

Review of

Ice tectonics during the rapid tapping of a supraglacial lake on the Greenland Ice Sheet

By S.H. Doyle et al.

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General comment

This paper is mainly a presentation of observations prior, during and after the drainage of a supraglacial lake on the Greenland Ice Sheet. According to their observations and conclusions the authors suggest hydraulic fracturing as main lake drainage mechanism to establish a temporal and efficient water pathway through the ice sheet. My main concern is how can the initiation of the main crack be explained? Once the crack is formed, its downward propagation can be explained according to Krawczynski et al. (2009) work. But the authors don't mention convincing arguments to explain why such a long (700 m) crack has formed after the lake started to drain. According to the authors, the lake started to drain supraglacially into lake Z and Moulin M4. In the following, rapid tapping started through the crack. If this is correct, I propose to make this clearer in the manuscript. My question is whether the first stage of lake drainage through the Moulin could have initiated the crack formation at the surface which could further propagate into depth as proposed by Krawczynski. I think that this initial crack formation should be scrutinized as it seems crucial for explaining rapid tapping.

Another point is the seismic analysis. Why do the authors use a butterworth filter 5-50Hz? I think the authors should justify this choice (by citing corresponding papers). What is the order of the butterfly filter? Dimensions of the concrete slabs? I am also wondering why the authors did not perform any location attempt of the seismic activity, at least at the glacier surface (eg Roux et al., JGR 115, 2010). If successful, this could reveal where fracturing occurred and, with some more elaborated techniques, provide some hints on the fracturing mechanisms (eg Walter et al., 2009, Bull Seism Society America, 99, 2A, 852-870).

It is not always clear how "transversal" and "longitudinal" are defined in the text, especially what concerns the orientation of the cracks. This should be defined. Also the direction of glacier flow should be indicated in the figures. This would help to understand the "simple shear" discussion.

The paper is well written and well presented. It deserves publication.

Specific comments

Section 3.2, line 16: discharge amounts to $3.6 \cdot 10^6 \text{ m}^3$ – wrong unit

Section 3.3, line 24: indicate on which day this happens (not only time)

Section 3.3, line 4 (> 1cm wide)

Section 3.3, line 25: A number of ice blocks had fallen – where from did the ice blocks fall?

Section 3.3: a photograph/cartoon showing the notch would be useful

Section 3.4, line 23: discharge rate (dZ/dt) – wrong symbol

Section 3.4, line 16: it would be helpful to mention the figure references where they should be for each figure separately and not all together

Figure 2: Where are the points P1 and P2?

Section 4, line 10: at 3:15 the fractures are effectively closed. However, the seismic activity was still high then according to figure 8. Why? It seems that figure 8 should also be referenced

Section 4, line 11: Both sentences are not linked to each other.