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Comment on se-2021-71

Anthony Doré (Referee)

Referee comment on "Impact of Timanian thrust systems on the late Neoproterozoic–Phanerozoic tectonic evolution of the Barents Sea and Svalbard" by Jean-Baptiste P. Koehl et al., Solid Earth Discuss., <https://doi.org/10.5194/se-2021-71-RC1>, 2021

This very interesting paper should certainly be published in Solid Earth, not because it provides a definitive solution to the Barents Sea tectonic mosaic, but because it provides a bold and well-argued alternative to the current basement models. In essence, the model would glue the pieces of the Barents Sea (and specifically Svalbard) together in the Neoproterozoic, thus eliminating the idea of later Caledonian assembly from different terranes. It would also put paid to the concept of "Barentsia", the putative microcontinent including Svalbard, formed between two supposed sutures representing arms of the Caledonian orogen.

So how convincing is the interpretation of the Timanian grain extending across from Russia to Svalbard? The idea has to some extent been "out there" for a while, based on the distinct cross-cutting trend of the Tiddlybanken Basin, and the offshore extension of the Trollfjord-Komagelv fault (not strictly Timanian, and actually contested by the lead author elsewhere). But my first reaction on seeing the seismic lines in Fig. 3 was scepticism that such detailed interpretations of deep basement structure could be made from such difficult data. Having to look at the seismic lines with my neck at a right-angle didn't help..... Yes I can see what might be thrust stacks, but I can see lots of other patterns too. That's what happens when you look at noisy data. However, it's good that this is an open review. Others can also take a look and tell me whether I'm being fair or not. Also in the interests of being fair, the authors have looked at a lot more seismic than I have, and for longer - plus the local panels shown in Figure 4 are more convincing.

A significant weakness in the paper's argument, acknowledged by the authors, is the non-observation of these Timanian structures on Svalbard despite the existence of a few apparently Timanian metamorphic dates. You would really think such a pervasive and dominant tectonic regime, actually not very deeply buried on the seismic lines, would be expressed onshore. The reasons given for the absence are depth of burial and obscuring by later superimposed tectonic events. The latter argument, in particular, is pretty thin based on what the seismic leads us to expect.

Despite these reservations, I think this one can get by with minor revision only. It is very well-written (thanks!) and the illustrations are mainly of good quality. I suggest the following improvement:

1) The multi-panel figures (particularly 3 and 4) are confusing, particularly in online format. Why not simply call all the different panels different figures? It would make things so much easier.

2) In any case, the seismic sections are wrongly labelled on Fig. 1. Unless I've got it badly wrong, they should read 3a, 3b etc., (not "2"). The first three sections need readable direction indicators (N-S etc.).

3) The paper badly needs its own plate tectonic reconstruction (not just the one that is being challenged, Fig. 2). What is your alternative? How was the Barents basement assembled? Pushing the Iapetus suture even farther west is OK, but where specifically? And what is the implication for Caledonian assembly, and supposed Laurentian affinity of parts of Svalbard? How does this idea fit with Caledonian thrust sheets extending as far east as (south of) the Varanger Peninsula? A few simple sketches would suffice to show what you are thinking.

Although these are comparatively minor changes, i look forward to seeing what others say. I'm happy to take a quick look at any revisions. I'm still not sure whether I agree with the idea, but I strongly believe it should be out there and part of the debate.

Tony Doré, Energy & Geoscience Institute (London outpost), June 2021.