Reply to Jeremy Rimando

Dear Dr. Rimando,

thank you very much for your input on the manuscript, it is highly appreciated. Here is our reply to your comments. We hope the changes we implemented improve the shortcomings of the manuscript highlighted by your comments and suggestions. Please do not hesitate to contact us shall this not be the case for some comments.

1. Comments from Dr. Rimando

Comment 1: I found this paper very thought-provoking. They propose an alternative mechanism and timing for the accretion of basement terranes in Svalbard and the Barents Sea. They propose that these basement terranes were accreted by top-to-the SSW thrusts faults during the Neoproterozoic 'Timanian Orogeny,' rather than by displacement along N–S-striking strike-slip faults during the Paleozoic Caledonian Orogeny. This paper really demonstrates the authors' breadth of knowledge of the previous work on the structures which they suggest belong to "continuous (undisrupted), hundreds–thousands of kilometers long, Timanian thrust systems."

Comment 2: However, I think that the paper will require a bit more work to convince readers of the presence of a laterally continuous system of Timanian thrust faults throughout Spitsbergen, Storfjorden, and the Norwegian Barents Sea. As it is, I am not convinced that the authors' interpretations of a few seismic profiles, including correlation of these interpreted structures with lineaments on gravity, magnetic, and slope direction maps, comprise compelling evidence for the lateral continuity of these WNW-ESE-striking and NNE-dipping Timanian thrusts. Ideally, they should have inspected multiple perpendicular seismic profiles from west to east and correlated these. It might help to include additional representative seismic profiles at different longitudes (and incorporate these in the supplementary file at the very least) to bolster their argument for a continuous thrust system.

Comment 3: The lineaments in the gravity and magnetic anomaly maps that the authors claim to be the continuation of the thrust faults could be anything. Even if these were faults, these might display different fault styles, kinematics, and/or timing of deformation. Granted that observing other kinematics on these WNW-ESE-striking faults does not rule out the possibility that these are the prolongation of the Timanian thrusts (i.e., overprinting may have happened), interpreting more seismic profiles and including a discussion similar to the section 'Devonian–Carboniferous normal overprint–reactivation' should help clarify this.

Comment 4: In short, I do not think the spatial coverage of the data and the amount of analysis conducted is sufficient to suggest the presence of such a large, continuous thrust system. The authors could either do additional analyses or at least describe their level of confidence in their mapping of different portions of the fault system, and be clear about which traces are speculative and which traces are certain.

Comment 5: In some instances, it's difficult to follow their line of reasoning for describing a lateral continuous Timanian thrust fault system. They claim that the structures they observed in the northwestern Norwegian Barents Sea are comparable to structures observed onshore and offshore in other areas, but it is unclear how some of their descriptions support such claims. For instance, the Vimsodden–Kosibapasset Shear Zone (VKSZ) is dominantly strike-slip. It is not clear how this is proof that the VKSZ displays similar configuration and kinematics and, consequently, represents the westward continuation of the Kinnhøgda–Daudbjørnpynten fault zone.

Comment 6: They describe associated map view folds and they explain the VKSZ's strike-slip kinematics, albeit much later in the text, through strong overprinting by the Caledonian Orogeny. What is the scale and timing of the folds that are observed in map view along the VKSZ? Is there proof that these are Timanian and not folding related to the Caledonian ductile shear zone? While later paragraphs seem to clarify the nature of this folding, the manner in which the VKSZ example is presented as proof does not seem convincing. Instead, it creates confusion. I only cite one example, but I suggest that the authors review how they presented their other arguments for an extensive Timanian thrust system.

Comment 7: As noted by Tony Doré (Reviewer 1), I am also not convinced with why these major thrust systems in Svalbard went unnoticed before. They argue that strong overprinting of the VKSZ by Caledonian Orogeny explains why such thrust systems were not identified before, but in an earlier paragraph they describe folds in map view (which are presumably large and obvious) as proof of the onshore continuation of this thrust system. I would expect to see more exposures of the Timanian thrusts onshore, despite 'deep burial' since, as they themselves claim, these areas onshore would have been intensely deformed, and most likely experienced high uplift and exhumation due to their proximity to the Caledonian collision zones.

Comment 8: On its own, this paper doesn't really provide definitive evidence of the presence of hundreds-thousands of kilometers long Timanian thrust systems and I think this issue should be addressed before they even consider exploring the impact of the existence of Timanian thrust systems on the tectonic evolution of the region.

