The Response to Comments from Anonymous Reviewer

General Comments
Based on geomorphology, sedimentology, and chronology, the manuscript reconstructing two damming and four outburst events occurred in the minjiang river during the late Pleistocene, which suggests that the blockage and collapse of the palaeo-dam have been a major factor in the formation of tectonically active mountainous river terraces, and tectonic movement and climatic fluctuations, on the other end, play a minor role. I think the topic of the paper is interesting. However, this manuscript mainly focuses on sediment dating and geomorphological interpretation. The content association with dynamics is much weak, thus I am wondering whether it is suitable for this journal or not. Considering that this manuscript still has a plenty of problems, we suggest a major revision.
Response We are very grateful for your professional suggestions on our manuscript. We have considered the comments carefully and tried our best to revise the manuscript accordingly. Our responses are given in a point-by-point manner below. All the revisions have been addressed in the revised manuscript shown in red. We have asked native English speakers to improve the language, and clarify our ideas.
Specific Comments
Comment 1 Language should be improved by a native English speaker, please avoid all kinds of grammar errors and please use scientific language to write the paper.
Response 1 We are sorry for the grammatical problems and have corrected them based on your suggestions. We have asked native English speakers to polish and modify the manuscript.
Comment 2 The evolution of Diexi landslide-dammed lake in eastern Tibetan Plateau has gotten special attention of a plenty of scientist. The author should introduce the details of Diexi landslide dammed lake, including the history of repeated landslide damming.
Response 2 Thanks for your comments. We added the description on *L64-67*, as follows: *Moreover, the sedimentological analysis also suggests that the Diexi palaeo-dammed lake*

experienced at least two periods of blocking and outburst events (Yang, 2005; Yang et al., 2008), and four periods of fluvial progradation (Xu et al., 2020).

The concept of repeated blockage is introduced in this manuscript, as previous studies have only mentioned multiple instances of progressive breaching. As mentioned in *L61-64*:

Currently, Tuanjie Terrace is thought to have resulted from the outburst of a palaeo-dammed lake 15000 years ago, and each terrace corresponds to different stages of outburst (Duan et al., 2002; Wang et al., 2005; Wang, 2009; Zhu, 2014).

Comment 3

Ordinarily, uncertainties in estimating water content during burial are one of the largest sources of uncertainty in luminescence dating methods. Please give out the process of the determination of water content.

Response 3

Thanks for your comment. We were in an emergency situation in the field at that time and did not have enough time to excavate water content samples that could accurately reflect the true conditions. However, considering factors such as modern climate, depositional facies, and climate change history since deposition, we assumed the water content data.

We rewrote the water content on *L186-189*, as follows:

Considering the current climate conditions, the sedimentary facies, and past climate changes since the sample deposition, the water content of the gravel and paleosol was assumed to be 10±5%, while the water content of lacustrine deposits was estimated to be 20±5%.

Comment 4

For OSL dating, the results of recycling ratios and recuperations should be presented, and aliquots with recycling ratios out of 0.9-1.1 and recuperations higher than 5% should be rejected.

Response 4

Thanks for your constructive comments. We added the result on *L177-180*, and presented the recycling ratios and recuperation ratios on the supplementary, as follows:

Conventional tests in SAR protocol, including recuperation ratio, recycling ratio, quartz OSL brightness and fast-component dominated nature, growth curve shape, and D_e distribution (Figs. S2 and S3), indicate that the protocol can be robustly used to date the samples in this study.

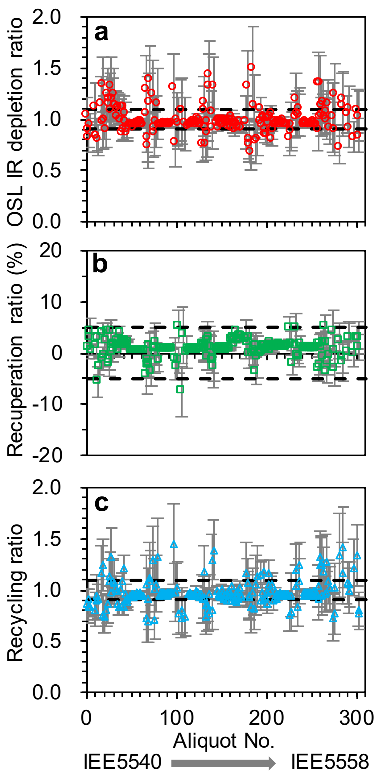

Fig. S2. *Quartz OSL IR depletion ratio (with IR/without IR **a**), recuperation ratio (recuperated/natural, **b**), and recycling ratio (repeated/regenerated, **c**) for all the 222 aliquots (used for D_e determination) of the 19 luminescence samples.*

