

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

Anonymous Referee #1

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General comments The manuscript titled “Early Cenozoic Eurekan strain partitioning and decoupling in central Spitsbergen, Svalbard” by Jean-Baptiste P. Koehl combines seismic data with field and petrographic observations to address the deformation patterns in the Devonian-Permian sedimentary successions in central Spitsbergen. This study shows that during the Devonian there was not reverse movement, and instead the region underwent experienced normal faulting during the Carboniferous followed by early Cenozoic reactivation and fold-thrust belt formation. Overall, the paper is a very interesting work presenting data that contributes to scientific knowledge of the Spitsbergen area. However, some updates are still needed regarding the interpretation of the seismic data as well as the overall organization of the text. Specific comments Text organization and clarifications: (Line 45): The introduction does not state the signifi-

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cance of this study. It reads more as an outline of the paper rather than introduction to the problem. Each paragraph starts with the phrase “this study. . .”. For someone who is not interested or not familiar with the study area it is hard to follow. I would recommend briefly summarizing 1) previous work and lack of knowledge, 2) broader impact, 3) questions that the paper addresses 4) and methods that were used to address the questions. After reading the introduction of this paper, the reader would expect just a case study for the Spitsbergen area, however, this study has a broader impact for fold and thrust systems worldwide, and this needs to be clear in the introduction.

(Line 206): In the methodology section, I would recommend separating the three different methodologies into different sections. The field and petrologic methodology sections lack significant information about the methodological steps that the author performed. In which lithologies were the data measured? Where is the raw data presented (which are in figure 2,3) etc? Additionally, remote satellite imagery is not mentioned in the methodology section neither in the discussion.

In the “Results” session a lot of parts include interpretations, comparisons and discussion about this study and previous studies. These remarks do not belong in the results section and they should be in the discussion. Alternatively, the author could create a new “interpretation section”. Examples in lines: 231, 239, 256, 267-271, 290-299, 326, 402

(Line 235): What is the exact lithology of these sedimentary rocks? Sample numbers?

Context and major issues As mentioned above, the motivation and broader impact of this work is not clear from the beginning in the abstract and introduction.

Line 326: Is that information coming from the well? It is unclear! How can you tell what type of lithology it is just from seismic reflection data? As stated before, this part is an interpretation and not part of the results section (raw description of reflectors). In the discussion you mention that this information comes from the well, but it should clearly be stated in the results (i.e. core, cuttings, well logs?).

Need an extra figure: I believe a figure showing the stratigraphy will be very useful. Especially for a non-expert in the area it is hard to follow the different terminology and complicated formation names. The author could recycle and modify a pre-existing stratigraphic model ex. figure 2 from Piepjohn and Dallmann 2014.

I have some major issues with the interpretation of the seismic data. A lot of the seismic images are significantly overinterpreted (drawing lines blindly over non-existent features which are poorly imaged) and some of the labeled “brittle faults” do not appear in a realistic geometry nor do they have fault-plane reflections or offset adjacent reflections with enough confidence given the quality of the data. Example in figure 4b – the author connects positive to negative reflection peaks. In figure 4g a lot of the brittle faults below the base of Devonian Mississippian cross cuts reflections in strange patterns and they are not well imaged. I would recommend revisiting the seismic interpretations and removing overinterpreted lines, since they are misleading. The author should focus on the major structures which are nicely imaged in Figure 4, and not overinterpret the deeper section where the resolution of the data is poor (e.g. Figure 4g – unnecessary lines and not convincing interpretations between pink and green horizons).

(Line 720): I agree that the map on this part is wrong – please use some field photos. Where does the crystalline basement actually appear?

In figure 5 the illustration of the large displacement of the basement is not supported by the seismic lines neither is explained in the text. Figure 5 needs to have a vertical scale associated with it. It appears that multiple kilometers of reverse basement throw are drawn across the BaF – where does this come from? The seismic images in Figure 4 support only modest reactivation of older normal fault features.

Figures Figure 4: The color scheme is not color blind friendly, the green lines on top of blue and red will be impossible for some people to see. Please consider changing the seismic colors. The legend is not very clear – please reword. “top uppermost

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Devonian-Mississippian coal”. Again, this would be clearer if the author included a stratigraphic column. Add in the legend the well for 4g. What is the length of the well? Please add a scale.

Figure 5: (E) the schematics are very small. I would recommend re-arranging this figure. Can you make them all the same size? Or maybe put boxes on the final version of D?

Figure 6 and 7 in the supplementary material are not discussed or mentioned anywhere in the main text.

Technical corrections: Missing references: Lines 223-231 Line 310: “are believed to represent”, missing reference! Add figure calls line 338 Grammar and syntax mistakes: The text still needs some work for grammar and syntax mistakes. A general suggestion is to shorten sentences – there are sentences 10 lines long with a lot of commas and parentheses that makes it hard to read and follow. A few examples of long sentences, and grammar or syntax mistakes: In the abstract: First sentence is 9 lines, Line 86, Line 89: Caledonian grain, Line 97, Line 101, Line 108, Line 492, Line 494, Line 576, Line 777, Line 799

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