RC1: 'Comment on egusphere-2025-2515', Sarah Greenwood, 04 Sep 2025

We are grateful for the time and effort that has been put into reviewing our manuscript. Especially, we also appreciate all the additional comments on the representation of the data on the figures.
We have carefully considered the comments and addressed them below. The comments are in bold and our answers in italics.

In general:

Language: *Thank you for the advice. We agree that some pronouns are misleading and we will clarify all of these pronouns in the manuscript. We will rephrase all misleading paragraphs that were highlighted.*

Structure: *We agree that the narrative will benefit from a combination of results and interpretation. We would like to restructure the chapter so that we have geomorphology results and interpretation followed after one another and sedimentology results and interpretation followed after one another.*
We therefore would also like to move Figure 5 (Geomorphology/ Bedforms) back to the result section and rename it to Figure 3.
We will change the structure of the study area and the discussion chapter to improve the flow, as mentioned in the line-by-line comments.

Morphology:
We will name the previously identified GZW from Mackintosh et al., GZW-I and GZW-II to improve identification in the text and make it easier to follow. We will rephrase the core descriptions and hope it will be easier to follow.

Figure: We will check the suggestions made for Fig.1, Fig.3, Fig.4, Fig.5, Fig.6 and adjust them if needed according to the comments and hope the visual representation improves.

Line by line:
15: that all modern observations are "of limited value" is a bit harsh! Reframe this.
We apologize and agree that it sounded a bit harsher than it was meant to be. We will rephrase it.

47: ambiguous pronoun – what does "they" refer to? (However, they concluded)
Thank you for noticing all the ambiguous pronouns. We will replace them.

51: ambiguous pronoun – what does "it" refer to? (From here, it)
(I note these two as examples of ambiguous pronouns. They occur throughout the manuscript and the authors should carefully check sentence by sentence.)
It refers to the DSW mentioned in the sentence before. We will replace it with "DSW".

52: define CDW
Thank you for noticing. We will define it.

59-64: these sentences are muddled and contain repetitive phrases
We agree and will rephrase the sentences.

66-69: repeats previous sentences

We will rephrase it.

70-1: revise to end with a more concrete statement – shut-off does mean absent or different.
We will replace it with e.g. "absent on the continental shelf."

73: "cross-cutting" implies two features are superimposed but with different orientations, i.e. onecuts across another. Troughs are not typically cross-cutting. "cross-shelf troughs" would be a betterway to phrase what I think you mean.
Thank you, we will correct the term to "cross-shelf troughs.

77-8: missing/incorrect word – prominent what? The main rock types, or lithologies? (And perhaps you mean predominant?) Sentence should end "formed ~3100-2800 Ma ago".
We apologize for the unfinished sentence and will correct it.

79: since you refer to both continental shelves and ice shelves, clarify which you mean: "The continental shelf area is bounded by"
We will clarify if we talk about the continental shelf or the ice shelf.

89-90: ambiguous "which". Suggest break into two sentences, with the second: "These GZWs, which are at equal water depths in both troughs, are thought to mark the most recent expansion of the ice sheet onto the continental shelf." Suggest also "limits" or "limits of expansion" instead of "most recent expansion".
We fully agree and will correct this.

92-6: this paragraph doesn't follow from the previous – it would benefit from an opening sentence that lets us know the relevance. Locations of the Cape Darnley polynya and Wild Canyon ought to be shown on a figure. Who has "newly described" CDBW? Provide a reference or otherwise clarify or delete. Also clarify "grounded iceberg tongue" – an ice tongue is usually considered an elongate ice shelf, i.e. floating, so what do you mean by iceberg tongue? The text doesn't explain the formation of CDBW – are we to assume it's equivalent to ISW? Or DSW? I suggest reducing the acronyms and names for each state, and focus on describing the process.
We will add Wild Canyon to Figure 1, Cape Darley is already labelled in Figure 1 and we will describe the location of the polynya more detailed in the text. We agree that it was confusing and will clarify where the information comes from (Oshima et al., 2013) and why it is relevant. CDBW is a local variety of AABW. We will clarify it in the first sentences. We took the term 'grounded iceberg tongue' from Oshima et al. 2013, but to keep it simple, we will delete this term.

