

***Interactive comment on “Subglacial sediment transport upstream of a basal channel in the ice shelf of Support Force Glacier (West Antarctica), identified by reflection seismics” by Coen Hofstede et al.***

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Dear authors,

I really enjoyed reading your manuscript - I'm very sorry that it has taken me so long to review it.

General comments:

The paper explores a little-studied feature in the base of Antarctic ice shelves, but one

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that is nonetheless important for ice shelf stability and sub ice-shelf circulation. The study also indicates subglacial sediment transport. The data acquisition and processing is of a high standard and the imaging is unambiguous. Most of the comments in the attachment are suggestions for grammatical corrections or improvements for readability; some of the paragraphs seem a little rushed, and some sentences aren't as easily understood as I think they might be. I also have some more substantive requests for clarification of a few points, as mentioned below, but I don't think that these are major issues. Overall, I think that the paper is a nice contribution to the understanding of ice shelves and their dynamics.

Best regards, Adam Booth

Specific comments:

Abstract - I found this a little qualitative, and maybe some hints at the dimensions of the subglacial channel could be useful?

P2 L7-8 - similar to my comment in the abstract, maybe some quantitative detail about the geometry of surface channels could be useful?

P3 L12 - 'active source' seismic

P3 L16 - if its important to mention the date of the radar acquisitions, do so for the seismic too; I'm not sure you say when the data were acquired at any point in the manuscript.

Figure 1. Add a distance scale for the arrow lengths in (a). I also wonder if the figure would benefit from some textual geographic labels (e.g., the landmarks and features mentioned in the intro?).

Section 2.5 - again, I'd mention the acquisition date here.

P6 L3 - define p as compressional (equally, S as shear when it comes up later). Additionally, you occasionally swap between "P wave" and "p wave". Be consistent.

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P6 L4 - your sample rate is actually a sample interval.

TCD

P6 L5 - consider putting the manufacturer of the GEODE system... something like "four Geometrics GEODE units"?

P6 L7 - should II be III, given the information in Table 1?

P6 L10 - I think your description of the acquisition (particularly for the long offset gathers, but maybe also for the profiles) might benefit from a schematic diagram of the survey.

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P7 L9 - define  $R(\theta)$  at the start of this paragraph, otherwise Reflectivity and the symbol in Equation (2) is undefined.

P7 L11 - it's unclear how  $V_p$ ,  $V_s$  and  $\rho$  relate to the primary reflectivity, in the way that you have described it here. I would consider splitting this sentence, explaining how reflectivity is defined by contrasts in these quantities, and then introducing Equation (2).

P7 L14 - just give the Section number explicitly, rather than the cumbersome "determination of A0 subsection".

P7 L20 - give references for the parameter ranges you use in Table 2, to provide you with reflectivity ranges.

Table 2 - explicitly state which material would have subscript 1 and 2 (i.e., which is above and below the interface). You might also consider defining the impedances as well as the Reflection coefficients?

P9 L15 - the abrupt transition is, of course, only abrupt on the wavelength scale of your wavelet; maybe simply adding "at the XX m scale of vertical resolution" in here?

P9 L19 - here, and throughout, I think you're mis-using the term 'accuracy'. If something has 19% accuracy then it is very poor indeed! Do you mean 19% uncertainty, or "accuracy better than 81%", or suchlike? If I'm correct, that you're mis-using this term, make sure that other instances of accuracy are checked too. In this specific case, it's

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also not clear to me how the numbers above end up giving this accuracy.

Section 3.1, header - I'm not sure that these are 'artefacts' as such, which I'd consider more to be residual effects of processing (e.g., migration smiles). I'd suggest that this subsection is retitled "Seabed depth conversion"?

Figure 2 - this is a nice figure, but I'd suggest that the other figures in the section are given the same interpretation panels - it's unclear why you'd only provide it for this one. It might also be good to show an enlarged section of the subglacial feature; I know it features in other figures, but I really couldn't see it here.

Figure 2 caption - "switches from positive to negative" - how do you define what is positive and negative polarity? You might just be better saying "changes polarity".

P11 L3 - it seems a little premature to be referring to this feature as a 'drainage' feature. It's only in the Discussion where you start to present the evidence for this, based on previous work. At the moment, it is a subglacial feature, but it's impossible to know it's a 'drainage' feature from the seismic results alone. I'd suggest that you remove 'drainage' at this point in the manuscript.

P11 L7-8 - is the gradational, rather than abrupt, transition the reason why you see the deviation to smaller-magnitude reflectivity? Is it worth making this comment explicitly?

P12 L17 - The sentence "Consequently..." makes it sound like you did this deliberately, whereas I don't think you did at all! I'd rephrase this as "Consequently, along-profile II samples the west flank of the channel rather than its crest, and therefore complicates the recorded seismic response."

P12 L17-19 - It took me quite some time to recognise what was going on with the appearance of the 'double bed' in Profile II and Figure 3. I think you need to explain the geometry more clearly, and explain that you have these two laterally-offset reflectors within a Fresnel zone of each other. I also think it would be helped if you presented Profiles III, IV and V first - they don't have to come in numerical order. That said, I do

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wonder if Profile II adds much to the interpretation - you don't really refer to it later in the manuscript, and it's clearly not acquired in the most ideal location (not that I blame you, of course, it happens!!). Maybe it should be relegated to supporting material?

P12 L20-21 - Why would depth conversion obscure the sea bed?

Figure 4 - these seismic images are lovely :)

P15 L17-18 - with the likely complex pattern of reflectivity close to the uncoupling, I'm not sure you can say that the polarity 'confirms' the presence of water - but it might certainly support or imply it.

Figure 6 - it might be good to include a refresher of the location map?

Section 4.3 - again, I'm not sure that 'drainage' is yet appropriate in this section header.

P18 L11-12 - Given that the landform likely represents a diffracting point rather than a specular reflection, I'm not sure that reflectivity calculations hold. I agree with your geometric arguments and think that you do a good set of analyses here, and I think that the reflectivity argument is in any case superfluous. I'm not sure what the reflection coefficient equation would be for this; I think you can likely speculate that the amplitude appears weaker than surrounding reflections, but the quantitative assessment might be an over-interpretation. (this comes back on P19 L17-18).

P20 L4 - define 'trend'. Do you mean the magnitude? As in, you're interpreting based on indicative reflectivities rather than a fully-quantitative assessment?

P20 L16 - I wonder if the terms 'disturbed' and 'undisturbed' imply a process rather than a geometry? As in, the implication that the sediment has been disturbed by something (e.g., ocean currents). Of course, this might be the case, but as an indicator of simple geometries then I think that 'stratified' and 'unstratified' of 'homogeneous' might be less weighted?

P22 L5-6 - I think flat and horizontal might be the same thing? The difference here

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might be in the terms 'planar' and horizontal.

P22 L19 - I agree with you, Bradley Morrell is great!

Technical issues:

There are many grammatical issues which I have flagged up in the attached manuscript. These are flagged up, and suggestions made for alternative wording; all of the comments above are also included.

Please also note the supplement to this comment:

<https://tc.copernicus.org/preprints/tc-2020-54/tc-2020-54-RC1-supplement.pdf>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-54>, 2020.

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