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Solid Earth
Discussions

Interactive comment on "Devonian–Mississippian collapse and core complex exhumation, and partial decoupling and partitioning of Eurekan deformation as alternatives to the Ellesmerian Orogeny in Spitsbergen" *by* Jean-Baptiste P. Koehl

Anonymous Referee #2

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Comment on ''Devonian-Mississippian collapse and core complex exhumation, and partial decoupling and partitioning of Eurekan deformation as alternatives to Ellesmerian Orogeny in Spitsbergen" by Jean-Baptiste P. Koehl.

General Comments. This contribution presents new field data along with seismic profiles from the area of Central Western Spitsbergen to support a radical reinterpretation of the post-Caledonian geological evolution of Svalbard. The new data is limited to ca

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130 field measurements from one outcrop near the defunct Russian coal mine of Pyramiden. The proposed new concept is supported by newly interpreted seismic sections from the Templefjorden area some distance south of his field study area and a satellite image to the west. The latter lacks any real interpretation for the reader to see what exactly can be gained from the image to support his following re-interpretation. The authors re-interpretation enlists support from a wealth of references many of which are of doubtful relevance and could be omitted. Other references are given that are supposed to support the central ideas but are not balanced by consideration of others that may be contradictory. Basically, there are too many references. In general, the author starts by suggesting that a particular point may be explained by (with references) then later refers to such statements as a matter proven fact. The principal concept is not supported by any significant data generated by the author. The study area is too limited to propose such a large conceptual step-change and it is evident that the author has not gathered any of his own field data from the critical areas he enlists as failing to meet the widely accepted, current interpretation that the Svalbardian Event is represented in Svalbard. He is thus not in a strong position to discuss the merits of either interpretation.

The contribution is far too long and the first step should have been to consolidate the data from the reported field area. The author should then work toward gathering data from those areas he considers critical and balancing such against that reported published accounts.

Specific Comments. The field data is a welcome addition to the existing knowledge and will go toward furthering knowledge on the evolution of the Billefjorden Trough. I am not convinced by many of the details presented in the interpreted seismic sections. The sections were interpreted quite differently by Baelum & Braathen (2012) especially section NH8706 (Koehl Figure 4d). This figure and the detailed Figure 4f (Koehl) is over-interpreted, the array of east-dipping thrusts above the Wordiekammen sequence are not easily distinguished. The interpreted fault propagation folds to the west seem to have an easterly vergence? The underlying Devonian-Mississippian sequence is syn-rift? Again, Koehl's Figure 4. g (section NH8802-32) is complex and the Wordiekammen sequence is clearly syn-rift and most of the interpreted duplexing is within the Devonian which could reflect the Svalbardian deformation? The overlying Wordiekammen sequence is less deformed and could reflect later West Spitsbergen Fold Belt's effects.

Consideration of the role of exhumed metamorphic core complexes in the deformation of the Devonian rocks although interesting is really beyond the scope of this contribution given the data presented. It is not enough to troll the literature to support this aspect of his interpretation. The topic has been raised by Braathen et al., 2017 and discussed in detail by Piepjohn & Dallmann, (submitted). Allied to the question of the role of exhumed MCC's in controlling the subsequent geological development of any emerging orogen is the extent to which pre-existing basement structures have been reactivated. A consequence of the collapse of the Caledonian Orogen would be, during a tectonic subsidence phase, to unroof the orogen to a least the brittle-ductile transition zone. Active normal (brittle) faulting would be responsible for most of the later exhumation. The degree of fault activity can be judged by the nature of the sediment build-up. For the Devonian Basin of Northern Svalbard, the Riveratoppen/Lilleborg / Siktefjellet conglomerates include large olistolith like fragments of the basement suggesting strong, Devonian very high-level normal faulting. Some syn-sedimentary deformation of the accumulating sediments is found. Determining the role and timing of ductile deformation (mylonites) is fraught with difficulties (Platt et al., 2014: Cooper et al., 2017) in many exhumed metamorphic core complexes reported in the literature. In the case of Keiserhjelmen Block of Northern Svalbard (Braathen et al 2017) illustrate the mylonites (Figure 4c) from within the Generalfjella Marbles (Hjelle, 1975). The ages Braathen et al., 2017) have obtained most probably reflect some partially reset or cooling Caledonian age, and are difficult to assign specifically to a major controlling ductile shear zone. The ages are obtained are from a variety of rock types and locations (not necessarily collected by the authors?). Only one of the samples is from anywhere near the proposed detachment. These rocks are affected by Caledonian metamorphism and are disposed around large-scale NS striking flat-lying F1 folds. A characteristic of these marbles and associated schists is a strong mylonite fabric axial planar to the folds with a shear sense parallel to the fold axial traces. These rocks are exposed all the way south to Kongsfjorden and constitute most of the Løvenoyane and Blomstrand. Despite the author's dismissal of the importance of these southerly examples of the Generalfjella marbles it is important to note that they display west vergent F2 fold arrays that in many cases are seen to be fault propagation structures related to east-dipping thrust faults. There are, in addition, many examples of Early(?) Devonian red-bed deposits on the islands and on Blomstrand which show evidence of west directed thrust faulting, cleavage development, and minor folding. Again, it has long been known that there are pockets of Carboniferous quartzitic sandstones on Blomstrand that are undeformed. The author dismisses these showing he has not seen them in the field? Recently, Michalski (2019) has shown from palaeomagnetic evidence that Blomstrand has not been significantly deformed since Late Devonian time and that the F2 folds on Blomstrand are most likely of Svalbardian origin.

Other examples of involved exhumed MCCs quoted by the author are less convincing. In particular the Pinkie Group of Prins Karls Forland. Two points should be made here, first the age of the metamorphism reported for the Pinkie Group as Svalbardian/Ellesmerian by Kosminska et al (2017) Faehnrich et al 2017 is robust. To interpret theses rocks as an exhumed MCC shows a basic lack of appreciation of the structural setting of these rocks on PKF. The Pinkie Group contains a number of high strain zones not limited to the Boureefjellet zone. The sequence of high-grade rocks is tightly infolded with the low-grade rocks which display at least two major fold phases best seen in 3D from the nunataks south of Bourrefjellet onto Monacofjellet-Jessiefjellet (west and east ridges) part of the Grampian Range. It is difficult to view these relations with the high-grade rocks being part of an exhumed metamorphic core complex and avoiding the importance of the Ellesmerian ages obtained. In conclusion, I cannot recommend publication of this contribution without a major re-write and re-focussing on the obtained field data. To promote the idea that the Ellesmerian deformation has not affected Svalbard needs much more author owned evidence from critical areas and a more balanced discussion of previous works that suggest otherwise. It is not enough to call on referenced works alone from other parts of the world that appear to support the author's point of view.

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