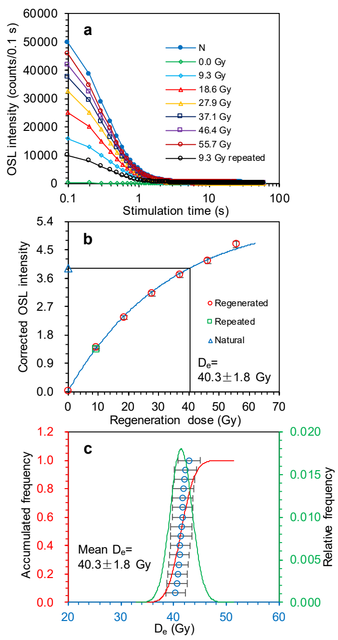

Fig. S3. *Quartz OSL D_e determination for sample IEE5543. (**a**) Natural and regenerative-dose OSL decay curves from one of the 15 aliquots used for D_e determination. (**b**) Dose-response curve and D_e determination for the aliquot in (**a**). (c) Probability density distribution of D_e and mean D_e.*

Comment 5

The authors should select appropriate preheat and cutheat temperatures based on a preheat plateau test (Murray and Wintle, 2000) or following some case studies, and add some references.

Response 5

Thanks for your comment. We rewrote this progress on *L173-174,* as follows:

Quartz grains were preheated at 260°C for 10 s for natural and regenerative-dose, and a cut-heat at 220°C for 10 s was applied for test dose.

We rewrote and added some references in *Section 3.2.1* to clarify the OSL procedures.

Samples were processed and measured at the Institute of Earth Environment, Chinese Academy of Sciences. The quartz grains were extracted following the laboratory pre-treatment procedures (Kang et al., 2020; Kang et al., 2013). The sediments at the two ends of the tubes, which may be exposed to daylight during sampling, were removed. And, the unexposed samples were prepared for equivalent dose (D_e) and environment dose rate determination. Approximately 50 g samples were treated with 30% HCl and 30% H_2O_2 to remove carbonates and organic matter, respectively. Then, the samples were washed with distilled water until the pH value of the solution reached 7. For samples IEE5542 and IEE5550, the coarse fractions (90-150 µm) were sieved out and etched with 40% HF for 45 mins, followed by washing using 10% HCl and distilled water. For the other 17 samples, the fine polymineral grains（4-11 µm）were separated according to the Stokes' law. These fine polymineral grains were immersed in 30% H_2SiF_6 for 3-5 days in an ultrasonic bath to extract quartz. Finally, the purified fine (coarse) quartz was deposited (mouted) on stainless steel discs with a diameter of 9.7 mm for experimental use. The purity of quartz was verified by IRSL intensity and OSL IR depletion ratio (Figs. S1 and S2a; Duller, 2003).

All OSL measurements were performed on a Lesxyg Research measurement system, with blue light at (458±10) nm, and infrared light at (850±3) nm for stimulation and a $^{90}S/^{90}Y$ beta source (~0.05 Gy/s) for irradiation. Luminescence signals were detected by an ET 9235QB photomultiplier tube (PMT) through a combination of U340 and HC340/26 glass filters.

The single-aliquot regenerative-dose (SAR) protocol (Table S2; Murray and Wintle, 2000; Wintle and Murray, 2006) was utilized to determine the Equivalent Dose (D_e), as used in Kang et al. (2020). *Quartz grains were preheated at 260°C for 10 s for natural and regenerative-dose, and a cut-heat at*

220°C for 10 s was applied for test dose. The quartz was stimulated for 60 s at 125°C with blue LEDs. The OSL signal was calculated as the integrated value of the first 0.5 s of the decay curve minus the integrated value of the last 0.5 s as the background. For D_e determination, approximately 10 aliquots were measured for each sample. And, the mean D_e value of all aliquots was used as the final D_e value. Conventional tests in SAR protocol, including recuperation ratio, recycling ratio, quartz OSL brightness and fast-component dominated nature, growth curve shape, and D_e distribution (Figs. S2 and S3), indicate that the protocol can be robustly used to date the samples in this study.

