

## ***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 #1**

Received and published: 19 February 2016

The manuscript ‘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 Gebhardt et al presents a detailed and interesting analysis of lake level fluctuations of Lake Issyk-Kul and links the fluctuations to past changes in the atmospheric circulation pattern. This is an interesting aspect because long climate archives from the investigated area are sparse. Unfortunately, no age information are available, which does not allow linking the circulation patterns to specific periods. However, the conclusion that a cyclic pattern caused by changes in the atmospheric circulation pattern exists, is significant and should be published. Hence, I strongly recommend

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publication of this manuscript. However, several modifications are needed prior to final publication. My main concern is the poor data description and documentation. Only one profile crossing deltaic features is shown. The reconstruction of the lake level fluctuations is difficult to follow, as many deltaic sequences are not shown on this profile. I am aware that not all deltas can be shown but it would be good to present some more data, which would at least prove that structures are similar at the western and eastern end of the lake. This is mentioned in the manuscript but not supported by any presented data. These profiles should be described first, which may then act as basis for the interpretation. I am not a native English speaker; hence, I have not made any language corrections.

My main general points of criticism are: 1) Show more data and give a better general description of the data. The detailed description of the stratigraphic units as presented now is not really a description. This is more a stratigraphic interpretation, which is not based on a proper description. Fig. 4 can be used for a general description but this figure is even not referenced in the text at all. I suggest to show one profile from the eastern and western parts, each. These profiles should be described first. Explain how you define the stratigraphic sequences in general. Point to the similarities (and differences) between the eastern and western area. Mark all the deltaic sequences.

2) Carefully check the usage of terminology for the seismic stratigraphic description/interpretation. E.g., you write that you have erosion at the upper and lower boundary of a unit. Per definition, an erosional truncation is termination of reflectors against an upper boundary caused by erosion. It may well be that both boundaries show erosional features, but then you need to carefully describe, that you have erosional truncation of the unit below the sequence boundary and downlap/baselap/onlap/conformity above the boundary. When describing unconformities, always describe termination above and below the unconformity.

3) You define the topset-foreset roll-over point as a proxy for the lake level at the time of its formation. This is a valid approach. Based on the distribution of the clinoforms,

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you can conclude that you had rapid lake –level changes. However, I do not agree that all clinofolds/deltas have been deposited at times of lake-level stillstands. Some of the clinofolds look like forced regression-system tracts, indicating a falling lake level. Others may show some aggradational patterns indicating a slow lake level rise. I agree that the clinofolds indicate relatively constant lake levels or only small changes compared to the rapid changes documented by the different locations of the delataic sequences.

4) Distribution of delta sequences. In order to reconstruct the lake level fluctuations, you use many delta-sequences not shown on your seismic example. You state that most delta sequences have been identified on both sides of the lake but this is not documented. You even do not mark all delta sequences identified on the presented line (Figs 4-7, you list much more in Table 1). Mark them. Why do you have such an incomplete record of deltas on single lines? I assume that this is caused by changing points of sediment input to the lake (as partly discussed in the manuscript) but you should mention this somewhere (distribution of deltas and what causes lateral shifts of deltas).

5) Good overview map is missing showing the general location of the lake and its tectonic setting (I doubt that most people would be able to place the lake on a world map). Many locations are given in the text, which are not shown on any figure. Link between text and figures should be improved.

6) It would be nice to include a small outlook in the conclusions. You clearly state that it would be important to date the delta features in order to establish a solid link between climate and deposited sequences. Come back to this point in the conclusion.

Below you find more specific comments for each chapter and the figures. Good luck!

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Specific comments:

Abstract:

P1, Line 18: Change 'identify' to 'reconstruct'

P1, Line 19: See general comment concerning lake level still stands. Lake level was relatively constant compared to quick fluctuations in other periods.

P1, Line 21: Delete 'during the past'

Introduction P2, Line 8: Summarize the previous statements. Something like. The examples demonstrate that lake level fluctuations may document climate change (regional and/or global), changes in basins morphology and barriers, as well as tectonic and volcanic forcing.

P2, Line 9: Refer to figure showing the general location of Lake Issyk-Kul in a broad context. Such a figure is missing. This figure should also include all regional features/locations you mention in the text.

P2, Line 14, 15. Split last sentence to two sentences.

Study area

P2, Line 18-22: Make sure that all locations are shown on a good overview map.

P3, Line 2: Refer to your figures. The link between text and figures should be improved.

