Bremerhaven, January 25, 2021

Dear reviewers,

Thank you for your comments which helped improving the paper. The minor revisions did not turn out to be so minor after all but I think it was worth it. The main changes are:

- I inserted a new figure, figure 4: (a) showing the seabed of profile II (that was previously taken out but has important clues) under the basal channel and (b) a top view showing the extend of the sedimentary sequence with chaotic to weakly stratified reflections.

- Figure 2d is slightly adjusted such that the seaward dipping reflectors are shown.

- Figure 3d is a zoom of the seabed of profile III.

Essentially our evidence for a grounding line has two main arguments:
- The sedimentary sequence having a chaotic to weakly stratified reflections, probably caused by gravitational flow along the steeply descending seabed. This sequence is very different than major part of the seabed.
- The extent of this sedimentary sequence. Towards the grounding line the outer boundaries converge towards the subglacial channel making the sequence point sourced and fan shaped.

Reviewer 1:
Thanks again for your concise comments, they have been entered.

Two remarks:
- Regarding the AVA data from the shot records. Amplitude loss due to geometrical spreading is accounted for by equation 3.

- Depth migration has been tried as well but did not give satisfactory results. The basal topography of the ice shelf (terraces) was affected by the larger concave cavities. Best results were depth conversion of time migrated sections.

Reviewer 2:
Our main evidence for the presence of a grounding line fan deposited by the subglacial drainage channel has several arguments:
- The sedimentary sequence with chaotic reflections. This is to be expected as we interpret this sequence as an outwash from the subglacial drainage channel deposited by gravitational flow. And that is a logic consequence considering the steeply descending seabed close to the grounding line seen on profile I. We can now add the seaward dipping reflectors of this sequence.
- The extent of this sedimentary sequence derived from the profiles.

Profile III is problematic to describe the seismic facies in detail. The seabed topography and morphology are significantly influenced by the topography of the basal channel. What is possible is to estimate the extend of the chaotic sequence because of its larger amplitudes and because profile III crosses profile I (the sequence top and base can be clearly defined) which are tie points to profile III. That is the strategy we adopted. At profile III (across-flow) the sequence is centered under the channel and as reviewer 2 points out, beyond the limits of the channel. But that is to be expected for a fan shaped deposit. We have now strengthened this argument with sedimentary sequence extent at the seabed of profile II.

- The ocean cavity with a steeply descending seabed and thus allowing for a large fan.
- The subglacial channelized flow upstream of the basal channel where these deposits
- The stable grounding line.

Reviewer 2 gives us an additional piece of evidence and a suggestion as to why the sedimentation sequence might indeed be a grounding line fan for which we thank him:

- The sedimentary sequence with chaotic reflections does show seaward dipping reflections.
- The seabed of the sedimentary sequence with chaotic reflections dips with 1.1d values that are found on large glaciomarine fans (Lajeunesse 2002, Dowdeswell 2015)

We adopted this in the text and adjusted figure 2d, 3d and a new Figure 4 accordingly.

Specific comments:

1. East or West Antarctica?

We adjusted the title with Antarctica.

2. Evidence for a grounding line fan:

Our arguments are listed in the intro.
The remark “fairly flat” page 10, line 15 should have said “if the base were fairly flat”. It’s an example under what conditions the seabed shows up as a mirrored version of the base of the ice shelf at a time migrated profile.

3. Dimensions of the fan and seabed topography:

Rev 2: “The volume of sediment is huge, 5.6 km3.”
If I do the math and recalling that the volume is probably closest represented by half the volume of an elliptic cone (and not a rectangle, fan-shaped) with a length of 6.75 km and two radii of 1.6 km and 0.2 km, I come to 1.1 km^3. This number is still a coarse estimate as a cone probably overestimates the lateral extend of the fan downstream. If I read Dowdeswell 2015 this is not unusual. Examples of these large fans are given by Lajeunesse 2002 at Hudson Bay. These fans are remnants of the Laurentide Ice Sheet that, in volume, comes close to Antarctica. SFG is a huge ice stream and its descending seabed is similar to the setting Lajeunesse describes.