The environmental dose rate was estimated from the radioisotope concentrations (uranium, thorium, and potassium) and cosmic dose rates. U and Th concentrations were determined by inductively coupled plasma mass spectrometry (ICP-MS), while K concentration was measured by inductively coupled plasma optical emission spectrometry (ICP-OES). The cosmic dose rates were calculated using the equation proposed by Prescott and Hutton (1994). The α-value of fine (4-11 μm) grained quartz was assumed to be 0.04±0.002 (Rees-Jones, 1995). Considering the current climate conditions, the sedimentary facies, and past climate changes since the sample deposition, the water content of the gravel and paleosol was assumed to be 10±5%, while the water content of lacustrine deposits was estimated to be 20±5%. Dose rate was calculated using the Dose Rate and Age Calculator (DRAC) (Durcan et al., 2015). Finally, the quartz OSL ages were obtained by dividing the measured D_e (Gy) by the environmental dose rate (Gy/ka).

Comment 6

How did the authors obtain the final De? Please illustrate.

Response 6

Thanks for your comment. We illustrated on *L171-172* and *L176-180*, as follows:

The single-aliquot regenerative-dose (SAR) protocol (Table S1; Murray and Wintle, 2000; Wintle and Murray, 2006) was utilized to determine the Equivalent Dose (D_e), as used in Kang et al. (2020). …

For D_e determination, approximately 10 aliquots were measured for each sample. And, the mean D_e value of all aliquots was used as the final D_e value. Conventional tests in SAR protocol, including recuperation ratio, recycling ratio, quartz OSL brightness and fast-component dominated nature, growth curve shape, and D_e distribution (Figs. S2 and S3), indicate that the protocol can be robustly used to date the samples in this study.

Comment 7

Line 281: "T1 has the youngest paleosol unit with an age of 3.78±15 ka. Terraces grow younger amid the increase in elevation." Obviously, this is paradoxical. Please find a better way to present the chronological results, to avoid the reader's misunderstanding.

Response 7

Thanks for your comments. We deleted and rewrote this sentence on *L312-314*, as follows:

The chronological results of lacustrine deposits are chaotic. Tuanjie T1-T4 becomes younger with increasing elevation. Tuanjie T5 and T7 have a similar age, but are older than T3 and T4. The highest lacustrine deposits are only about 5 ka younger than T1.

Comment 8

For the lacustrine terraces, the dates can only implied that the filling up ages of the dammed lake rather formation time of terrace. Because of this misunderstanding, the comparison between climate date and terrace "formation" ages is also problematic.

Response 8

Thanks for your comments.

We apologize for this misunderstanding caused by the ambiguities expressed in this text.

The Diexi palaeo-landslide dammed lake in the past 30,000 years was not a stable and continuous water storage process, as evident from our chronological data. The age of the lacustrine deposits is chaotic (Figure 5). Therefore, these ages not only represent the time when the palaeo-dam blocked the river, but also indicate the time of its failure. Specifically, at 27.11±0.18 ka, the water level of the palaeo-dammed lake reached its highest point (2900 m), but at 17.15±0.18 ka, the water surface of the palaeo-dammed lake only reached 2342.95 m (Table 4). Therefore, the dam must have failed around 27 ka in order to have another "water storage period" at a lower elevation. In other words, the palaeo-dam blocked the river between 27 and 17 ka.

During the repeated blocking and failure processes of the palaeo-dam, especially the catastrophic failure event (~27 ka, Ma et al., 2022), the banks of the river were eroded, eventually forming terrace staircases.

The comparison between climatic chronology and terrace ages in the manuscript illustrates that climatic changes have little impact on the lacustrine units, that is, they have little influence on the process of damming and failure of the palaeo-dam. Additionally, other depositional units of the terrace did not occur under significant climatic change conditions, thus excluding the significant influence of climatic changes on the process of damming and outburst of the palaeo-dam.

Comment 9

"The third and fourth gradual collapse events respectively occurred at ~10 ka and ~9.35 ka." How to divide the period of dammed lake? Is it just according to the age? How can we be sure that such a small difference in results is not due to a dating error? For the optical dating of the paper, both of the method and the internal checks of the results were not sufficiently presented. The reliability of the OSL data awaits further examination and more work is needed. My biggest concern about the OSL data comes from the bleaching extent of the OSL signals before deposition. However, the problem of bleaching extent has not been mentioned and explained in this paper, not yet anyway.

