

Minor comments

The comments from reviewer 2 (RC2) use the black font color. Our comments (AC) are using the blue font color.

Line 14. How much is giga?

Giga refers to the common prefix used on the metric scale indicating that the volume is in the 10^9 scale (m^3). In the revised manuscript the sentence will read: "Recent mapping of the seabed in the Vaigat Strait has revealed several prehistoric giga-scale (volumes of $10^9 m^3$), tsunamigenic landslides; however, their ages are unknown.

Line 19. How many (orders of magnitude difference) exactly?

It will be changed to "one to two orders of magnitude."

Line 22. How much is giant? And how does giant compare to giga?

We will change "giant" to "very large" in the abstract and the manuscript title. The change is incorporated into the response to your comments for line 23. There is no scientifically agreed on scale based on run-up heights or landslide volumes. Large, very large, giant – are subjective, but some (i.e., large, very large) are used to signify events that are very different from the normal. We have decided to discard the use of "giant" and use "very large" instead, so that the manuscript, including the title, are less attention catching, but still essentially non-quantitative.

Line 23. Shouldn't this be two separate sentences? I assume the rationale is that the two tsunami deposits must be linked to the two recent most landslides and that the older landslides are therefore pre-lake?

You are correct in your assumption of the rationale. We have made the sentence(s) clearer: "While we found deposits from two very large tsunamis in the lake sediments, landforms from at least nine giga-scale landslides are present on the seafloor of Vaigat. We infer that these deposits represent the two most recent tsunamis and older very large tsunamis must have happened between the last deglaciation and the oldest sediment in the lakes (c. 10 to 8.5 cal. ka BP)."

Line 28. Perhaps also good to mention the Aysen fjord event in Chile, in 2007... which was captured on photo (https://elpais.com/elpais/2007/04/23/album/1177310269_910215.html)?

Sepulveda et al., 2010 will be added to the sentence, which will be as follows:

"Landslide-tsunamis are among the most devastating natural disasters in fjord settings with several recent examples from Norway and Alaska (e.g., Blikra et al., 2006; Sepulveda et al., 2010; Higman et al., 2018; Svennevig et al., 2020, 2023a)."

In fact, the reference Sepulveda et al (2010) also appear on a similar context in lines 324-325 in the manuscript under review:

“Subaerial marine terminating landslides have the potential to produce very large run-up tsunamis in confined fjord settings (e.g., Dahl-Jensen et al., 2004; Sepulveda et al., 2010; Higman et al., 2018; Svennevig et al., 2020).”

Line 49. "underwater landslide deposits" Because there are many more landslides indicated on the map, most being subaerial ones. The nine you refer to are the ones visible in the bathymetry..

Agreed. It will be much more precise. The revised sentence will read: “In the Vaigat strait, nine large underwater landslide deposits were mapped.”

Line 50. This is a bit confusing... the fjord bathymetry is smooth, but that is because it has been filled with sediments and not because it is glacially carved (which is what you seem to imply by phrasing it like this).

Agreed. This sentence will be changed to: “They are recognizable by their hummocky and blocky topography in the otherwise smooth U-shaped glacial trough with a Holocene sediment cover comprising the bottom the Vaigat strait (Fig. 1.)”

Line 51. Do you have seismic data? If not, you do not really have an idea of the volume involved, do you? Only of the surface that is covered by the deposit...

...and...

Line 53. Ah you do... perhaps good to mention this first! [Refers to Line 51]

We have rephrased/switched sentences at the end of the paragraph so it will read:

“Seismic profiles from Vaigat show the presence of localized chaotic accumulations of sediment interpreted as either old submarine slides or submarine aggradations from subaerial landslides, with a general thickness of 50-100 m that can locally exceed 200 m (Marcussen et al., 2001; Pedersen et al., 2002). Based on long runout, large volume, and giant displaced blocks Svennevig et al. (2023b) suggests that these rock avalanches had a significant tsunamigenic potential, which should leave onshore evidence of tsunamis. However, nothing is known of when the landslides occurred after deglaciation or magnitude of the tsunamis they could have generated.”

