late Quaternary Lake Level History of Qinghai Lake Based on Quartz Optically Stimulated Luminescence. Dissertation, Qinghai Institute of Salt Lakes, Chinese Academy of Sciences.

Long, H., Tsukamoto, S., Buylaert, J.-P., Murray, S.A., Jain, M., Frechen, M., 2018. Late Quaternary OSL chronologies from the Qinghai Lake (NE Tibetan Plateau): Inter-comparison of quartz and K-feldspar ages to assess the pre-depositional bleaching. Quat. Geochonol. (in press)

Madsen, D.B., Liu, X., 2018. Comparative post-IR IRSL ($pIRIR_{290}$) K-feldspar age estimates for Qinghai Lake highstands: a comment. Quat. Geochonol. 48, 104-107.

Madsen, D.B., Ma, H.Z., Rhode, D., Brantingham, P.J., Forman, S.L., 2008. Age constraints on the late Quaternary evolution of Qinghai Lake, Tibetan Plateau. Quat. Res. 69, 316-325.

Murray, A.S., Buylaert, J.P., Thiel, C. 2015. A luminescence dating intercomparison based on a Danish beach-ridge sand. Radiat. Meas. 81, 32-38.

Murray, A.S., Thomsen, K.J., Masuda, N., Buylaert, J.P., Jain, M., 2012. Identifying wellbleached quartz using the different bleaching rates of quartz and feldspar luminescence signals. Radiat. Meas. 47, 688-695.

Rhode, D., Ma, H.Z., Madsen, D.B., Brantingham, P.J., Forman, S.L., Olsen, J.W., 2010. Paleoenvironmental and archaeological investigation at Qinghai Lake, western China: Geomorphic and chronometric evidence of lake level history. Quat. Internat. 218, 29-44.

Wintle, A.G., Murray, A.S., 2006. A review of quartz optically stimulated luminescence characteristics and their relevance in single-aliquot regeneration dating protocols. Radiat. Meas. 41, 369-391.