Comment 9: Besides, considering that they discuss the impact of these thrust systems on the tectonic evolution of the region, the authors should include schematic diagrams, or better yet, time-lapse images of their proposed plate reconstruction model.

Comment 10: Overall, the paper is well written. A few stylistic changes, including tweaks to figures and consistency in using in-text citation of figures and figure labels, will significantly improve the readability of this paper. Below are a few minor technical comments to consider:

1) Please make sure that all features/places (e.g., Baltica, Caledonides, Norway, Laurentia, Pearya, Sassendalen, Hornsund) you described are included in your maps. In all of the sections, figures (and panel letters) should be cited consistently in the text right after the feature being described to make it easier for readers who are not familiar with the area to locate the features you are referring to. Please also make sure that the labels on the maps are big enough and easy to read. Some of the text might need to be outlined in another color to provide a contrast to the background and some may have to be brought to the topmost layer items on your figure to prevent them from being blocked by other lines/shapes.

Comment 11: 2) I suggest indicating the ages of these 'Timanian fingerprints' on the map to emphasize the contemporaneity of structures and citing the corresponding references on the figure captions as well.

Comment 12: 3) Indicate the abbreviations of geologic features and places in the text, similar to how you did in the figures (e.g., BAFZ for the Baidaratsky fault zone), so that it is easier to locate them on the maps.

Comment 13: 4) Please include a north arrow, a scale bar, and northing and easting labels around the map frame. It’s difficult to visualize some descriptions of fault lengths in the text since you did not put any scale bars on your map in fig 1.

Comment 14: 5) The authors plot the other seismic profiles that belong to the DISKOS database on a map, which is good, but these should be labeled and cited in the text alongside citations of previous studies that inspected these particular seismic lines. If there are other previous studies that look into seismic profiles that are not part of the DISKOS database, these should be included as well. The locations of previous studies which were discussed to provide evidence of the lateral extent of these Timanian thrusts should also be plotted.

Comment 15: 6) Rippington et al. (2010), and the lead author himself in Koehl (2018), cast doubt on the existence of an ‘Ellesmerian Orogeny’ due to the lack of compelling evidence from cross-cutting relationships and age constraints, but ‘Ellesmerian Orogeny’ is mentioned several times in the text.

Comment 16: 7) Is ‘top-SSW’, ‘top-E’, or ‘top-S’ standard notation? Why not use 'top-to-SSW'/ 'top-to-the-SSW', 'top-to-east'/'top-to-the-east', or 'top-to-south'/ 'top-to-the-south' instead?

Comment 17: 8) I think it is necessary to outline the approximate extent of the Precambrian basement terranes on a map.

Comment 18: 9) In the section geologic setting, can you describe the orientation of the structures (e.g., N-S-striking BFZ and LFZ) as well as the direction of the maximum horizontal stress (and changes thereof) associated with each major tectonic event, to provide context for the kinematics of the structures you describe?

Comment 19: 10) Is there a specific reason for using ‘interpret basement-seated structures’ instead of 'basement-structures?' It seems like a combination of 'basement-structures' and 'deep-seated.'

Comment 20: 11) Double check the labelling of figures, especially of the seismic profiles on the map (figure 1).

Comment 21: 12) In figure 2, what do you mean by main tectonic stress? Do you mean direction of maximum horizontal stress?

Comment 22: 13) I don't think yellow is the best color to outline reflectors in the pink and purple units in your seismic profile interpretations.

Comment 23: 14) Indicate the location of the potential field data in figure 5 on the map (figure 1) using a box.

Comment 24: 15) 2D seismic profiles only give you the vertical component of displacement, and don't really give a complete picture of the kinematics of faulting. I wonder if the faults you describe as thrust could be oblique or dominantly strike-slip?

Comment 25: 16) The authors cite the paper Koehl et al (in review) a lot. Please refer to the guidelines of EGU (Copernicus Publications) on citations of unpublished work.

