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Climate of the Past Discussions

Interactive comment on "Alluvial fan dynamics in the El'gygytgyn Crater: implications for the 3.6 Ma old sediment archive" *by* G. Schwamborn et al.

Anonymous Referee #2

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A long sediment core of the Lake E is a valuable archive of terrestrial palaeoclimate in the Arctic region. Lithostratigraphic framework of the core sediment of this study is essential basis for the palaeoclimate studies. As the alluvial fan delta is a climate-sensitive sedimentary system, sedimentology is the key for gaining a better understanding of palaeoclimatic evolution in the western margin of the Lake E. Unfortunately, however, the general scope in terms of alluvial fan sedimentology is unclear and the manuscript structure is rather confusing. Global implications for alluvial fan delta is rather weak. More importantly, the authors interpret and discuss based on limited sedimentary model and do not consider alternative models. In general, combined formative processes of sedimentary succession cannot be explained by single sedimentary model. The authors need to consider various sedimentary models and explain why they are accepted or not. I am not an expert in the Arctic sediments and I

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Interactive Discussion
Discussion Paper

may have missed some important aspects here. But even so, the authors should make more careful consideration about their studied material and put much more effort into explaining general sedimentological importance of this study. I think that this paper needs major revision for publication in CP.

1.Introduction

The introduction describes about previous studies of Lake E sediment and does not provide general sedimentological information about alluvial fan delta. Therefore, the general scope in terms of alluvial fan delta sedimentology remains unclear after reading the introduction. Earlier sedimentological works on alluvial fan delta should be reviewed, and general information, question, and purpose on the alluvial fan delta is necessary in the introduction.

2. Geographical Setting of El'gygytgyn Crater

In this section, the authors should explain tectonic setting. The authors wrote tectonic framework of the Lake E in the discussion section. Such background information should be provided in this section.

3. Material and Methods

I think the authors assume that the frozen core hold the primary sedimentological information. However, as the authors wrote in the Results section and showed in core photo (Fig. 4), ice cracks were present in the studied frozen core. This indicates the possible destruction of primary sedimentary structure and sediment grains. This raises questions on the utility of standard sedimentological analysis. The authors should evaluate what kind of analytical data are reliable, and what kind of data are not reliable for the sedimentological interpretation.

4. Results

4.1. The modern environment

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This is rather a strange section, because the authors do not mention about the investigation of modern processes in the purpose of this paper and in the Material and Methods section. The authors should describe how to investigate the modern processes in the Material and Methods section. Furthermore, they need to show more detailed data of modern sediment with figures (e.g., grain size data, photographs, etc.). Readers may have difficulty in the understanding modern processes only based on description.

4.2. Lithostratigraphy

Lithostratigraphic description is not enough. Provide detailed description of the lithostratigraphic unit boundary. Lithological changes represent changes of formative processes in the Lake E sedimentary succession. This is critical in discussion of sedimentary dynamics of this paper. Other points which the authors should describe are sand/gravel boundary in each unit, modal composition of gravel, thickness of sand layer, color of sediment in Unit 3 and Unit 4.

4.3. Granulometry, mineralogy, and organic matter content

I would like the authors to show stratigraphic trend of mean grain-size and sorting in Fig. 5. Although the authors wrote overall the mean grain sizes decrease slightly from the bottom to the top (p. 2197, l. 2-3), Fig. 7. show that the maximum mean grain size is recorded within the Unit 2. The mean grain size increase from the Unit 1 to Unit 2, and decrease from Unit 2 to Unit 4?

4.4. Ground ice characteristics

I think first paragraph of this section could be incorporate with the section 4.2. Presence of ice cracks in the core could destroy sedimentary structure and sediment grains. The authors should describe whether the ice cracks destroy primary sedimentological information or not. Without this description, it is difficult to evaluate overall discussion in this paper.

4.5. Pollen content

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It is necessary to provide a full pollen diagram not just description of presence of some taxa. In addition, a detailed examination of the relative changes of the different pollen taxa in the single pollen zone is necessary in the discussion section.