Summarizing: I don’t see the size of the fan as unusually large.

“Why do we not see any topographic evidence in profile III?”
This is not necessarily the case, the seabed may topography on the eastern side but this may also be caused by the topography of the basal channel (see adjusted figure 3d). Figure 4a (profile II) clearly shows the sequence is deposited on top of a different formation at a topographic high in the seabed.

4. “What is it specifically about the reflections (e.g. thickness, scale, morphology etc.) that provides diagnostic evidence of deposition by meltwater? ”

Facies:
Originally, we named the sequence “disturbed reflections with some stratification”. Your comment here was:

- “**How can a material be transparent yet stratified and disturbed?**”

And now is:

- ”Based on figure 2d, to me it looks like the reflections, whilst sloping, curved, **disturbed etc. actually have some lateral continuity and stratification,** so their description as ‘chaotic’ may be a misnomer.“

Having checked classes of seismic facies of sedimentation several times now, I did not come across the term “disturbed” and as such I did not adopt this term.
If I were to more accurately and meaningful describe this sedimentation sequence I will opt for: “The sequence is chaotic to weakly stratified. Reflections are mostly curved upward, discontinuous (a lateral extend of 100 to 600 m which to my mind is discontinuous) and occasionally dipping in a seaward direction. The amplitudes are high and a show little signal loss with increasing depth, however boundaries (lower and lateral) are transitional. We’d like refer to this sequence as the **“sedimentary sequence with chaotic reflections”**.

That this is a description of the along-flow profiles is and was obvious as I describe the seismic facies per line. Subchapter (profile I) where I describe it, I originally named along-flow profile I. The direction of the facies description is given per profile and should thus be obvious.

We added the seabed of profile II (Fig 4a) where the reflections are more continuous, stratified and are less chaotic. But as it is the same sequence, we refer to it as **“sedimentary sequence with chaotic reflections”**.

We have explained why we do not describe the seismic facies description of profile III

Why this facies description strengthens the argument for a grounding line fan we argue at the intro

Extent:
Plotting the shots with the sedimentary sequence with chaotic reflections of profiles I, II (withdrawn before but adjusted and resubmitted now) and III and extrapolating these outer boundaries provides “the smoking gun” as to why these deposits most likely come from the

subglacial drainage channel and are fan shaped (Figure 4b). Towards the grounding line the boundaries converge to the subglacial drainage channel at the grounding line (radar profile 6). The point source entrance of the fan derived through extrapolation lies 750 m exactly downstream of the subglacial drainage channel. This small mismatch can have several reasons. A linear extrapolation may be too simple. It can also be that, as with profile I, the seabed does not

5. Agreed
6. Agreed
7. Agreed

8. Figure 2 and 3 are annotated the same way, the seismic profile followed by a schematic interpretation. I have amplified the visibility of the seabed and added a zoom of the seabed. As mentioned, the topography and morphology are influenced by the topography of the ice shelf base so it is a complicated figure. The key message of figure 3d is the lateral extend of the sedimentary sequence only being centered under the channel. The sequence is absent at the eastern and western end. To me that is a strong indicator the subglacial drainage channel is the source.

   Rev 2: "The sequence manifests far beyond the limits of the channel".
   It does, roughly 1.5 km in each direction but not to the ends of profile III. That makes the subglacial channel causing the basal channel a likely source of deposition (see added figure 4b).

9. "Figure 3 – there are very significant differences between 3c and the other two seismic profiles in this figure".

   This is and was clearly explained in the text (was page 13 lines 7-10, now lines 19-22): no the ice-water interface of profile III is not very different than profile IV. The source is different and produces a ghost making the source wavelet longer.

Best regards,

Coen Hofstede