Response 9

Thanks for your comments.

The Tuanjie terrace, as the closest terrace to the palaeo-dam, is used as a criterion for delineating the palaeo-lake period based on the chronology of lacustrine deposits and gravel units. Due to the better exposure of gravel layers in only T2 and T5 terraces, we obtained the ages of these two gravel layers. Therefore, the division of periods for the damming and failure events of the palaeo-dam is primarily based on the ages of the lacustrine deposits, combined with previous dating results. As mentioned in the text, such as *L407-425*, we listed regional paleo-disaster events during Phase I to Phase IV to support our conclusions.

In the revised manuscript, we rounded the ages to ensure data consistency:

Phase I is 32 ka, Phase II is 27 ka, Phase III is 27~17 ka, Phase IV is 17 ka, Phase V is 10 ka, and Phase VI is 9 ka.

For Phase V (10 ka) and Phase VI (9 ka), we initially divided them based on the ages of the lacustrine deposits. We believe that dating errors do not cause them. Firstly, our operating procedures were also standardizeds. Furthermore, climate changes during the Holocene were frequent, and the current records from archives, such as lakes and stalagmites have achieved high precision at scales of 100 years (Yuan et al., 2004; Cheng et al., 2016; etc.). Therefore, we believe that these two dam failure events should be distinguished.

We mentioned the bleaching extent on *L335-337*, as follows:

Considering the fine silt dominated nature, the relatively stable depositional environment, and the normal distribution of D_e particularly for the two coarse samples, we assume that all the OSL samples were well bleached before deposition.

Comment 10

Tectonic uplift and climate changes are the two critical factors controlling the evolution of river landscapes and the formation of terraces. However, rock uplift rate is calculated from bedrock terraces, rather than lacustrine terraces.

Response 10

Thanks for your valuable comments.

The primary purpose of calculating the incision rate based on lacustrine deposits is to distinguish the influence of tectonic activity from the effects of damming and failure events. The main applications of uplift rate and incision rate in this study are demonstrated as follows:

The Tuanjie and Taiping terraces are located in a tectonically active area, where several thrust and inferred faults are developed within the region (Fig. 1b). To determine whether the formation of terrace staircases is related to the strong tectonic activities in the Quaternary, we compared the incision rate of the Diexi area with that of the upstream and downstream, and the average uplift rate of the Minshan Block. The results indicate that the incision rate in the upstream reaches of the Minjiang River is significantly higher than that of the Minshan Block, suggesting that the formation of terrace staircases in the region is less influenced by tectonic activity. Particularly in the Taiping-Tuanjie area, the incision rate is much higher than in the upstream and downstream areas, indicating its unique characteristics. As mentioned in *L465-470:*

It can be observed that the incision rates of the upper reaches of the Minjiang River during the period of 32-10 ka are significantly higher than the uplift rate of the Minshan Block, indicating that tectonic activity has little influence on the formation of regional terraces. In particular, the Taiping-Tuanjie region has a higher incision rate than the upstream and downstream areas, highlighting its unique characteristics. That is, tectonic activity is not a critical factor in the evolution of Tuanjie and Taiping terraces.

In addition, we compared the downcutting rate of the Tuanjie terraces (T7 to T5) with the river incision rate at 10 ka in the study area. The downcutting rate of the terrace staircases was found to be significantly higher than the river incision rate. This rapid incision not only suggests that regional tectonic activity has little influence on the formation of terrace staircases, but also supports the viewpoint that the damming and breaching of palaeo-dam played a crucial role in forming the Diexi terraces. We described this in *L543-549*:

Most lacustrine deposits in the Tuanjie and Taiping Terraces were deposited from 32.40 ±2.07 ka to 7.97±0.81 ka. *Initially, the palaeo-dam had a large blocking scale, resulting in a high lake level, and corresponding lacustrine deposits at higher positions with older age. Since the palaeo-dam gradually broke, the height of the palaeo-dam body decreased, leading to a drop in the lake surface and the formation of lower staircases with younger ages, such as the age of the highest lacustrine deposits older than Tuanjie T2-T7. Besides, the downcutting rate of Tuanjie T7 to Tuanjie T5 (1652.33 mm/a) is higher than the maximum channel incision rate (198.00 mm/a) of the study area around 10 ka ago (Duan et al., 2002).* This rapid downcutting supports that the damming and dam-breaking of the palaeo-dam are critical factors in the formation and evolution of the Diexi terraces.

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