

Response to Editor Comments

Thank you for revising the manuscript and addressing the referee's comments so thoroughly. Before I accept the manuscript, I'd like to give you the opportunity to address some minor points I noticed when reading through the changes:

We thank the Editor for her work and for her helpful comments, which we hope we can address satisfactorily. We respond point by point below.

- Would it make sense to mention the HPEs as an additional parameter being explored early on, in the Methods section? (for example, in 2.4 Parameters Explored) As it is, it comes a bit as a surprise in 3.3.

We changed the manuscript to introduce the cases with HPEs at the end of Sect. 2.4. We also moved the relevant methodological details from Sect. 3.3 to 2.4 (see lines 160-171 in the markup file). In Sect. 3.3, we now only focus on describing the results of this secondary suite (lines 341-353; 366-370, markup file).

- It looks like some text in the caption of Figure 3 still refers to original version of the figure

Thank you for spotting this, we corrected it

- I would suggest to increase the font size of the labels for density change/viscosity contrast in figure 5 and 6, I found these quite hard to read.

We increased the label size

- line 322: acros --> across

Corrected (line 326, markup file)

- 340: Would it make sense to mention the regimes of these models here as well? (just briefly in parentheses to remind the reader)

We added such a reminder (lines 345,346 in markup file)

- 338 and following: I think it is great that you decided to not simply discuss the effect of HPEs but to run new models that demonstrate their effect. I think that gets the point across much better. There was one point I wanted to make though: It took reading the whole new section and the whole new Appendix C for me to realize that for the 4 new models, they had all changed their regime compared to their counterparts without HPEs, so that according to the criteria outlined above (fprim smaller than 0.3) they would now count as being in a completely new regime (ROC layer and no blobs). This of course changes how we should interpret the results, but on the other hand, you make the argument that the models with added HPEs

are way hotter than we expect Earth to have been in the past (and therefore the viscosity is lower compared to what we would expect). Since there are HPEs present in Earth's mantle, I think it would be good to clearly state these two points the end of section 3.3 (the change of regime and the limitation of the models being much hotter than we the Earth's mantle was), just to make it obvious to the reader, so that they know: Yes, HPEs do affect the regime boundaries, but their full effect is complicated and requires additional models beyond the scope of the current study. In addition, I think these results are also relevant to the discussion in Section 4.1 "Results summary and Relation to Previous Work", so I was surprised that they were not mentioned there.

Thank you for pointing this out. We added lines 366-370 to clarify that 1) a different regime is obtained when HPE are considered, and 2) that the mantle is hotter than realistic, affecting the applicability of these four cases (we then refer the reader to the more detailed discussion in Sect. 4.5).

We added a brief summary of these results to Sect. 4.1, with references to previous works dealing with ROC segregation and preservation of viscous blobs in models with internal heating (lines 403-409, markup file).

- I did not see the video supplement. Not sure if that's a problem on my end; I just want to make sure it's included in the final version that will be published.

We ensured the video supplement (line 600, markup file) contains a working [link](#) to the online repository where the videos are stored.

In addition to the changes listed above, we:

1. propose a simpler title, for the sake of clarity: "Primordial-material preservation and Earth lower-mantle structure: the influence of recycled oceanic crust";
2. replaced: "vigor" --> "vigour"
3. fixed minor text inconsistencies, repetitions, typos etc. (lines 158, 170, 171, 176, 239, 359, 361, 412 in markup file; Caption Fig. 6);
4. included additional acknowledgments (lines 690-692, see markup file)

We hope all these changes will improve the clarity of the manuscript, and thank again the Editor and Reviewers for their suggestions in this regard.

Best regards,

The Authors