Comment 26: 17) Check completeness/accuracy of descriptions of different figure panels and features on figures. Figure 5b shows a slope direction map, but the caption says it's a gravity map.
Comment 27: 18) The authors write in the passive voice too much. I think it's fine to write in the active voice to avoid making sentences too wordy and difficult to understand.
Comment 28: 19) Please make sure if saying "The complete seismic study is also available from the corresponding author upon request" complies with Copernicus Publications' commitment to the 'Coalition on Publishing Data in the Earth and Space Sciences' (COPDESS) and the 'Enabling FAIR (findability, accessibility, interoperability, and reusability) Data Commitment Statement in the Earth, Space, and Environmental Sciences.'
Comment 29: It was a pleasure reviewing your interesting work! I believe the paper is worthy of being published in Solid Earth after addressing the issues I raised. I look forward to hearing your thoughts and I'd be happy to a look at a revised version of this manuscript.

2. Author's reply

Comment 1: agreed.
Comment 2: agreed. However, if Dr. Rimando is referring to the lack of seismic data in the Russian Barents Sea, it is not possible to obtain data on Russian territory outside of Russia and one must physically go to Russia to interpret such data. Thus, for mapping of the Baidaratsky fault zone, the authors of the present manuscript rely on previous seismic interpretation and onshore–offshore by Prof. Lopatin and Prof. Korago (Lopatin et al., 2001; Korago et al., 2004), which are summaries of mapping campaigns in the Russian Barents Sea and onshore northwestern Russia. Regarding the Norwegian sector of the Barents Sea, the authors of the present manuscript did look at many more N-S and E-W profiles but had not secured permission to show these prior to submitting the manuscript. Figure 1 attached the present response to Dr. Rimando's comments shows the whole seismic database used for the present study. The authors of the present manuscript have now secured permission to show the whole dataset and, in addition to those presented in Figure 3a–e or in the supplementary data, the authors of the present manuscript direct the reader to the DISKOS database.
Comment 3: agreed. The lineaments in the gravity and magnetic anomaly map could indeed be anything and the present manuscript does not have the ambition of providing a definitive answer to this. However, the present manuscript presents evidences suggesting that they may represent

Timanian faults and/or folds. Timanian faults–folds onshore Russia with the exact same WNW–ESE strike/trend as those mapped on seismic data in the Norwegian Barents Sea and Svalbard correlate with the eastern continuations of the gravimetric and magnetic anomalies Timanian thrusts (and folds) that coincide with Timanian thrusts in the Norwegian Barents Sea and Svalbard. This interpretation is also backed up by previous studies in Russia (Lopatin et al., 2001; Korago et al., 2004), which have successfully mapped the largest of these Timanian faults all the way to the border with the Norwegian Barents Sea, where they coincide with the eastern continuation of the Kongsfjorden–Cowanodden fault zone (Baidaratsky fault zone) and Trollfjorden–Komagelva Fault Zone (Central Timan Fault; see Figures 1 and 5). The fact that these anomalies display relatively homogeneous character from the Norwegian Barents Sea to the Russian Barents Sea and onshore northwestern Russia further suggest that the geometries and kinematics (and, quite possibly, the timing of formation) of the faults (and folds) are consistent throughout these areas, thus further supporting the model proposed. The only exception would be towards the Uralides farther east in Russia, and in central–western Spitsbergen where these faults would have been strongly overprinted (e.g., Vimsodden–Kosibapasset Shear Zone reactivated as a sinistral strike-slip fault in Caledonian times and rotated into a subvertical fault – Faehnrich et al., 2020; Kongsfjorden–Cowanodden fault zone folded into north- to NNE-plunging Caledonian folds and overprinted by Devonian–Carboniferous brittle normal faults, which were themselves inverted in Cenozoic times in Svalbard and Storfjorden, i.e., close to the active Cenozoic margin of western Spitsbergen, but not farther east). These exceptions are discussed in the present manuscript in section "Phanerozoic reactivation and overprinting of Timanian thrust systems" (starting line 810).

Comment 4: agreed. The authors of the present manuscripts used more seismic data than is available as figures in the manuscript (see response to comment 2) and therefore do believe that spatial coverage of the data is sufficient to support their argumentation (see attached Figure 1 showing the complete seismic database). The authors of the present manuscript also note that they tried to use language throughout the manuscript that acknowledges that their interpretations are tentative. As both reviewers agree, the aim of this work is not to promote a definitive idea but to offer interpretations and a conceptual model that needs to be further tested. However, the authors of the present manuscript concede that the more speculative portions of the mapped faults should be highlighted in Figure 1.