Line 63. Do you mean specifically in lakes? Or in general?

Yes, it means in general. We will rephrase to:

“Evidence of tsunamis is in general rare in Greenland and has only been encountered by coincidence three times in relation to paleoclimatic studies or relative sea level reconstructions using lake sediment records.”

Line 80. I probably don't quite understand the sentence... but it was more submerged then because of glacial isostatic subsidence, no? Later on, uplift moved the land upward and made it less susceptible to tsunami inundation, no?

You are completely correct. The revised and much improved sentence will read:

“Weidick & Bennike (2007, Fig. 22) provides a minimum age of the last deglaciation of 10 cal. ka BP from dating marine shells at 70 m elevation today (Fig. 2). Thus, susceptibility of the lakes to inundation from tsunami waves would have been more pronounced in the Early Holocene considering Saqqaq would have been submerged more than 70 m due to glacial isostatic subsidence, and in the mid-Holocene the glacial isostatic subsidence would be c. 6-25 m (5.8-7.6 cal. ka BP) relative to today.”

Line 84. Garde & Steenfelt, 1994?

Agreed. Will be changed accordingly.

Line 95. Sorry... I am not entirely sure what you mean with this? Do you mean in terms of tidal effects?

Yes. This will be specified in the revised manuscript.

Line 97. I think you never even mention the water depth in the fjord offshore Saqqaq... although that would be an interesting metric to know. It is indicated -very roughly- on Figure 8... but could be mentioned in the text.

Agreed. It would not be the best place to add it at line 97. It will be added to line 73 where it will read: “The Vaigat strait is generally between 500 and 600 m deep with depths of up to 620 m south of Saqqaq, except where landslide deposits and dykes and sills (Paleocene intrusions) are present.”

Line 112. Can you provide a few words of motivation as to WHY exactly these elements/ratio's in this specific setting?

We will elaborate in why we use Ti and Ca/Fe in this setting. The single sentence has been expanded to a several paragraphs:

“In this study we use the element Titanium (Ti) as a proxy for minerogenic input to the lake (e.g., tsunami and glaciofluvial deposits) and the element ratio Ca/Fe as a proxy for marine influence in the sediment i.e., in tsunami deposits.

Titanium is suitable to differentiate between marine and glaciofluvial deposits with a high minerogenic content, and lacustrine deposits with low minerogenic content. As Titanium is a common constituent of rocks such as gneisses or schists, it primarily indicates a terrigenous continental source (Rothwell & Croudace, 2015). In our setting, high Ti values are interpreted as minerogenic deposits flushed into the lake from either shoreline or onshore surroundings as the tsunami wave loses energy and the water runs back to the sea. The Ca/Fe ratio is used as a proxy for input of biogenic carbonates of marine origin (Ca) relative to

detrital clay (Fe) of terrigenous origin into the lake and can be used to indicate tsunami deposits (Chagué-Goff et al., 2017).”

Line 117. Not in reference list

It is a typographical error. It will be changed to “Long et al. (2015)”, which can be found in the reference list.

Line 134. Bronk Ramsey

Agreed. Will be changed accordingly.

Line 155. Figure 4 shows that only cores 06 and 09 contain tsunami deposits... that's only 2 cores, not 4? Or am I missing something?

This is an issue also raised by a different reviewer (Bondevik) and will be revised. The revised manuscript will throughout emphasize that we found tsunami sediments in two lakes, and we use the data from the two other lake cores to constrain timing and run-up height of the tsunami events. Also, consequently, the two lake cores with data of little relevance will be mentioned but not presented in detail.

Line 184. Euh... I can see on the figure that it is slightly over 40 cm thick in core 09... but it appears to be much thinner (30-something cm) in core 06. This sentence seems incomplete...

Agreed, the data are presented inconsistently. The text is correct, and Fig. 4 shows the layer correctly, but there is an error in Fig. 5 and Table 1. Sample Ua-74363 is inside the tsunami deposit, not above (an interpretation error from the notes at the time of sampling). This will be changed so all data are consistent.