105: this section launches into data collection specifics without any introduction. What is PS128? Itwould be helpful for part of lines 125-6 to be moved here (did you originally have the sedimentcoring section first, or even didn't originally include any geophysical data in the manuscript?).
We will move the description of the expedition and include a more detailed data introduction. We will clarify what we did on the cruise PS128 and we will refer to the cruise report (Tiedemann and Müller, 2022).

106-8: awkward wording, and it's not clear what your set up choices were – are the opening angle settings yours? Suggested edits: "The frequency of the MBES system… and transducers are arranged in a Mills cross…" (?). "In water depths <2000m, the opening angle was set to 70°, while in greater depths the angle was reduced to 50° either side of nadir.
We agree that this paragraph was not clear enough and we rephrase.

109-110: "Afterward, the data" – which data – new and legacy data were processed together? 50m x50m seems rather coarse resolution for modern multibeam systems in these water depths – did you try gridding at higher resolution? Or was data too noisy or sparse for that?
We will clarify the description of the multibeam data and add a data description at the beginning of the chapter. We also gridded the data to a 25 x 25 m resolution and will add these grids to the manuscript now. Gridding them to a higher resolution did not change the perception of the submarine bedforms

because most features were on larger scales, and the GZWs are too small to see them in the bathymetric grids (~6m height). We identified the GZW on the subbottom profiles.

111: Redundant wording. Suggest "Sub-bottom profiles were acquired with a Teledyne…"
Thank you, we will rephrase.

112-123: the rest of this paragraph is muddled, and should be revised to clarify settings that contribute to penetration, vertical resolution, lateral resolution, and footprint.
We agree and apologize for the confusing paragraph. We will see what we can rephrase and delete for clarity.

130: Results refer to CT-scans (images in Figs 3 & 4?) – include these in the Methods
We apologize for forgetting to mention the CT in the methods. We will include it.

134-165: These methods need a clearer narrative – it is unclear what samples have been taken, from where, how, for what purpose. In this section, first describe the sampling scheme and purpose, before describing how samples were then handled. E.g. line 134 – which samples? Line 141 – what spatula samples? Are these the same as the ones just described, or a new set? Was datable material (line 145) picked from samples – which samples (in relation to those you've just been describing)? Does microfossil extraction (line 162) also relate to picks for dating – mention this first.
We apologize for the confusing description and will rephrase the entire paragraph for a clearer description. We hope that now the working procedure can be followed more easily.

136: how were inorganic carbon + carbonates removed?; line 138 – clarify bulk sediment organic C.
With 20% HCL. The sentence with the bulk sediment does not describe the organic C measurement. It is for the C:N ratio. Here, we used the ground and freeze-dried bulk sample for the Vario Cube analyzer and it is total carbon content, not only organic C. We will add this to the manuscript.

152: Edit to something like - The maximum reliable age limit… was estimated to be, or determined to be… A limit of 42 radiocarbon ka is something that arises from the method, not a parameter or setting you arbitrarily decide on?
The limit of ~42 ka comes from the MICADAS system. This is the value of the blank age for combusted samples, which lies between ~39-47 ka BP depending on the combustion method (gas, graphite..) Mollenhauer et al., https://doi.org/10.1016/j.nimb.2021.03.016, 2021.

164: revise "carefully considering" – having considered, what deltaR values did you use?
We calibrated the radiocarbon samples with the software Calib 8.2 (Stuiver and Reimers, 1993). We decided on reservoir correction of 1300 ± 100 yrs BP from Berkman and Forman 1994, GRL for our glacial samples (DeltaR 900) to ensure comparability to other sediment records from the Antarctic Shelf (e.g.,Ingolfsson et al. (1998), Anderson et al. (2002), Hillenbrand et al. 2010).
We also considered Heaton et al. 2023 approach for modern deltaR for samples younger than 11.5 cal. ka BP and adjusted glacial deltaR for glacial samples >11,5 cal. ka BP). We will add a more detailed description to the method section.

168-70: inner, mid and outer are geographic descriptors – they don't need referencing to other studies, or to particular landform assemblages. If you find that the landform assemblages that occur in different zones match the distribution of landforms observed elsewhere, then state this as a result.
We agree and will delete this sentence.

170: why start on the mid-shelf, not inner (or outer)? Consider the order of presentation, and try to be systematic.
We started on the mid shelf because we do not have sediment cores from the inner shelf, so we only analysed mid and outer shelf bedforms.

