Authors' reply to EC1

EC1-1: I agree with the referees on the point that your initial model geometries should be better justified. Please add explanations, especially on how you defined your top-basement and the partition between your crustal layers.
The first paragraph of the revised chapter "3.1 Constraints on the density configuration of the sedimentary and volcanic rocks" (chapter 2.1 of the original manuscript) details which data have been used to define the top of the crystalline basement. We added:
"The scattered data from inside and outside Kenya have been jointly interpolated to obtain a continuous regular grid (of originally 5×5 km horizontal resolution) of basement depths covering the entire study area (Fig. 2a)."
In addition, the caption of Figure 2 says: "all interpolations in this study have been performed using the Convergent Interpolation algorithm implemented in Petrel (©Schlumberger)".
More detailed information on the way how crustal densities have been found (domains partitioned) by manually adjusting the geometries / densities of model units to fit the observed gravity field has been provided in chapter "3.4 3D gravity modelling" of the revised manuscript. Refer also to our reply to **RC1-9**.

EC1-2: In that scope, please add the KRISP profiles to your contribution (in the Appendix). These will help justifying your initial geometries and help the reader better understand the geological setting of the rift.
We have added figures of the KRISP profiles ABC, E, F, and G as Appendix B to the revised manuscript. We also plan to provide the original data in a digital form (as ASCII files) in the Supplements of the revised manuscript.

EC1-3: You should also add information on the uncertainties regarding your input constraints and consequences for your modelling approach (e.g. the geometries and thicknesses of your various layers).
Please refer to our comments to **RC1-9**.

EC1-4: The density values in your input parameters are also crucial to your results. Please expand the explanations and justifications given on pages 5-7 regarding the density/velocity values: what are the uncertainties / error bars on the initial density/velocity values? How does that impact the model results and resolution? How the uncertainties of each input dataset have been handled in the final model?
Again, please refer to our comments to **RC1-9**.
As the KRISP profiles and related velocity-depth distributions have been published in various articles that also inform about the technical details and uncertainties in the data acquisition and processing and interpretation, we refer to these articles. A review and overall interpretation of the velocity profiles used in this study has been provided by Khan et al. (1999). Further sources of reading on the KRISP campaigns can be found there.
For the conversion of seismic velocity to density, a linear function equivalent to Birch's law has been used (Eq. 1). The obtained point-wise information on crustal densities already indicates major lateral differences within the Upper and the Basal Crustal Layers (Fig. d, e). For the starting density model, these lateral variations have been neglected, assigning a constant density of 2750 kg/m³ to the Upper Crustal Layer and 3000 kg/m³ to the Basal Crustal Layer, as described in section 3.4 (2.4) of the

revised (original) manuscript. This “starting” contrast may have some influence on the manual density/gravity adjustment process as described in the last three paragraphs of section “3.4 3D gravity modelling” of the revised manuscript copied to our reply to **RC1-9**.

EC1-5: (e.g. values such as 6.325 km/s are extremely precise, is such precision realistic? what is the associated error bar?).
We have estimated average velocities in eastern and western Kenya, i.e. east and west of the dashed line in Figure 4d, by analysing the point-wise available velocity values and inspecting their frequency distributions (medians in the histograms). In this way we derived “representative mean values” for the two domains. Although the accuracy of this method leads to the values given, we agree that this precision is not necessarily corresponding to the data as they have been processed (e.g. vertically interpolated) beforehand. For this reason, we have changed the values to $v_{p,c}$≈6.33 km s^{-1} and $v_{p,c}$≈6.43 km s^{-1}, respectively.

EC1-6: Please add a proper ’Geological Background / Tectonic Setting’ section.
Done.

EC1-7: Your figures are very good, complete and clear, and very well referenced. I have only minor recommendations: - same comment as RC1: please add a title on each of your figure so that the reader can easily and rapidly get what the maps are about.
Done.

EC1-8: please increase the font size of all your labels and texts (many of them will probably be difficult to read on the final version of the manuscript).
Done.

EC1-9: Would it be possible to generate ’3D perspective views’ of your model? (e.g. with the topo/top-basement/Moho layers). That would help a lot the reader getting a good understanding of your geometries and of the rift configuration (to be placed for instance on the Figure 7?).
Done.

EC1-10: can you display the volcanoes on the Figure 8b as done for the Figure 6c? –
Done

EC1-11: add labels for your upper/basal crustal layers on Figure 9.
Done

EC1-12: Your reference list is very complete. Many doi numbers are however missing. Could you carefully check and add the information wherever needed?
Done