Line 195. Did you notice any preferential orientation or imbrication of the clasts, which could point to a flow direction? And if so, did you observe different flow directions at different levels in the deposit? Such fabric analysis could help fine-tuning your reconstruction of the succession of events (separate waves?) that caused the deposit...

We did not notice any preferential orientation or imbrication. I think X-ray tomography may be the only option to perform such an analysis and this was not planned (and not available) as part of the analysis.

Line 232. Do you now mean T1 and T2?????

Agreed, this is confusing and will be changed to:

“We interpret the deposits in the two cores as tsunami deposits. While identification of the tsunami deposits is based on visual description of sediments and structures, and sedimentological proxies, the correlation of the units between the two cores with tsunami deposits is primarily based on the laminated gyttja separating the two tsunami units T1 and T2 in core SAQ21-06, constrained by the age control. This

correlation is supported by the rough match of visual appearance and sedimentological proxies of T1 and T2 in the two cores. Since we did not map the entire lake stratigraphy, we cannot exclude the possibility that the c. 42 cm unit of laminated gyttja could be a large rip-up clast and T1 and T2 may be one tsunami event.”

Line 261. you mean of older organic matter then? As there are no carbonates in the catchment...

Yes, it means older organic matter. The interpretation of dates will be revised so that the type of dated material is taken better into account. Line 261 will be updated to and discuss older organic carbon as according to the updated interpretation found below.

Bondevik et al., (1997b) found that radiocarbon dates sampled from just above the tsunami facies commonly show older dates than samples from inside the tsunami facies. The redeposition of older sediments and carbon can occur hundreds of years after the tsunami facies was deposited. This has implications specifically for the bulk sediment sample just above the T1 tsunami facies in core SAQ21-09, which has an age 6.7 cal. ka BP. This date would be significantly affected by redeposition of organic carbon post tsunami and show an age that is significantly older than the time it was deposited. In core SAQ21-06 the youngest date in the core is sampled inside the T1 tsunami facies (as shown in Fig. 4). It is an aquatic moss and provides a maximum age of 5.8 cal. ka BP for the most recent tsunami deposit in the T1 unit, i.e., if the unit represents one landslide-tsunami event then the whole the unit would have this maximum age. If the T1 unit represents multiple landslide-tsunami events, then it would show the maximum age of the youngest event.

Bondevik, S., Svendsen, J. I., Johnsen, G., Mangerud, J. & Kaland, P. E.: The Storegga tsunami along the Norwegian coast, its age and runup. *Boreas*, Vol. 26, pp. 29-53. OSIO. ISSN 0300-9483, 1997b.

Marty, J. and Myrbo, A.: Radiocarbon dating suitability of aquatic plant macrofossils, *J Paleolimnol*, 52:435–443, DOI 10.1007/s10933-014-9796-0, 2014.

Line 267. In theory there could be 3rd... and that is that Lake 07 was not inundated by the tsunami (or that it was but recorded no trace of it). I agree that this is highly unlikely, but perhaps you should nevertheless mention it?

Bondevik pointed out that dates aquatic mosses are very sensitive to reservoir effects, and it is an aquatic moss providing the date at the bottom of core SAQ21-07. It should be treated as a maximum age and it is possible that it has an age that is 1.5 ka too old, explaining the absence of tsunami traces. If this is the case, and it seems likely, the dates constraining T1 provide a bracket of 5.8-7.2 cal. ka BP in which one or more tsunami could have occurred, but would be present in core 07. The tsunami dated in lake Tasiusarsuit was found to have an age of 6.0 cal. ka BP (Long et al., 2015) which falls within this bracket.

Line 278. So... essentially you now ruled out other possible mechanisms to create the event deposits you described above... and you galvanize your interpretation that they indeed represent tsunamis. Perhaps you could add that in a short sentence?

Agreed. We will add the sentence:

“Lake inundation by tsunami waves is the remaining depositional process that can explain the presence of sediments with the stratigraphical signatures of the deposits identified here.”

Line 309 Bennike

This typographical error will be fixed.

