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Reply to Letter to the Editor

Early to mid-Holocene lake high-stand sediments at Lake Donggi Cona, northeastern Tibetan Plateau, China—Response to comments by Mischke et al., Quaternary Research 79(3), pp. 325–336

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We thank S. Mischke, C. Zhang and R. Fan for their comment on our manuscript. We agree that sedimentological analyses alone may allow more than one likely interpretation of past depositional environments, such as wetland sedimentation of lake shore and lake terrace sections. The conclusion of the main processes from sedimentary sections on the Tibetan Plateau should be considered carefully. Additional evidence from biological proxies definitely can help to better tackle past environmental settings, but they need to be considered with care as well. Only a combination of independent approaches may lead to reliable results.

Unfortunately, biological proxies were not available during publication of the original manuscript by Dietze et al. (2013). We appreciate the opportunity to explain in more detail our arguments for higher levels of Lake Donggi Cona during the early and mid-Holocene, now further supported by the results of Mischke et al. No reinterpretation of the records is necessary due to several reasons:

(1) The strongest indication for synchronous lake level changes of Lake Donggi Cona is that similar sediment facies were deposited during similar time intervals (see Fig. 3, Dietze et al., 2013). They were found at similar heights above the present lake level (a.p.l.l.) in the same onshore terrace generation several kilometers apart. Lake terraces (morphologically identifiable as flat surfaces slightly inclined toward the lake with associated steps, for example Abu Ghazleh and Kempe, 2009) were mapped in detail along nine profiles around the lake by Lockot (2010) using two different dGPS systems (mean measurement error in height = 0.12 m). Lockot (2010) found four statistically different height generations at 3.5 ± 0.4 m, 6.1 ± 1.0 m, 10.1 ± 0.9 m and 16.7 ± 1.2 m a.p.l.l. (T1 to T4, mentioned in Dietze et al., 2013). These terraces and shorelines could be followed all around the lake using rectified Corona satellite images (KH-4B, November 1968; Altmaier and Kany, 2002). Section P14 belongs to the T3 terrace.

(2) Lake Donggi Cona sediments showed a consistent sedimentological and chronostratigraphical pattern around the lake, not just at one site, although backshore configurations differ at the nine sediment sequence sites (Dietze et al., 2013). Everywhere around the lake sediments could be associated with properties that can clearly be linked to water level-related depositional processes.

(3) We carefully discussed the sediments found in the sections presented by Dietze et al. (2013) and also mentioned the possibility that in some cases clayey sediments and some other evidence, e.g. the presence of *Radix* spec. and *Gyraulus* spec. shells might be ambiguous since they indicate depositional environments "independent of a large permanent lake" (Dietze et al., 2013, p. 331–332). Hence, for the final lake level reconstruction only sedimentologically and stratigraphically non-ambiguous indicators that were found at more than one site, and that could be associated with ^{14}C-dates and their uncertainties, were used and compared to support local and regional evidence.

(4) We closely inspected the new ostracod results of Mischke et al. and found several species present in section P14 that also were found in the large Lake Donggi Cona. *Candona candida*, *Fabaeformiscandona rawsoni*, *Limnocythere inopinata*, *Eucypris mareotica* and *Ilyocypris sebeiensis* were found in both surface sediment samples of different water depths and lake sediment core PG1790 covering the last 19 cal ka BP (Mischke et al., 2010a,b). For example, the ostracod species *Ilyocypris sebeiensis*, dominating in section P14, was found in 23–38 m water depth of Lake Donggi Cona (Mischke et al., 2010b) and "often occur [red] in shallow water" on the Tibetan Plateau (Mischke, 2012). Hence, it does not seem to be a typically "stream-dwelling" species as suggested in the comment by Mischke et al. The presence of wetland and terrestrial species (e.g., *Pulpa* spec.) in the high-stand sediment can also be explained by relocation from near- or farther backshore positions in this geomorphologically dynamic setting by frequent high-energy overland flows (Dietze et al., 2012), which could have been even more frequent in times of intensified monsoonal air masses over the Tibetan Plateau during the early and mid-Holocene. To allow a full consideration of the new biological proxy record we suggest that other high-stand sediments from the other available sites around Lake Donggi Cona should be analyzed for organism remains to get a spatially significant signal.

(5) The lake-level reconstruction of Dietze et al. (2013) is the first step toward a refinement using lake-level sensitive proxies, e.g., within the continuously deposited sediments presented by Opitz et al. (2012). Although a clear association of ostracod species with water depth was shown by Mischke et al. (2010b), interpretation of ostracod assemblages and the application of the established transfer function for a detailed lake level reconstruction are still missing at Lake Donggi Cona. For example, Mischke et al. (2010a) interpreted the analyzed ostracod assemblages only in terms of salinity. In sediments of core PG1790 in 34.7 m water depth, *Leucocythere* spec. was very prominent in the period 11.9–6.8 cal ka BP (Mischke et al., 2010a), the time of the highest lake stands suggested by the onshore high-stand

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sediments. This species had the "greatest depth optimum (48.7 m [water depth]) of all recorded species" in the modern surface sediments (Mischke et al., 2010b). Hence, given the minimum 1 m of sediment that accumulated at the site of core PG1790 since 6.8 cal ka BP, up to 13 m higher lake level could be inferred for this time period—in agreement with the relative suggestions by Dietze et al. (2013).

Although it is often necessary and useful to integrate independent biological proxies into sedimentological studies, a careful sedimentological description and independent interpretation of multiple geomorphologically different sites does allow the reconstruction of the water-level changes of large lakes such as Lake Donggi Cona.

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