171: "subparallel features" and "wedge-like structures" should be followed by semi-colons, and/or the 3 separate groups of features should be numbered, otherwise the list of terms that are supposed to represent 3 groups is confusing.
We agree and will add this

181: delete "Based on this morphology" – the internal composition is its own result, not based on shape.
We will delete it.

179-189: clarify what direction the "length" of a wedge means – in the along-flow direction, i.e. cross-wedge direction?
It is along-flow direction, so we will add it.

206: refer to Fig 2, not Fig 1
Thank you for noticing, we will replace it.

209: "shelf break of Nielsen Basin"
We will add it.

213: "in front of" -> seaward ?
Yes, it means seaward; we will add it.

219 + 223: does "poorly rounded" mean angular, and "poor angularity" mean rounded? If so, say so more simply!
Yes, we mean that. We will try to describe it simply.

219: ambiguous reference to "previous cores" -> Unlike the lowermost unit from the other outer shelf cores, it has…
We will change the wording of this paragraph.

222 onward: "some layers", "distinct sequences" – it is not clear where in the stratigraphy theselayers are found. In the mid-core? At the core top? Where are the fining upwards and coarseningupwards trends, in the stratigraphy? The sentences in lines 227-231 ought to be incorporated intothe previous paragraph with a more clear, explicit description of core stratigraphy. Refer to depthintervals, if that helps.
We agree that the description was not clear enough and a bit muddled. We will rephrase the entire chapter and add depth intervals. We hope it makes it easier to follow.

236: "boundary" and "mid-shelf cores" are confusing here – I think you mean an up-core boundary,rather than referring to spatial core site boundaries? Instead: "Above the diamicton unit, the shear strength drops." ?
We agree that it is confusing and will rephrase.

256: why are 14C ages plotted on the figures, and not calibrated ages?
It was just a personal decision, because we thought it was nice to have the uncalibrated ages in the figures with the error. But we agree that it is more consistent to have the calibrated ages in the figures, because the uncalibrated ages are already in the table.

Here, or in the Methods earlier, you should also mention that other published ages are re-calibrated and included in your study. The core sites for these published ages should also be plotted on at least one of your figures. The caption for Table 2 is confusing – you refer to Heaton et al. 2024 for two other cores, yet in the table itself you list Leventer et al. 2006 for these cores, and you add another core/reference from Borchers et al. 2016. Please explain clearly what you've included, from where,and whose re-calibration you use.
We will mention the legacy cores in the method section and mark their location in Figure 1. We will clarify this in the method section and in Table 2, we will clarify how we calibrated the ages (see earlier comment).

265-275: this paragraph has limited referencing to substrate (or other) controls on ice streaming and lineation morphology. Consider also Livingstone et al 2016 (J. Glac.), Jamieson et al 2016 (J. Glac.), Halberstadt et al. 2016 (Cryosphere), Ó Cofaigh et al. 2007 (JGR), Greenwood et al 2021 (Sci Adv)
We agree that the references got a bit limited due to the fact that the sentences got moved around a bit during the writing process. We apologize for not checking again. We checked your provided references and will include them in the paragraph. Thank you.

266: inappropriate reference – King et al. 2009 was a sub-ice sheet study (imaging the active bed), not a continental shelf study of relict landforms. *We will remove it and replace it with e.g., Klages et al., 2014, 2015; Livingstone et al., 2016a; Halberstadt et al., 2016.*

273: relate landform types to your subbottom profiler data? Roches moutonnées and whalebacks are bedrock landforms…
We apologize that the sentence was misleading. We identified the drumlinoid features from the bathymetry data, not the subbottom profile data. We will clarify the description.

280: see also Simkins et al 2018 (Cryosphere)
Thank you for providing this reference. We checked it and will include it in the paragraph.

286-8: I don't follow these two sentences. Which previously described GZW, and what interpretation do you make about shelf transitions or cavities that relate to multi-directional iceberg scouring?
Here, we were talking about the (now labelled GZW-II) in Nielsen Basin outer Shelf. We will rephrase the sentence. We interpreted the scours in front of GZW-II as sub-ice shelf keel scours after the description in Table 1 from Smith et al 2019(nat.comm.) They were deeper and more pronounced compared to other scours farther away from the GZW and were cross-cutting each other, indicating different flow directions. We interpreted these different directions due to different break of areas of the ice shelf.

