

Interactive comment on “Variability of geothermal gradient across two differently aged continental volcanic passive margins: The Southwest African and the Norwegian margins” by Ershad Gholamrezaie et al.

Anonymous Referee #1

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General comments

In this paper "Variability of geothermal gradient across two differently aged continental volcanic passive margins: The Southwest African and the Norwegian margins", Gholamrezaie et al. present the results of two 3D models of the conductive thermal state in magma-rich rifted margins. They propose that the geothermal gradient is highly variable in time and from one margin to another: (1) in the amplitude of the geothermal gradients, (2) in the lateral distribution across the margin, (3) in the sedimentary basins. One of the main controlling parameter is the age of the breakup and thus the age of

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the oceanic lithosphere.

The authors stress that this evolution of the geothermal gradient with time, its non-linearity with depth and its spatial variability has major implications for the calculation of paleo-temperatures and paleo-elevations (as very simple and constant paleo-gradient are used).

I think the manuscript can be improved by clarifying some points and by some additional discussions, all of which is discussed in detail below. In particular, the figure captions could be improved and more recent references could be added. In summary, this paper describes topics and an area of interest to a large audience and will be a very nice contribution to Solid Earth Discussion after minor revision.

Specific comments

I would suggest adding recent references in the geological settings of the two margins. Both area are widely covered by a substantial number of publications and only 4 references are more recent than 2010.

The authors state that the Norway margin is not in an equilibrated thermal state. How does this result agree with the calculation of a steady-state (i.e. equilibrated) conductive thermal model? Maybe this could be discussed.

There is no reference for the statement: "One of the typical characteristics of volcanic passive margins is an extremely thinned continental crust (~ 5 km in the distal margin)" (p. 5 line 9). Actually, I would rather state that it is a characteristic of magma-poor rifted margins. Hyper-extended continental crust in magma-rich settings is proposed, but with consequent magmatic additions that increase the thickness of the crust.

Figure 10 illustrates the evolution of the mean thermal gradient with increasing depth intervals. Maybe it could be helpful for the reader to represent the more classical "temperature vs depth" graph for each margin. It would be interesting to represent it also for each domain. While it is not well constrained, the author could also propose

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an evolution of this gradient through time in order to better illustrate the time variability.

In the conclusions, you mention the influence of the Iceland plume. However, the role of plumes and their relative timing with the breakup (wide debate) are not discussed at all in the paper. A brief paragraph could be added.

Technical corrections, minor suggestions

Title :The margin community would rather use “magma-rich rifted margins” than “volcanic passive margins” but this is not a problem for the understanding of the paper.

Part 2.2: I did not understand the significance of “upper thermal boundary” at first. Maybe it should be defined.

Part 2.2: The order of citation of the figures in the text is not respected: figure 1 and then directly figure 4.

Part 2.2, line 26: Please explain why it is more relevant to use increasing thicker intervals of calculation with depth.

Part 4.3, line 28: please remind the reader the ages.

Part 5, line 3: add an “s” to “margin”.

Part 5.3, line 11: Please remind the reader all the mentioned hypothesis.

Part 6, line 12 “in” instead of “of”.

All maps: a short title on each map would greatly help the reader.

Figure 2: Does the sediment thickness map includes Proterozoic sediments?

Figure 8 and 9: Abbreviations should be explained in the captions. Precambrian basins could be highlighted. The color scale changes for each map: would it be interesting to keep it the same for each interval?

Figure 10: It would be more logical to attribute the blue color to SW Africa and the red

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color to Norway as it is hotter.

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