Line 312. Is that today's water depth at the mouth of the fjords, or was that the water depth 7-8 ka ago?

The statement will be revised to reflect water depth at 8 cal. ka BP. It will read: "The maximum water depth at the mouths of the two fjords would have been 280 (Kangia) and 380 m (Torsukattak) at 8 cal. ka BP restricting the vertical height of the icebergs to less than 400 m and consequently a theoretical upper limit of the open-water tsunami wave height to c. 4 m."

Line 319. Winds

This typographical error will be fixed.

Line 329. In the abstract they are called "giga". Normally, using terminology like "giga" and "giant" sounds good (and may be OK in a title to catch the attention), but it does not say very much. It is highly subjective and non-quantitative. I have now come to page 11 of this manuscript and I still have no idea how big they really are!

Agreed. Giga refers to the common prefix used on the metric scale indicating that the volume is in the 10⁹ scale (m³). In the revised manuscript the sentence will read: "Recent mapping of the seabed in the Vaigat Strait has revealed several prehistoric giga-scale (volumes of 10⁹ m³), potentially tsunamigenic landslides; however, their ages are unknown.

We will change "giant" to "very large" in the abstract and the manuscript title. The change is incorporated into the response to your comments for line 23. There is no scientifically agreed on scale based on run-up heights or landslide volumes. Large, very large, giant – are subjective, but some (i.e., large, very large) are used to signify events that are very different from the normal. We have decided to discard the use of "giant" and use "very large" instead, so that the manuscript, including the title, are less attention catching, but still essentially non-quantitative.

Line 330. "et al." implies that the subject of this sentence is plural.

Agree. "argues" will be changed to "argue".

Line 335. Landslides

This typographical error will be fixed.

Line 339. Can you briefly explain what input it uses and what output it generates exactly? [SPLASH eqn.]

Currently the manuscript reads: "The SPLASH equation is based on a limited number of landslide tsunamis events, and none of them are of the magnitude we infer in the present work; however, it provides an

estimate of the magnitude without using more advanced tsunami models which is beyond the scope of the present paper.”

In the revised manuscript the SPLASH equation will be described in more detail:

“The SPLASH equation is a parametrization of a power-law relationship between landslide volume, distance, and vertical run-up of the tsunami wave. Parameters were found by least-squares fitting data from a limited number of large rock slope failures and the observed run-up at different distances from each landslide. It provides a semi-empirical prediction of run-up height from intended for preliminary regional studies. We use it here since it provides an estimate of the magnitude without using more advanced tsunami models which is beyond the scope of the present paper.”

Line 460. Not called in text?

This excess reference will be deleted in revised manuscript.

Line 475. Not called in text?

This excess reference will be deleted in revised manuscript.

Line 502. 2022?

This typographical error will be fixed.

Line 504. Bronk Ramsey

Agreed. Will be changed accordingly.

Line 511. Not called in text?

This excess reference will be deleted in revised manuscript.

Line 519. In full?

The authors list will be written out in full in the revised manuscript.

Line 586. I think this should be Bronk Ramsey (listed under B). This is also what the journal itself suggests:

"Bronk Ramsey, C. (2009). Bayesian Analysis of Radiocarbon Dates. Radiocarbon, 51(1), 337-360.

doi:10.1017/S0033822200033865"

Agreed. Will be changed accordingly.

Line 597. Not called in text?

This reference is now used in the text, see your comments to line 112.

Line 624. 2023a?

Agreed. Will be changed accordingly.

Line 627. 2023b?

Agreed. Will be changed accordingly.

Line 650. No depth values on the contour lines!

Depth values will be added to contour lines on revised figure.

Line 695. I do not understand where this comes from? Fig 5 clearly shows that you do have sediment younger than 6 ka BP!

Agreed. It is nonsensical. It will read: "There is no sediment older than 8.5 cal. ka BP in our core record, and after c. 6 cal. ka BP a tsunami would have to have a minimum run-up of up to 19 m to reach a lake."

Line 707. Bronk Ramsey.

Agreed. Will be changed accordingly.