Dear Referee,

Many thanks for the constructive comments. Below I have made a point-to-point response to the comments. The comments are in black, and our response is in blue. I hope that the response can be acceptable.

Sincerely yours,

Hou Shugui

General comments:

The Manuscript by Zhang et al. is interesting, original and well written and suitable for publishing in the cryosphere after a few minor adjustments.

Specific comments:

1) The inconsistency in chronology between the Guliya ice core record and the Kesang stalagmite mentioned in the introduction, should be described.

We include a short introduction about the records of the Kesang Cave and the Guliya ice core in the Supplement in order to make the communication as concise as possible.

The Guliya ice core and the Kesang Cave core

In 1992, a 308.6 m ice core to bedrock was recovered from the Guliya ice cap located at 35°17'N, 81°29'E on the northwest Tibetan Plateau (Figure 1). The drilling site is at an elevation of 6200 m a.s.l. Top 266 m of the core was dated to a period spanning 110 ka, and ice below 290 m depth was suggested to be more than 500 ka old due to ^{36}Cl-dead in the ice (Thompson et al., 1997). Three Guliya interstadials (Stages 3, 5a, and 5c) are marked by increases in δ^{18}O values similar to that of the Holocene and Eemian (~124 ka ago) (Thompson et al., 1997).

The Kesang Cave is located in the Tekesi County, western China (42°52′ N, 81°45′ E, elevation ~2000 m a.s.l.) (Figure 1). Eight samples from the Kesang Cave were collected to establish the Kesang δ^{18}O record with three covering the Holocene and five covering the rest of the Pleistocene portion. Cheng et al. (2012) obtained precise ages (~150 dates), all in stratigraphic order within errors, using a ^{230}Th dating technique in the University of

Minnesota. The stalagmite $\delta^{18}O$ variations largely reflect changes in the $\delta^{18}O$ of meteoric precipitation (Cheng et al., 2012).

To reconcile the difference in the $\delta^{18}O$ variations between the Guliya and the Kesang records, Cheng et al. (2012) suggested that the Guliya record needs to be younger about a factor of two.

2) It seems that the dating has been performed on basal ice, however it is a little unclear and should be more clear!

Yes the dating was performed on the basal sediment. In fact, this sediment is a mixture of particles and ice. We will clarify this content in the revision.

3) "Ice content" and "water content" seem to be used randomly. This should be more clear.

We took a small portion of the sediment (13.4 g) for measuring ice content, which is determined by weighting the mass before and after drying, resulting in ~30% ice (water equivalent) content.

4) The influence of the ice matrix on the dose-rate should be accounted for in detail and explained and an evaluation of dose-rate for each scenario should be performed.

The infinite matrix dose rate was estimated using concentration-to-dose rate conversion constants presented by Adamiec and Aitken (1998) and the estimate of the dilution of the external dose rate by ice was assumed to be consistent with calculations recommended by Aitken (1985). Water, if present in the sediment matrix, absorbs radiation differently from mineral sediment, and has to be accounted for in the dose-rate calculations. Since we have, for the moment, no information about the influence of the ice matrix on the dose-rate, we use two extreme cases as our bounding scenarios, i.e., no water under the frozen condition and 30% water content if the sediment is saturated with water. The latter case (with high water content) results in a lower dose rate. Thus our upper limit age may be over estimated.

Adamiec, G. and Aitken, M.J.: Dose-rate conversion factors: update, Anc. TL, 16, 37-50, 1998.

Aitken, M. J.: Thermoluminescence dating, Academic Press, London. 1985.

5) The photograph of the Core 2 show a very clear transition to basal ice in the core, however Core 4+5 are retrieved at a different place at the ice-cap where the contourlines in the map of Figure S1 suggest more ice dynamics, and the bottom part of the cores can be much more mixed. The 4-11 micro-metres fin-grained quartz used for the dating could be eolean material deposited onto the ice and therefore younger than the ice-cap. If this is the case, the grains would recieve most of their dose after mixing with the basal ice. The authors should discuss this possibillity.

Yes the 4 -11 μm fine quartz grains used for the dating are mostly an eolian origin. The OSL age of the eolian component would represent the time for the ice to move from the surface to the bed, which is younger than the ice cap. In fact, this OSL age, as an upper limit, does not imply for an ice-free region in the Chongce region, but for an retreat of the ice cap above the elevation of the bottom at the drilling site during a (or more) warm period (or periods) since the upper limit age (e.g., MIS3, the Bølling-Allerød period, Holocene Climate Optimum). Because only limited results are gained, and many processes (each with its uncertainty) are involved in affecting the final age, we are cautious to avoid over-explaining the results at this moment.

6) In the conclusion the authors suggest collecting more suitable glacier basal sediment. It should be explained what "suitable" means.

We have drilled ice cores from several glaciers and ice caps on the Tibetan Plateau. This is the first time to collect sufficient amount of sediment at the Chongce ice core bottom for the luminescence dating. To avoid misunderstanding, we revised this sentence as the following.

The major limitation of the current work is the very small number of absolute datings. Future work should include collecting more glacier basal sediment samples for the luminescence dating....

Technical corrections:

page 1, line 9: more than one order of magnitude younger

Revised accordingly.

page 1, line 15: interpretation of this information.

Revised accordingly.

page 5, line 5-6: The sentence "We have no information about the behavior of ice in the sediment" should be refrased.

We revised this sentence as the following.

Since we have, for the moment, no information about the influence of the ice matrix on the dose-rate, we use two extreme cases as our bounding scenarios, i.e., no water under the frozen condition and 30% water content if the sediment is saturated with water.