Comment 5: agreed. The Vimsodden–Kosibapasset Shear Zone does display indications for sinistral strike-slip movements. However, these were recently dated to be Caledonian in age (Faehnrich et al., 2020; their sample 16-62A), thus attesting of the reactivation–overprinting history of Timanian faults during subsequent events. Nonetheless, it is clear that amphibolite facies metamorphism along the Vimsodden–Kosibapasset Shear Zone was coeval with the formation of a regional latest Neoproterozoic unconformity north of the shear zone in southwestern Spitsbergen (Bjørnerud, 1990; Bjørnerud et al., 1991; Majka et al., 2008, 2012; Mazur et al., 2009), i.e., similar to the configuration and deformation intensity along Timanian thrust systems in the Barents Sea and Svalbard. Considering the obliquity of the (most likely) Timanian Vimsodden–Kosibapasset Shear Zone to subsequent E–W Caledonian contraction, the WNW–ESE-striking shear zone would have been ideally oriented to be reactivated as a sinistral strike-slip fault in Caledonian times (e.g., Figure 7b in the present manuscript).

Comment 6: map-view folding along all Timanian thrust systems in Svalbard and the Barents Sea are inferred to be Caledonian in age, not Timanian. The Timanian Orogeny is believed to have been a relatively simple event in the Barents Sea and Svalbard's crust, involving top-SSW thrusting along a series of dominantly NNE-dipping thrust systems. Later on, these thrust systems which were oriented highly oblique to subsequent E–W Caledonian contraction) were reactivated as sinistral strike-slip faults (e.g., Vimsodden–Kosibapasset Shear Zone; Mazur et al., 2009; Faehnrich et al., 2020) and folded into N–S-trending (north-plunging; due to the north-northeastwards dip of the thrusts) folds. These map-view N–S-trending, NNE-plunging folds (see illustration of the geometry of the folds in Figure 3d in E–W cross section and Figure 3e in N–S along-strike section) are not directly related to sinistral strikes-slip reactivation of Timanian faults but represent more gentle deformation of the thrust systems away from the Caledonian margin in western Spitsbergen. Figure 7b illustrates how WNW–ESE-striking Timanian faults were reactivated as sinistral strike-slip faults and/or folded into N–S-trending, NNE-plunging folds during the Caledonian Orogeny. However, the authors of the present manuscript concede that the figure does not illustrate the variation in the intensity of Caledonian reactivation–overprinting along Timanian faults. Timanian faults were intensely deformed along the Caledonian margin in western Spitsbergen and reactivated as sinistral strike-slip faults and folded (e.g., Vimsodden–Kosibapasset Shear Zone), whereas they were only folded in the Barents Sea and eastern Spitsbergen away from the Caledonian margin (Figure 3b). The authors of the present manuscript are open to redesign/update Figure 7 to include such along-strike variations in reactivation–overprinting intensity should it be judged necessary by both referees and the editor. These along-strike variations also apply to post-Caledonian deformation as shown by the contrast between Figure 3a and Figure 3c where the Kongsfjorden–Cowanodden fault zone was overprinted by Devonian–Carboniferous listric normal faults that were later inverted due to Eurekan contraction in Storfjorden (Figure 3a) and Svalbard (Koehl, 2021 and supplement S2c) but were not inverted farther east, away from the West Spitsbergen Fold-and-Thrust Belt margin (Figure 3c).

