

Dear Associate Professor Knutsen,

Many thanks for taking the time to review our article and providing very useful and insightful comments.

I have included your comments in normal text below with our responses in bold. We have also attached a PDF version with our responses in red to help distinguish the comments vs responses.

With best regards  
on behalf of the authors

Tom Birchall

The relationship between the topics of the paper is intriguing but also very complex. The current set-up of the paper, especially the methods and the discussion part, is a bit unfocused, and the many different topics appears to be treated a bit lightly.

**We agree and will restructure this to an extent. Addressing your next comment should also help to develop the focus of the article better.**

I would recommend the authors to focus on the observations of permafrost and maybe trapped gas, and how this is distributed in the Svalbard area. The distribution and timing of this might also be more elaborated. However, I am not sure if the link to petroleum system (or maybe release of gas to the atmosphere and climate implications) should be included. If the latter topics are to be included, the presentation and discussion of these should be strengthened.

**We think this is a good point, and we can tone down these aspects to make the paper clearer without removing the important data. Though we do believe it is important to be clear that gas is trapped, and that permafrost is very young clearly demonstrates migration is ongoing (both onshore and offshore). We will shorten the speculation with respect to the climatic impact and explain much more work is needed to quantify this. We also think removing some of the more speculative modelling of permafrost and hydrate stability zone will help bring more focus to the paper.**

Specific Comments in attached (tc-2021+226-RC2-supplement) supplement

**Your comments here are all very helpful and we will make the recommended amendments and elaborations. Some specific comments and responses are below:**

Line 69 – Please refer to figure 1 - and this figure might be bigger, maybe with some minor tectonic elements? (The Billefjorden Fault Zone?)

**We will do this. We will enlarge the map and include more tectonic elements (it is likely they are important for ongoing migration).**

Line 84: Generally: could it be possible to differentiate between the fjords and the west coast .. how far in the fjords are "inland"?

**Yes – we can bring in information from many of the good UNIS Arctic Geophysics papers on this (e.g. Skogseth et al., 2020). It also seems the thinking and evidence around coastal permafrost are changing (since writing this manuscript even) so we will update this.**

Line 102 Suggest to rephrase this section - or remove. Generally the manuscript could be strengthened by deciding how much "operational" parts should be included: these parts are not the always the best parts..

**We will remove this.**

Line 267 Locations in Figure 1? Could it be possible to include depths to base permafrost and shows in the table?

**Yes – a good idea and we will do this in the revision.**

Line 308 Generally the "model and parameters" might be better presented and explained.

**We agree and actually think that removing much of these models will benefit the paper. Based on responses we feel the manuscript would benefit from being based on more certain observations than the more speculative modelling. The case of Adventdalen we feel may still be of use where we have calibration points, (which we will be careful to provide more details of.**

A general comment: the language is in places very "oral" - that might be a the authors personal approach, but can also in places overshadow the message..

**Noted and we will amend this.**

The overall discussion of pressure / aquifers and thin/cold based glaciers is important - and complex. Please consider to elaborate (or leave it "out").

**A good point – we think this is probably worth its own paper at some point in the future.**

Line 590 - A map showing the areas with permafrost (observed / modelled) would be very helpful!

**Agreed and we will do this.**