293: what differences in substrate? Please be specific in your interpretations.
We mean the change in bedrock composition from harder to softer bedrock/sediments. We will clarify this.

296-7: GZW superimposition on MSGLs has not been presented in the results section or figure – this seems important and you return to it in the Discussion, so please address specifically.
We will add a mapping of the MSGLS in Fig.3, Panel c and describe it.

320 + 335: "towards the top" seems inappropriate in both cases – these units are lower-mid-core
322: what tells you sub-ice shelf, and not due to freely moving icebergs?
We apologize for the misunderstanding. Here, we mean the transitional facies in the middle of the core and meant with towards the top that it is above the basal unit but not the surface unit. We will rephrase.
Refer to comment (line 286-8)

324: what proxy signatures do you find that are indicative of ice shelf break-up and turbation of sediments?
This interpretation builds on the previous comments about sub-ice shelf facies (see line 322). We interpreted this from core PS128_44-1 (Supplement Figure S1). The proxies indicate a turbation of the sediments, e.g, with a diamicton as surface unit (14C ages of ~14 cal. ka BP). We also recognized heavy scouring in the subbottom profiles for core PS128_44-1; this is why we took the 14C ages out of our interpretation. We can not really say if its sub-ice shelf, so we generalized the facies as 'transitional'.

327: meltwater plumes should also leave a distinct sedimentological/physical record, e.g. well-sorted silt fraction, rounding, lamination. E.g. Witus et al 2014 (QSR), Lepp et al 2023 (Cryosphere). What evidence of these do you find, in addition to particular microfossils? The

microfossil reasoning should also be more specific – are there particular species that favour fresh or nutrient-rich waters?
The layers (laminations) we refer to already have been identified by Leventer et al. 2006, Sedwick et al., 2001 and Alley et al. 2018 (Referencelist Manuscript) and are annual iron-rich laminae with phytoplankton species Corethron spp. and Chaetoceros spp.
We likewise identified Corethron spp. and *Chaetoceros* spp. resting spores, which are indicative of meltwater input (Leventer et al. 2006, Alley et al. 2018). The sedimentology oft he lamination were mainly mud with fine sand and no clasts. We had a high water content of ~50-70% and a TOC maxima. We will add a zoom-in on these laminations in Figure 5 and clarify in the text

333: higher variability of what?
The proxy values are less homogeneous than in the other facies. We will add this.

338: why grounding line proximal?
The transitional facies of PS128_39-1 has still high clast content with big dropstones and is in the lower part still characterized as a diamicton. This diamicton indicates supply from subglacial sediments close to the GL. It has lower shear strength and at the upper part of the transitional facies we found calcareous microfossils and some sandy mud to sand stratification with an increase in water content, which indicates the transition from GL proximal to stronger glaciomarine influence. In PS128_41-1 (supplements Figure S1) we have a GL proximal sediment as basal unit overlain by a transitional gravelly sandy mud, which transitions into a diatom-rich, bioturbated sandy mud.

340: advanced GL retreat is ambiguous! -> "suggest that the GL had already retreated towards the inner shelf"
We will rephrase, thank you.

349: do the sediments/proxies tell you about GL oscillation? An oscillating GL should have already been clearly argued from the landform and sediment evidence
We apologize for using the wrong term. We did not mean oscillation of the grounding zone, which we can see from bedforms e.g recessional moraines. We meant a varying subglacial sediment supply from the GL during the retreat. The core location PS128_39-1 is situated in a depression in front of a sill. We concluded that the GL-proximal facies was deposited while the ice sheet was pinned at the sill during retreat, supplying subglacial sediments to the core location. We found coarse but not consolidated material in this facies (see comment for line 338). We will take out the term 'oscillating'.

350-5: these arguments are unclear
We apologize that this paragraph was muddled and will rephrase it.

361: only a few studies of Mac. Roberson land? Otherwise, this statement is incorrect!
We apologize for the misunderstanding. We meant along the East Antarctic margin compared to West Antarctic margin. We will rephrase it.

363: "varves" is widely used in the context of annual laminations -> replace with "layers" or "laminations"
Leventer et al., 2006 and Sedwick et al., 2001 likewise use the term varves, because they found out that these distinct laminations in their cores were annual diatom-rich depositions. We still will replace the term with "laminations" because we did not have high-resolution age constrain to say if our depositions are annual.