Comment 7: disagreed. Timanian thrusts systems onshore Svalbard are either deeply buried and/or intensely overprinted along the western Spitsbergen margin, which was the locus of both Caledonian and Eurekan (and possibly Ellesmerian) contraction. Other arguments as to why they went unnoticed in northwestern Spitsbergen (where some Timanian ages were recorded for eclogite facies metamorphism) are (1) the remoteness of the area and the large amounts of funding required to access potential outcrops and further date them, and (2) the strongly eroded character of outcrops in glaciated areas like Svalbard. Seismic sections in Figure 3a–c clearly show that the Timanian portions of the thrust systems (i.e., not related to Caledonian and post-Caledonian brittle overprints, e.g., listric brittle faults and offsets of the seafloor) are buried under at least 2.0–2.5 seconds (TWT; i.e., several kilometers thick) successions of Phanerozoic sediments in the Barents Sea and Storfjorden. In its shallowest segment in Nordmannsfonna where it is folded into an anticline, the Kongsfjorden–Cowanodden fault zone is still buried under at least 1.0 second (TWT) of sediments (Figure 3d–e), which still corresponds to a depth of at least 2.5–4.5 kilometers based on seismic velocities for Pennsylvanian to Cretaceous sediments from Gernigon et al. (2018). Nevertheless, the authors of the present manuscript do not argue that Timanian fault systems are buried everywhere in the Svalbard Archipelago, especially because they were uplifted and exhumed in western Spitsbergen due to strong Caledonian contraction (and subsequent Eurekan contraction). Based on the arguments presented by previous workers for the Vimsodden–Kosibapasset Shear Zone in southern Spitsbergen (e.g., Bjørnerud, 1990; Bjørnerud et al. 1991; Majka et al., 2008, 2012; Mazur et al., 2009), it is highly probable that this major fault zone formed during the Timanian Orogeny as a top-SSW thrust, thus generating the observed regional unconformity between Neoproterozoic and latest Neoproterozoic metasedimentary rocks in the area. In addition, recent dating by Faehnrich et al. (2020) along the Vimsodden–Kosibapasset Shear Zone and other related minor fault zones in southern Spitsbergen further illustrate the authors' point about the overprinted character of Timanian thrusts in western Spitsbergen. The Vimsodden–Kosibapasset Shear Zone yielded exclusively Caledonian ages (their sample 16-62A), whereas related parallel minor shear zones were only mildly reactivated–overprinted by later Caledonian contraction and preserved partly their Timanian signal (their samples 16-25A and 16-73A). This is discussed in the present manuscript lines 878–887.

To the comment as to why these major thrust systems went unnoticed on seismic data despite the data have been acquired in the 90s, the issue is simple. Only very few researchers (if any at all) in the world would have known what to make out of the seismic expression of these faults. The seismic expression of (mylonitic) shear zones on seismic data was first investigated by avant-garde work by Fountain et al. (1984), Hurich et al. (1985), and a few others. But even back then, the shear zone geometries correlated to seismic signals were relatively simple and consisted of linear single mylonitic detachment surfaces. It is only recently that this research front was pushed further by innovative new works like Phillips et al. (2016) and Fazlikhani et al. (2017; to cite only a few) and that kilometers thick shear zones were eventually correlated from onshore field geometries to offshore seismic geometries. This field is being further developed here, especially considering the amount of details (down to 100 meters scale) possible to observe within Timanian thrusts systems in Storfjorden (e.g., SSW-verging asymmetric folds versus mylonitic brittle–ductile shears and detachments; see high-resolution version of Figure 3a and associated zooms in Figure 4d and e). It should also be noted that seismic data around Svalbard have mostly been investigated with emphasis on shallow Paleozoic–Cenozoic sedimentary successions in the perspective of hydrocarbon exploration and carbon storage. Deep basement structures were therefore not a priority but are now being increasingly studied (e.g., Klitzke et al., 2019).

<u>Comment 8:</u> partly agreed. It is true that the present manuscript does not constitute a definitive answer to the structure of basement units in the Barents Sea and Svalbard. Much further work is needed to further investigate the thrust systems described herein and to better constrain their geometry in 3D. However, it is important that this model becomes part of ongoing discussions about the geology of the Barents Sea and Svalbard. These thrust systems cannot be ignored anymore and should be top-priority targets in the next few years, e.g., to constrain plate tectonics models in the late Neoproterozoic to Cenozoic, or to explore for hydrocarbons or minerals, or for carbon storage, or even studying the hazard risk they present (e.g., Mitchell et al., 1990; Pirli et al., 2013). Regarding the 3D geometry of Timanian thrust systems, no 3D seismic data exist in the

northern Barents Sea since it is not open for hydrocarbon exploration. However, high-resolution 3D seismic data on the Loppa High do further illustrate the model argued for in the present manuscript. These data being private and located in the southern Barents Sea, they will be described and discussed in a future manuscript.

Comment 9: agreed. This is a great point and the authors of the present manuscript agree that the present findings will lead to a new plate tectonics model for the Norwegian Arctic in the 650–0 Ma period. However, considering the recent discovery of the Timanian thrusts systems described in the present manuscript, it is without saying that a new plate tectonics model is beyond the scope of the paper. However, a new model is currently being worked out using GPlates and will follow up on the present manuscript's findings and its implications for plate tectonics reconstructions. Nevertheless, the authors of the present manuscript agree that a local and simple plate tectonics model should be included to the manuscript as suggested by Prof. Doré. Following Prof. Doré's recommendation, the authors of the present manuscript propose to include such a model as Figure 8.