P3, Lines 2 – 5: Split sentence to two sentences.

P3, Line 8: Explain how the shelf is separated from the slope.

P3, Line 20: Was the lake ice-covered during the glacials? Did glaciers cover the shelf? Any information?

P5, Line 3: Show Tien Shan Mountains on overview map. Also true for other locations and not mentioned again in this review. Check carefully.

P5, Line 14, 15: Split to two sentences.

Data acquisition and processing

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P6, Line 10-14: This statement should be supported by a figure (in the result section).

Results and Interpretation

P6, Line 22: Penetration of 375 m is not documented on any figure.

P6, Line 26: The MTF should be marked on an overview figure.

P7, Line 2: Correct 'becaoem'

P7, Line 3: 'The anticline' has not been introduced before. Some information is needed.

P7, Line 6: I agree that deformation is still active but I cannot see that the uppermost layers still display a slight dip angle.

P7, Line 9: For which period are the sedimentation rates valid? Are they only valid for the Holocene as they are based on short cores? Can you really use them as mean rate for calculating age? You partly comment on this further down but I would expect significant variations of sedimentation rate between humid and arid climatic phases.

P7, Line 19/20: Are these anticlines visible on your data. Not clear. Make clear what results are based on your data.

P8; Line 23: I cannot see the onlap on the figure.

P9, Line 19: Change 'forming' to 'formation'

P9, Line 22 and following: How is the upper boundary of this unit defined?

P10, Line 1-5: Give reference to figures. On Fig 5b, no delta is marked despite the fact that Tab. 1 suggests that delataic sequences 7.1., 7.2 and 7.3 should be visible. I may see one delta but it remains unclear where you interpret the other deltas. Mark all interpreted deltas very clearly on the figure.

P10, Line 8: A sequence may have erosional truncation as upper boundary but not as lower boundary. Hence, the statement that the sequence exhibits erosive upper and lower boundaries is not precise. As for sequence 7, no deltas are marked on Fig. 5 for

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sequence 6.

P10, Line 12 and following: When describing unconformities, always describe termination above and below the unconformity. The upper boundary of unit 6 shows erosional truncation. I cannot judge the characteristics of the lower boundary of sequence 5. Check very carefully for the description of all sequences. I will not comment on this for the other units. For delta 5.2. I do not see details but it seems to be a forced regression and not a real stillstand.

P10, Line 21 and following: How do you explain the pronounced step in the morphology of the upper boundary of Sequence 3/4?

P11, Line 8: Sequence 3 may fill erosional features but the lower boundary is not erosive. It is the upper boundary of the underlying sequence. Check also for other sequences.

P11, Line 26: This is a correct description (It lies above an erosional unconformity and sediments fill the channels).

P12, Line 3: I assume it should be Sequence 1 (and not 2)

Discussion P13, L3: See general comment concerning lake-level stillstands.

P13, Line 28, Boom gorge has not been introduced before. Refer to Fig. 1, where it is shown.

P15, .Line 10: See previous comment about the anticlines (P7, Line3).

P15, Line 25: What do you mean with 'May have influenced' Again, no detailed information about the anticlines is given in the manuscript. The anticlines are not critical for the manuscript but you draw conclusions based on the anticlines without a real presentation of these anticlines.

P16, L1-5: see general comments. Should be illustrated in a figure.

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P16, Line 22 – 28: This has already been partly discussed in the previous section but it also partly contradicts the previous section, where it is stated that subaerially exposed terraces may indicate lake levels 100 m higher than present. Clarify.

P18, Line 3, 4: Is there a reason that you are not listing rainfall/direct precipitation?

Page 18, Line 15: See general comments about lake-level stillstands.

Conclusions

P19, Line 16: Change to 'each stratigraphic section contains at least 2 ...'

Figures:

Fig. 1: An overview map showing the general location of the lake and regional features is missing. Colour code would be useful. The profiles shown in the manuscript should be marked much clearer (direct reference to the Figure).

Fig. 2: Depth below lake floor scale is a bit confusing. How have you set the zero point? I would recommend changing the scale to depth beneath present lake level.

Fig. 3: OK. If you show a profile from the western shelf, you should mark some of the prominent deltas identified on both profiles.

Figs. 4-7: See comments above. You need to mark all deltas identified on this figure. Much more delta features than marked on the figure are listed in Table 1 for this profile. There is no reference to Fig. 4 in the text.

Fig. 8: OK

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