



## ***Interactive comment on “Early Cenozoic Eurekan strain partitioning and decoupling in central Spitsbergen, Svalbard” by Jean-Baptiste P. Koehl***

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Received and published: 17 March 2021

Solid Earth – 2020-165 Koehl – Early Cenozoic Eurekan strain partitioning and decoupling in Central Spitsbergen, Svalbard See supplement for pdf version of this review.

This paper evaluates aspects of the geological evolution of the Spitsbergen area of Svalbard, combining field- and seismic-based observations. The paper shows how coal-bearing intervals may effectively decouple and partition strain above and below, negating the need to invoke a period of Late Devonian contraction in the area. Furthermore, the paper demonstrates how the major fault in the area, the Billefjorden Fault Zone, did not undergo reverse reactivation previously purported to relate to this Late Devonian event. The paper is very detailed and critically evaluates information from a

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large range of previous studies, and will be of great interest to people working in this area. However, the wider implications of the study are currently lacking outside of a local geological context. In addition, there are a number of issues that make the paper difficult to access for someone not already familiar with the area. I here list a series of overall comments below, followed by technical queries and corrections.

1. The introduction is relatively narrow and the overall aims of the study are unclear. At present the introduction outlines that the study aims to achieve, but does not place these into the wider context. It should be made clearer at this point what are the rationale and key scientific questions to be addressed in this study and how does this compare/contrast with previous studies in the area. In addition, it would be good to consider the wider implications of the study, separated from their local context, e.g. examining how deformation may be partitioned across coal-bearing intervals in rift systems generally as opposed to just in this locality. A further interesting aspect that could be expanded upon is the integration of seismic and field observations and the difference in scale between the two. A scale is required on Figure 3b.
2. The stratigraphy and nomenclature used throughout can be difficult to follow and to relate to the figures. A combination of formation names, groups and ages is used throughout the manuscript. I would recommend establishing these early in the manuscript by establishing a stratigraphic framework and including a stratigraphic column for the area as a figure. In addition, it would be worth increasing the annotation on the figures to enable greater cross-referencing between figures and text. This is especially important with regards to the ages of the different intervals on the seismic section and satellite images, and also to identify features when multiple sub-figures are called out simultaneously in the text.
3. Figures – there are currently only 5 figures in the manuscript which are heavily used and referred to in the text. It would be worth including more information on these figures with increased annotation or including new figures, such as the aforementioned stratigraphic column. In particular, it would be worth including some close-ups of the map based figures to show stratigraphic relationships (e.g. L203, 854). Additional figures such as 5e should be expanded and further explained

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on the figure itself. 4. The broader implications of the study should be explored in more detail. At present the Discussion focusses on a range of different theories regarding details of the evolution of Spitsbergen. Comparisons and the implications for similar rift systems should be drawn to emphasise the broader implications of this study – e.g. how does this compare to other rift systems where deformation is partitioned. 5. At present, the key points of the paper can be lost in the discussion section discussing the various models and competing ideas for the evolution of various aspects of Spitsbergen geology. This would be made clearer by incorporating more figures related to these models and establishing the stratigraphic framework early in the paper with the aid of a stratigraphic column. However, the discussion still accounts for a large proportion of the overall paper and could be shortened to focus on the key aspects of the paper as outlined in the title and introduction of the paper and backed up by the data shown. The early points of the conclusions (1-4) are succinct and very interesting, however the latter points are less clear from the figures and do not contribute as much to the overall story.

Technical comments Line 82 – When did the orogeny stop? Line 153 – Where is the Billefjorden Fault Zone located? And how does it relate to the Balliobreen Fault and the Odefjellet fault? This is not clear on Figure 1, where the fjord is labelled, but not the fault zone. Also, the text refers to Carboniferous deposits, but the figure to Pennsylvanian. A stratigraphic column would help greatly associated with this figure. L194 – Can you show some indication of the orientation on Figure 1a. It appears to be reflected in the orientation of the fjord and some landscape lineations but this is not clear from the text or figure. L203 – Unconformable relationship is not clear from the figure. Close up of the area would be beneficial. Is the Billefjorden fault zone present on the map? L211 – What is the purpose of the microscopic analyses, is this to confirm structural measurements? Figure 2 – Label the location of the mine entrance, along with other key features referred to in the text (e.g. the different groups and formations) L242 – change to 1-2 m L244 – potentially change to > 3m Figure 4 – Basement horizon not always interpreted on the subfigures Figure 4g – Label the well name on the section.

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Duplex interpretation is clear, but wedge-shaped geometries difficult to identify. Figure 4b,e – Z-shaped geometries not immediately clear on the figure. Label on the figure? L400 – difficult to tell what is being referred to L557 – Very long sentence that is difficult to follow. Breakup to make clearer. L583 – Is this an example of where there is no decoupling interval present? If so this should be stated. L601 – State explicitly how this model relates to your observations, is it in agreement? Figure 5 – More labelling is required on the figure, e.g. the collapsing orogen and exhuming core complexes are not present/clear on 5a. L813 – Exposure of the basement is also not shown on the figure?

Please also note the supplement to this comment:

<https://se.copernicus.org/preprints/se-2020-165/se-2020-165-RC2-supplement.pdf>

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Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-165>, 2020.

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