Comment 10: agreed.

Comment 11: disagreed. This would overcrowd a figure already crowded with information. In addition, the age of Timanian fingerprints in other Arctic areas is not the point of the manuscript.

Comment 12: agreed.

Comment 13: agreed.

Comment 14: labelling each seismic section in Figure 1 would overcrowd the figure with trivial information. Instead, it is possible to obtain the name of each seismic section from the main author or from the Norwegian Petroleum Directorate. The authors of the present manuscript also feel that mentioning which specific studies did inspect which specific seismic lines in the Barents Sea would lead to a significant amount of irrelevant text. It is safe to assume that each previous study referenced in the present manuscript does include an overview of the database it used to support its own conclusions. If Dr. Rimando has any particular suggestion of previous works not acknowledged in the present study, the authors of the present manuscript welcome any addition, provided that it adds to the manuscript and allows further discussion. To the knowledge of the authors of the present manuscript, all seismic lines in the northern Norwegian Barents Sea are part of the DISKOS database. Again, if Dr. Rimando is aware of any data or contribution not acknowledged or discussed but should have, the authors of the present manuscript would welcome its addition to the manuscript.

The authors of the present manuscript feel that adding the “locations of previous studies which were discussed to provide evidence of the lateral extent of these Timanian thrusts” by, e.g., adding a frame for each study’s extent in Figure 1, is irrelevant and would overcrowd an already crowded figure. If the reader is interested in the extent of a previous study or in the database used in a previous study, she/he should refer to the associated publication and/or contact the relevant author(s) if needed.

Comment 15: agreed. The Ellesmerian Orogeny, though believed not to have occurred by the lead author, is still commonly thought to be part of the geological history of Svalbard. In the present manuscript, it is only mentioned in the introduction and geological setting sections, and in the discussion where it is refuted as a possible cause of the accretion of Svalbard’s basement terranes. However, it does not constitute the focus of the present manuscript and is therefore not discussed further. This issue will nevertheless be addressed in two manuscripts in preparation.

Comment 16: “top-SSW” is standard, as much as “top-to-the-SSW” is. The former requires fewer words and space and is not less explanatory. The authors of the present manuscript will of course update the manuscript if both reviewers and the editor judge it easier to read and comprehend for the reader.

Comment 17: agreed.

Comment 18: agreed. The strike and trend of geological structures will be added where appropriate but are already stated by dip direction, which are more informative because inform about the trend/strike and dip of the associated geological structure (e.g., “…-dipping”). However, the stress directions and changes of stress direction are mostly speculative and still a matter of debate in most cases. In addition, local variations exist (e.g., Brøggerhalvøya segment of the West Spitsbergen Fold-and-Thrust Belt which trends WNW–ESE, i.e., oblique to the rest of the fold-and-thrust belt). Stress directions will therefore not be added.

Comment 19: agreed. Yes indeed, it is a combination of “basement structure” and “deep-seated”. If this is not correct, it may be rephrased of course.

Comment 20: agreed. The labels of seismic sections in Figure 1 are erroneous.

Comment 21: agreed. The label in Figure 2 was rephrased to “Max. horizontal stress”.

Comment 22: agreed. However, these reflections need to be displayed in the same scheme (color/pattern) as their counter-parts in other units.

Comment 23: agreed.

Comment 24: agreed. The faults the present study deals with are actually oblique-slip. However, it is neither possible nor useful for the present manuscript to establish/discuss this issue. As mentioned by Dr. Rimando, it is important to establish the continuity of Timanian structures first. The oblique-slip character of the fault systems discussed in the present manuscript will be discussed in two other manuscripts. Two major lines of evidence suggest oblique-slip kinematics: (1) recent (2008–2019) deep (c. 15–16 kilometers) earthquakes in Storfjorden erroneously ascribed to a putative NE–SW-striking fault in Storfjorden suggest recent–ongoing sinistral-reverse oblique-slip movements along the KCFZ, BFZ, and KDFZ, and (2) major N–S-trending, Caledonian and Devonian basement ridges (e.g., Atomfjella Antiform; Witt-Nilsson et al., 1998) are offset left-laterally by c. 10–25 kilometers and in a reverse (top-SSW) fashion by c. 5–5.5 kilometers across the KCFZ.