368-9: delete "a minimum", delete "further"
Deleted 'further' but we need 'minimum' because 12.5 ka is the minimum retreat age from a range

370: if the outer shelf GZW was vacated at 12.5, that doesn't mean that it couldn't have formed during the LGM – just that the limit was stable for a long time. What is the argument for GZW formation at, or "during" the period around 12.5? Are you referring to a single outer GZW or a sequence of GZWs?
We apologize that our description was misleading. We did not imply that the GZW formed around 12.5, the GL was gone around 12,5. We assume it did not form during LGM because we found MSGLs

beneath wedge (grounded fast streaming ice and ice was grounded at the continental shelf break during LGM, small size of GZW indicate short stillstand period (only 6m high, 1km long)

383: what is the evidence for GL retreat accelerating? Why should that be due to CDW? And what does freshwater have to do with enhanced CDW?
We inferred the GL acceleration from the retrograde topography and the short timing between the GL retreat (12.5 cal. ka BP to 11.0 cal. ka BP) from outer shelf core PS128_45-1 and mid shelf core PS128_39-1.
The intrusion of relatively warmer CDW causes melting at the ice shelf base and therefore can accelerate retreat at the GL. Freshwater input e.g, DSW can protect the ice shelf base from the CDW and therefore influences stratification in the ice shelf cavity and retreat behaviour.

389: I think the previous AIO ages need drawing into the narrative better, e.g. Previously only bulk/AIO dates were available, and carbonate is a big improvement on those for … reasons. Published AIO ages from Leventer indicate…
We will rephrase the paragraph to make it clearer.

393-5: you contradict yourself here in a confusing passage: RPO ages help better constrain… reworking complicates efforts to constrain… Does the bioturbation sentence link to the RPO ages sentences? Make these elements of the narrative clearer.
We will rephrase it.

401: awkward wording -> "for the mid-shelf of Burton Basin, east of Nielsen Basin". You could also note that "These ages are almost identical to ours, and this strengthens…"
Thank you. We will change the wording.

414: spell out ACR, MWP1a, MWP1b. And discuss these forcing mechanisms clearly. How would each drive retreat? Do you conclude that the ACR or MWP1b was important, and why? You consider the ACR important enough to mention in the abstract, but don't discuss it here beyond the first sentence.
We will connect the narrative better and explain the processes and how they are connected.

421 onward: you mention various retreat timings from around Antarctica, but these come a little out of the blue – we are expecting discussion of East Antarctic timings, then suddenly and without signalling, we're on the Antarctic Peninsula. Try to build this story more clearly, and then the argument that these different timings might be something to do with the accessibility or intensity of CDW water. CDW as a theme also appears in this paragraph very suddenly. Introduce us to why it's relevant, and then present the evidence and arguments for how it might vary.
We will connect the narrative better and explain the processes and how they are connected.

440: this key point about AABW – included in the sub-header – comes without clear connection to the previous discussion.
We will connect the narrative better and explain the processes and how they are connected.

450-1: and Iceberg Alley? Your Conclusions opening statement should reflect your whole study.
Thank you for noticing. We will correct this.

456-7: how does an age that contradicts LGM formation of an outermost shelf GZW also support grounded ice at the shelf break? Do you mean that the GZW is actually a bit retracted from the shelf break, and that ice sat beyond the GZW at maximum? That hasn't been clear from the earlier presentation.
We apologize for the misunderstanding. The retreat age of 12.5 ka BP is from core PS128_45-1 on the outer Shelf. This is not retrieved from a GZW. GZW-II lies a bit more landward from core PS128_45-1, close to PS128_44-1 ca. 10 km. We therefore concluded that if we had grounded ice until 12.5 in front of the GZW-II, GZW-II likely formed after 12.5 and is not of LGM age because it was situated beneath the grounded ice. We inferred a similar formation age of GZW-I to GZW-II because of the similarity in bedforms and topography of the troughs. "Do you mean that the GZW is actually a bit

retracted from the shelf break, and that ice sat beyond the GZW at maximum? "→yes, that is what we tried to tell. We will clarify this by also labelling the GZWs.

Suggest also mention your radiocarbon timings in the Conclusions?
Thanks we agree, we will add this.
460-2: I would delete these last sentences – they repeat the end of your Discussion, and are a weak way to end the paper:
Thank you for this remark. We agree and will delete this sentences.