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The Cryosphere Discussions

Interactive comment on "Stable isotope and gas properties of two ice wedges from Cape Mamontov Klyk, Laptev Sea, Northern Siberia" *by* T. Boereboom et al.

Anonymous Referee #2

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This paper presents very detailed different types of data from two ice-wedges from Siberia, and attempts based on these data to infer several details about ice-wedge formation primarily what processes controlled the ice-wedge growth. As the paper is presently, it has several weak points, which has to be addressed for it to be of wider use and interest.

General comments:

Missing parts: A short overall presentation of the state of knowledge about ice-wedge and sand-wedge formation, and their composite version often called composite wedges. Sand-ice wedges, as is the used type in this paper, are not a very used term

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in the periglacial literature to my knowledge. This should preferably also include the meteorological conditions controlling ice- and sand-wedge formation.

The purpose of the paper is not clear to me. On p. 3629 line 12 an approach is suggested, which I think, but there is nothing on what is directly the purpose. And obviously this approach is to be tested in this paper.

Too much use of glacial literature instead of periglacial literature as both background for the study e.g. p. 3629 line 3-6..old references to the periglacial literature mentioned and several glaciological references included despite this being about ice properties within ice wedges.

Introduction: The permafrost climate considerations are very overall, and have no details about the study area/region. Also there is nothing on ice-wedges specifically in this context, which would have been highly relevant, as one of the most ice-rich periglacial landforms.

Study area: There is nothing on the overall geomorphology of the study site. What landforms are the ice-wedges located in, and what is the overall Quaternary history ? Only the overall regional ? stratigraphy is outlined. Landscape development during ice-wedge / sand-wedge formation is important to evaluate the results in the end in the discussion as well. There is nothing on the connection geographically between the two sampling sites. There is nothing on why exactly these two ice-wedges have been studied of out several ? in the area. There is nothing on why the sampling is done at the specific depths used.

Sampling and analytical methods: It would be nice with a better description of the sampling of horizontal sections from the chain sawed ice blocks sampled in the field. Why was the organic content not simply determined by burning in the end ?

Results: In the ice texture and fabrics part it seems like you mention results from ISW on Fig. 5 yet there is not such legend on Fig. 5..probably you have forgotten.

TCD

5, C1984–C1988, 2012

Concerning gas properties you highlight the low gas content compared to the glacial environment. Why is this a highlight ? The periglacial environment is very different from the glacial environment. . .and ice-wedge growth is not about simple snow compaction (this is also why I suggest you identify the relevant periglacial processes responsible for ice-wedge formation as background for this paper). The section of sediment properties is strange. It ends with a sentence which is not making any sense..must be a part missing ? And it starts with a sentence repeating the method section on this. Otherwise the results reported here are not very detailed. What about real sediment information such as grain size data ?

Discussion:

5.1 most of this section is about comparison to the glacial environment and using results/interpretations from there to assume ice-wedge formation. Particularly the 'ribbon-like' structure is interpreted this way. And then it end up with saying that liquid water was present during ice-sand wedge formation. This is rather obvious again if one consider normal theory for ice-wedge formation. So I find this entire section very speculative, and less convincing in terms of understanding ice-wedge / composite wedge formation.

5.2 Again I think there is a problem with understanding the ice-wedge morphology and how ice-wedges work when discussing the apex above the crack. I assume you mean the trough ? Mainly there seem to be a missing understanding of how ice forms in ice-wedges and which ice types are dominant in ice wedges. Ice veins in ice-wedge typically do not form due to a firnification process of snow. Page 3638 line 24 you mention bulk refreezing of a mixture of snow and interstitial water as the process of ice formation in IW-28..This is to my knowledge not the traditional understanding of ice vein formation in ice-wedges. Why include several measurement possibilities that do not work ?

5.3 page 2 3640 line 12-13. You already differentiated the three facies of the ice-

TCD

5, C1984–C1988, 2012

wedges when presenting the site. Spell out LMWL line 23. Page 3641 line 16-17. Why '..' on these processes ? Line 26 Tsite = the air temp of the site ? Tsource = snow temp or ground temp ? I think the interpretations of the isotopic values are too much dependent of the overall global/regional (again mainly glacial !) environmental conditions and too little on the local periglacial conditions. The local conditions are very speculative. . .assuming a thinner snow cover or an earlier crack opening enabling particles to be blown/entrained into cracks. What is this based on ? And is this really likely in the arctic environment ? Why couldn't it simply be aeolian sediment in the snowpack, which is transported with the snow meltwater into the cracks during spring/summer ? Likewise with the increase in albedo due to thin snow cover suggestion leading to more meltwater. When would this happen ? During which parts of the year and in which air temperatures typically in Siberia ?

Conclusion: First sentence is over simple - delete. Then it is claimed that the analyses has improved the ice-wedge process understanding. This I cannot see, as most of what is stated is assumptions, which has not been documented in any detail. But rather we have got lots of comparisons with how the glacial world works, which might not be directly relevant for ice-wedge formation.

Detailed comments:

Figures: Generally the figure texts are not very informative. Do not assume that the reader directly go into the text and find all relevant details. These should be included in the figure texts. Fig. 1. Why not photo of the sampled section or the overall stratigraphy of the study site and then have this overview map as a small insert. Fig. 2. No good scale on either of the photos. Not easy to see the extent of the ice-wedges. Boxes are grey not black on my file here. Fig. 3. Plots too small. Make wider and make use of the full width of the page to improve readability. Unit on x axis on a) and b) should be width not sample no. also to improve direct comparison with figure 7. Fig. 4. Start with a real text, such as Thin section photographs of the textural properties of the ice-wedges. Fig. 5. Why no ISW28 ?and not indication of where this is on the fig like on Fig. 3 and 7.

TCD
5, C1984–C1988, 2012

Fig. 6. n = ? Fig. 7. Larger plots to full width of the page to increase readability. What are O and N in lower most d) part of the figure, should be explained directly on the figure. Fig. 8 The text is not sufficient. Make it at real text explaining that this is. . .and do not write see text for details ! Thanks.

A temperature is never warm or cold, but high or low (page 3640 line 4)

Always present the figure in increasing order, not Fig. 4 before fig. 3 (page 3630 line 29)

Typically we use ice-wedges in periglacial literature, you mainly use ice wedges, but in some places ice-wedges.

Always include all references used in the text in the ref. list. I found all on page 3640 line 19 not included.

The English language could be improved to also improve the understanding of your argumentations in several parts of the paper. This is particularly necessary on page 3642 lower half.

Interactive comment on The Cryosphere Discuss., 5, 3627, 2011.