Comment 25: agreed. However, this pre-print is already accessible at the following link: https://www.researchgate.net/publication/349124816_Devonian-Carboniferous_collapse_and_segmentation_of_the_Billefjorden_Trough_and_Eurekan_inversion-overprint_and_strain_partitioning_and_decoupling_along_inherited_WNW-_ESE-striking_faults?_sg=qtceO8VLbOUVZh5i5AT30gZbnAY8wO5q4mbX_u98eKImEuLQS8aOqk0mc6guKuoXeagQlv1F3v9ZoAwHOfdtHSpw5RoUCAQcOUcC6Usc.EPUrQi5OpABDFpUhLXMyvgdMKcNL97-WXB5QVOsPliueVegj9fNgWuQ8QAiKNQrv-ojIEvVkbheFo1nTMDjVcg. The EGU guidelines state that “Works "submitted to", "in preparation", "in review", or only available as preprint should also be included in the reference list”.

Comment 26: agreed. Figure 5b is a slope map of gravimetric data. This should be specified.

Comment 27: agreed.

Comment 28: agreed. The authors of the present manuscript are not allowed to transfer data from the DISKOS database directly to another party. Although the data are publicly accessible, the concerned party should submit inquiries to the Norwegian Petroleum Directorate.

Comment 29: agreed.

3. Changes implemented

Comment 1: none required by the reviewer.

Comment 2: modified Fig. 1b in the present manuscript to include the complete seismic database as in the attached Figure 1.

Comment 3: none.

Comment 4: "Speculative" portions of the faults (i.e., portions of the faults that are not demonstrated and argued for in the present study, but that are known from other ongoing manuscripts and studies) were added as dotted yellow lines in Figure 1b and c. Also see response to comment 2.

Comment 5: none.

Comment 6: awaiting further instructions from the editor and the two reviewers.

Comment 7: none.

Comment 8: none.

Comment 9: included a new Figure 8.

Comment 10: added "Hs" to Figure 1c and "Hs: Hornsund; " line 1535, "Norway" to Figure 1b, and "Pearya" in Figure 1a.

Comment 11: none.

Comment 12: added abbreviations of all major fault zones to the text lines 71, 86, 87, 88, 90, 135, 136, and 308–310.

Comment 13: added scale bars and north arrow (or "North Pole") labels to Figure 1a–c.

Comment 14: none but may include reference to other studies if Dr. Rimando has any specific study in mind that should be cited in the present manuscript.

Comment 15: none required by the reviewer.

Comment 16: may update the text if judged necessary by the reviewers and editor.

Comment 17: added "NE terrane", "SW terrane" and "NW terrane" labels in Figure 2.

Comment 18: added "NNE-dipping" lines 86, 89, 91, 119, 121, 123, and 152, "gently north-plunging" lines 88, and 142–143, "N–S-trending" lines 142, 144, and 145–146, and "N–S-striking" lines 135, and 193, and "E–W-trending" line 172.

Comment 19: may be adjusted into "deep-seated" or "basement structure" if incorrect use of English language. Awaiting further instructions from the editor and reviewers.

Comment 20: changed the labels of seismic sections in Figure 1.

Comment 21: rephrased label to "maximum horizontal stress".

Comment 22: none.

Comment 23: added a white dashed frame in Figure 1b showing the location of potential field data in Figure 5, and "(see location as a dashed white frame in Figure 1b)" line 1572.

Comment 24: none required by the reviewer.

Comment 25: none required by the reviewer.

Comment 26: added "for gravimetric data" lines 542–543 and "of gravimetric data" line 573.

Comment 27: changed from passive to active form lines 18, 21–22, 57, 92–97, 131, 139–142, 145, 216–219, 225–229, 232–233, 422–428, 530–534, 650–653, and 797–801.

Comment 28: removed "The complete seismic study is also available from the corresponding author upon request." lines 1113–1114.

Comment 29: none required by the reviewer.

4. Additional changes implemented

-Lines 80–81: added ", and imply that the Norwegian Barents Sea and Svalbard basement may contain Timanian structures overprinted during later (e.g., Caledonian) deformation events" for clarity.

-Lines 94–100: split the sentence into two and partly rewrote it to make it easier to read.

-Line 103: added "by future research" for clarity.

