

## ***Interactive comment on “An extended history of high-amplitude lake-level changes in tectonically active Lake Issyk-Kul (Kyrgyzstan), as revealed by high-resolution seismic reflection data” by A. C. Gebhardt et al.***

### **Anonymous Referee #2**

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General comments (comment refer to page number/line number where indicated)

This is a well presented and scientifically significant study that is very appropriate to be published in the 'Climate of the Past' journal. The interpretations are sound, well-based on data and provide new insights into a highly dynamic paleoclimate regime in Central Asia. Eventhough the data do unfortunately not allow a dating of the presented wet-dry climate cycles ('a reason to drill the lake'), the presentation of these patterns nevertheless provide novel data that are absolutely worth to be reported.

My main concern refers to limited amount of data shown as figures: The figures (beau-

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tifully crafted by the way, a pleasure to look at) focus basically on a single seismic line. The line is spectacular indeed, the seismic stratigraphic interpretation sound and somehow textbook-style, but that same seismic line is shown on 4 full pages with different levels of annotations, way to much. There is no need to show every infilling step of each seismic sequence, the only added value comes in Figs. 6b and 7b, where eroded sequences are reconstructed, but that can also go in a smaller extra figure. What is needed much more are more shown examples. I am curious how representative this singled-out seismic line really is. In fact, many of the discussed delta lobes are not presented but provide crucial elements of the lake-level reconstruction. As reader, I need to see at least 2-3 more examples of seismic lines from other areas of the lake (for instance also the Western delta area), i.e. more of the sequence stratigraphic architecture. This can be done at 'no cost', as Figs. 4-7 can be reduced to one full page, there is plenty of space available. Having said this, I also would appreciate with new figures or maybe also in map view what is really meant with the concept of 'delta lobes' and how they are distributed on both sides of the elongated lake. These lobes, and their vertical and lateral stacking pattern is the key to reconstruct the details of the lake-level curve, so these data are crucial but yet not presented.

I am intrigued by the fact that all sequences and their boundaries on the shown seismic line display a gentle basinward dip. Is this a pattern on all seismic sections, also in the West? Or is this formed by a general forced regressional pattern with falling lake level upon delta progradation? But why is there never an still stand (horizontal progradation) or even an aggradation of a delta sequence upon a gently rising lake level? Is this a function of tectonic subsidence or tilting?

I am also wondering why sequence 5 is not subdivided in two main sequences (currently called subsequences 5.1 and 5.2), as they are separated by a very clear unconformity. What defines the hierarchy of the sequences? On contrast, I am not fully convinced that sequences 2.1 and 2.2 represent clearly two pulses or whether they form a transitional package without major unconformity in-between them. Both of these issues

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are hard to track, as one shown seismic line alone from the shelf is not sufficient.

Discussion on p.14 about deltas 1.1-1.6 is hard to follow. I cannot judge on the basis of the limited shown data whether 1.1-1.6 is indeed in chronologic order or whether lake level plays as a 'jojo' reshuffling the lobes in maybe a different order? Moreover, the arguments presented for an uplifted nature of the subaerially exposed terraces are a bit weak, I am somehow not convinced in this matter.

Further comments

The English language can be improved in some of the sections....maybe have an English native speaker go through it.

Shorten title by deleting 'An extended history of', just start with 'High-amplitude lake-level fluctuations of...'

1/21: delete one of the two 'past'

1/22: ....from the Mongolian steppe blocking the mid-latitude Westerly's.

2/6: ... AND thermal expansion...

2/6: HenCe (spell checker!!)

2/6: no comma after curve

2/10: Three 'large' on one line, too much!

2/25: The quoted publication (Anselmetti et al., 2006) initially stated indeed glacial/interglacial cycles, which after drilling turned out to be stadial/interstadials, I would change to:....were correlated to wet-dry paleoclimate patterns with lowstands during the stadials and highstands during the interstadial periods (Hodell et al., 2008, Quaternary Science Reviews 27, 1152-1165)

3/2: Lake-level changes as large as 170 m have on one hand been attributed to....

3/5: Awkward short sentences, change to: The impact crater of Lake Bosumtwi

(Ghana) is....

3/8: ...is purely driven by the evaporation/precipitation ratio.....

3/9: Lake Issyk-Kul, subject of this study, is....

3/21: Figure 1 shows these mountains exactly reversed (N vs. S). Which one is correct?

4/4: '...and by steep...' poor English, unclear what is meant, reword or make 2 sentences

4/7: can this 110 m depth transition be marked on Fig. 1

4/21: thRough

4/22: Surface-water temperature...

4/26: This is a hydrologically 'bold' statement....any references?

5/16: 2004 is not 'recently'

6/14: avoid one-sentence paragraphs.

Fig. 2: I note a somehow prominent change in basal sediment geometry (draping vs. filling) at  $\sim 1.1$  s twt in the middle of the profile, in particular when correlating to the right side of the figure...is this worth to be discussed?

Make sure final Fig. 2 has sufficient resolution, I have problems seeing for instance the mass-transport deposit.

7/2: became (Spell checker!!)

7/4: Which anticline? Has no been mentioned before

7/4:...dip angle OF the strata....

7/12: two 'however' within 4 words:-(-

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7/12: But on the figure I only see ca. 200 m of sediments.....the authors report partly 370 m sediment thickness but no evidence is shown.

7/20-25: The longer anticline still is visible on lake floor, correct? It looks like a dipping anticline (towards SW), is that worth to be mentioned? Are the two anticlines aligned in an 'en echelon' pattern? Are these anticlines really tectonic in nature or simply a draping remnant of an underlying basement high?

8/7 and ff.: Use throughout the manuscript 'reflections' instead of 'reflectors'. On seismic data, you only see reflections. Reflectors (=impedance change in the sediment record) cannot have amplitudes.

Seismic facies 3, here the term 'retrogradation' may also be used, or a 'backstepping' delta.

13/6: ...riseS...

13/9:..mainly in the shallower parts of the lake

14/7: this 'some' here and in numerous other places in the text is not elegant: use 'ca.' or even better a '~'.

14/25: I don't agree with the mentioning of the outflow here: The balance is made by precipitation/inflow and evaporation only (maybe subsurface outflows). The outflow is a result of positive hydrologic balance, thus the difference in the balance, then the lake level is geomorphologically fixed and the system open. If the balance is negative, then the outflow will be zero and the basin closed.

15/10: No one-sentence paragraph

15/20ff: Why don't the authors call the system a half-graben? with the main border fault in the south? It has all indications, correct?

Time constrains on 15/20: suddenly the term 1 Ma pops up? What is the origin? based upon? No age data at all has been presented before!

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Discussion on highstands is necessary but what about tectonics as regulator of outflow level? 16/25 ff: It also could suggest that the outflowing area subsided relative to the lake, lowering the topographic outflow point.

The last figure and the general lake-level reconstruction based on 'shallow' sedimentary sequences is highly reminiscent to another study in a Patagonian hydrologically closed lake where the first- and one co-author were also co-authoring: I would also quote this study, as some of the concepts match very nicely (Anselmetti et al., 2009, *Sedimentology* 56, 873-892)

One should remove the thick red and blue arrows on last figure and make lake-level lines thicker, that will be much better to visualize these impressive lake-level variations,

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[Interactive comment on Clim. Past Discuss.](#), doi:10.5194/cp-2016-3, 2016.

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