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The Cryosphere Discussions

Interactive comment on "Subglacial permafrost dynamics and erosion inside subglacial channels driven by surface events in Svalbard" *by* Andreas Alexander et al.

Anonymous Referee #2

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This manuscript provides new information concerning how temperature variability in subglacial channels can impact fluvial erosion beneath cold-based glaciers in Svalbard. I'm not aware of a similar dataset and the results should be of interest to a broad community of glacier and permafrost researchers. While I think the paper should be published eventually, I'd like to see the authors more closely situate their manuscript within the modern published literature on the sedimentology and hydrology of cold ice glaciers in Svalbard, provide a clearer description of the sensor installations in the methods section, and more clearly link the discussion to their results. More detailed comments are included with page and line numbers below.

Page 1, Lines 15-20 – Fluvial incision of subglacial tills can erode sediment, but vertical incision of subglacial channels can become limited by boulder armoring. Fine grained materials are preferentially winnowed from till channel by flow and larger boulders and rocks accumulate on the floor (See Gulley et al., 2014). Because flow cannot mobilize these sediments, vertical incision largely ceases but the channel can still migrate and incise laterally. In the case of the till beneath cold-based glaciers in Svalbard, much of the sediment being eroded by streams was not produced beneath cold based glaciers, as seems to be implied by the authors, but instead is derived from past temperate basal regime or perhaps surges.

Page 2, Lines 25 – Boulton 1972 was written when it was widely believed that cold-based glaciers lacked active subglacial hydrological systems. Hodgkins (1997) highlighted water flow and erosion beneath cold ice in Svalbard. More recent work has shown that much of the water flowing out from under cold-based glaciers is likely derived from subglacial channels which began life as supraglacial streams and later incised through cold ice to reach glacier beds (see Gulley et al., 2009).

Page 4, Figure 1b and c – drawing an outline of the subglacial channel beneath Tellbreen in one panel and only showing the survey line of the channel beneath Larsbreen in the other panel is confusing. At first glance, the cave beneath Tellbreen looks like it is a giant loop! Also, "profile" is typically used to describe what the authors are calling "vertical cross-section (extended profile)" and cross-section is typically used to describe the cross-section of a passage segment (drawn perpendicular to the passage direction).

Page 4, Line 7 – remove "is reported"

Pages 5,6 - Figures 2 and 3 – there is too much information jammed into these figures. I recommend separating the maps from the photo panels and making the photo panels larger. The pictures are too small to see the information being described in them. For example, there is a logger setup mentioned in Fig 3C – but I can't see it.

Methods – HOBO pendant loggers have an accuracy of 0.53 deg C when used for above-freezing temperatures. Accuracy decreases to 0.75 deg C between 0 and -20C https://www.onsetcomp.com/products/data-loggers/ua-002-64/

Page 7, line 20 and 21 – I don't understand this installation. Was the pipe filled with silicone? If so, please make it clear why. Why were the temperature sensors not buried directly in sediment? For the logger installed into the ice, was it also installed in pvc pipe? What diameter holes were drilled in the ice and sediment and what was the diameter of the pipe? A clear line drawing showing the various types of instrumentation as installed in the caves would be very helpful in visualizing the experiment and this information is critical for interpreting the temperature signals.

Page 7, Line 30 – please describe the calibration procedure used for the DistoX.

Page 9, Fig 4 – It would really help visualize relationships between outside air temperature and the cave/sediment temperatures if they were plotted at the same scale.

Page 14, line 5 – the authors keep referring to "winter" but the dataset only runs from March until October. It would be nice if the timeseries graphs could be truncated at the end of the data collection period instead of having 1/5 of each graph displaying no information.

Page 14, line 19 – considering how thin the ice is here, creep closure is probably negligible in controlling the isolation of the cave atmosphere in winter. Snow plugs in the entrances are far more likely.

Page 16, Figure 9 – I don't understand the conceptual model for air flow. During summer, outside air is warmer than the cave. Air should be cooled in the upper entrance and then flow out of the lower entrance. If the cave were not plugged with snow, the opposite flow would occur in winter. I also don't understand how you have a channel in summer that lacks a stream.

Page 17, Figure 10 – mechanical erosion conjures images of plucking or abrasion of

bedrock by suspended bed load. Perhaps fluvial erosion is a better term?

Page 18, Lines 32-35 – maybe I'm missing something, but I cannot figure out what data the authors used to infer the rapid incision described here. Please clearly link this interpretation to the data.

Page 19, Lines 14-34 – Much of this is extremely improbable. . ...

References Gulley, J.D., Spellman, P.D., Covington, M.D., Martin, J.B., Benn, D.I. and Catania, G., 2014. Large values of hydraulic roughness in subglacial conduits during conduit enlargement: implications for modeling conduit evolution. Earth Surface Processes and Landforms, 39(3), pp.296-310. Gulley, J.D., Benn, D.I., Müller, D. and Luckman, A., 2009. A cut-and-closure origin for englacial conduits in uncrevassed regions of polythermal glaciers. Journal of Glaciology, 55(189), pp.66-80. Humlum, O., Elberling, B., Hormes, A., Fjordheim, K., Hansen, O.H. and Heinemeier, J., 2005. Late-Holocene glacier growth in Svalbard, documented by subglacial relict vegetation and living soil microbes. The Holocene, 15(3), pp.396-407. Larsen, N.K., Piotrowski, J.A., Christoffersen, P. and Menzies, J., 2006. Formation and deformation of basal till during a glacier surge; Elisebreen, Svalbard. Geomorphology, 81(1-2), pp.217-234.

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