-Lines 1004–1005: split the sentence into two and added ". If correct, a Timanian origin for these structures would" to make it more readable.

-Lines 1055 and 1064: added reference to the new Figure 8 as a consequence to Prof. Doré comment 6.

-Lines 1079–1080: added "We interpret these thrust systems as being related to the Neoproterozoic Timanian Orogeny." for clarity.

Attached figures

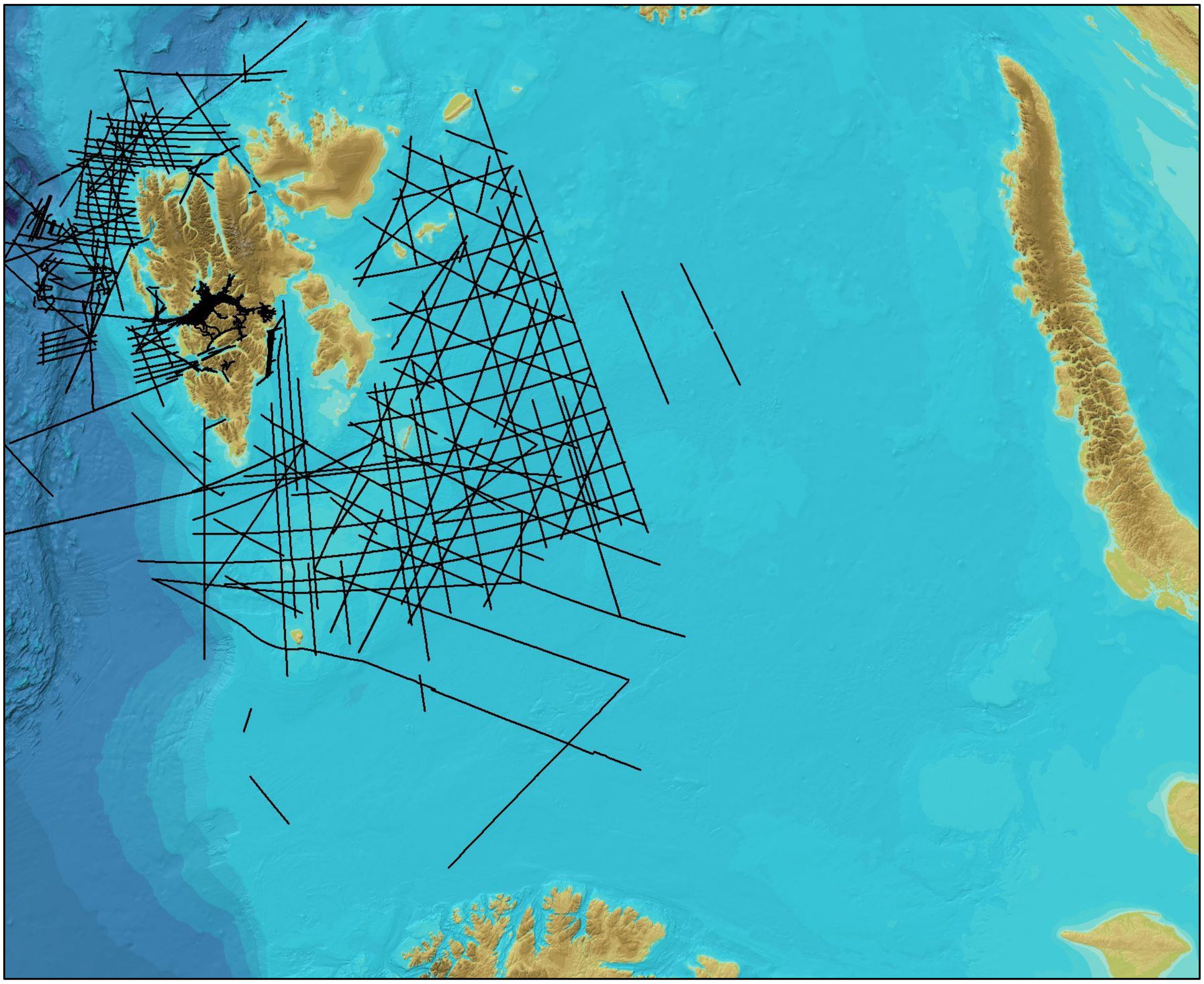

Figure 1: Seismic database in Svalbard and the Barents Sea.