Furthermore, pollen data provide a important time-control reference in this study. The authors should compile their original pollen data and the available numerical age which are presented in the discussion section. Although the role of this paper is to provide preliminary sedimentological results and establishment of age model is not purpose of this paper, the time scale is an important controlling factor of the sedimentary evolution. The readers may not be happy the sedimentological discussion without age model.

5. Discussion

As the general scope of this paper is unclear, discussion on the global significance of studied core sediment is unclear. The authors should explain what is new for the alluvial fan delta sedimentology.

I think the important reference, Galloway (1975), is not suitable for discussion in this paper. Actually, Galloway's model has been accepted as the basic sedimentary model of delta. However, the model was established based on the marine delta. The formative processes of delta in marine realm is different from the terrestrial realm, in particular mud deposition. The authors should consider the alternative model for the interpretation or explain why the marine delta model is applicable to the Lake E sedimentary succession.

5.1. Interpretation of the depositional environment

The discussion in this section is based on proposed scheme in Fig. 9, which is the most important figure of this paper. However, this figure seems to be speculative and difficulty remains in the understanding of Fig. 9. This study conducts one-dimensional analysis of sediment core. It is impossible to illustrate two-dimensional lithological variations based on one-dimensional data. Even if the authors may have information about

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5011-1 core and seismic cross-section, illustration of Fig. 9 is still impossible, because of the lack of sediment core between 5011-3 and 5011-1. Also, scale should be necessary in the schematic illustration. Scale is an important factor for the sedimentary evolution and is useful to compare the sedimentary system in other region.

Purpose of this paper is to discuss the sedimentary evolution in the western margin of the Lake E and is not to discuss the overall Lake E sedimentary evolution. In this respect, I think Fig. 9 is not necessary in this paper.

Instead, I recommend the authors to illustrate age-depth plot for the core 5011-3. Age-depth plot is the standard figure of the shipboard sedimentology in the ocean drilling program and represent changes in sedimentation rate. Such illustration would be helpful for the readers to understand the evolution in the western margin of the Lake E

5.2. Permafrost formation in the EAFD and lake level history

Here, the authors wrote the studied alluvial fan delta was the nearshore environment and classified as a wave-dominated delta. This interpretation is rather strange, because the authors discussed the presence of channel-fill deposits, which clearly indicate river processes, in lithostratigraphic unit 4 in the previous section and other units were interpreted as slope sediments. Lithological evidence of core sediment is necessary in order to confirm wave-dominated processes.

Reconstruction of lake level changes is an interesting attempt. One question is how did the authors estimate lake level? Previous studies seem to estimate the lake level based on present-day geomorphology. The authors should describe their method based on core sediment analysis in the Material and Methods section. Furthermore, in order for the reader's understanding, an illustration of relative lake level changes is necessary.

5.3. EAFD formation and regional tectonics

Tectonics is one of the main controlling factor for the sedimentary architecture. However, I think not only tectonics, but also other processes play an important role for the

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sedimentary evolution in case of Lake E. Location of provenance in the west could be additional factor for off-center deposition. In addition, autostratigraphy (Muto et al., 2009, J. Sed. Res.) is critical processes for the delta evolution. The authors need to consider alternative models and explain why they are rejected based on lithological evidence.

Figures

Fig. 3: What is the difference between 'sand' and 'layered sand'? I speculate that 'sand' of this figure show sand layer with amalgamated base. Color of layered sand is strange. Sand should use yellowish color.

Fig. 5: This figure should be illustrated with the lithological log. Below 90 m-CSF, the authors did not conduct measurements of TOC content? Or TOC was not detected?

Fig. 6: This figure is very tough to see each data. Also, I find that the authors do not explain about this figure in detail. The readers can understand the sediment is mainly composed of gravel and sand from Fig. 5. Please explain specific information of this figure.

Fig. 8: I would like the authors to compile the pollen zone with available numerical age data.

Fig. 9: As mentioned above, the authors should reconsider about this figure.

Fig. 10: The tectonic framework is the background information of this study and such illustration should be earlier part in the manuscript. I think this figure should be Fig. 2 or Fig. 3 in this paper.

Interactive comment on Clim. Past Discuss., 8, 2187, 2012.