Dear Lyudmila Khakimova,

Thank you for taking the time to read and provide comments on our work. Although critical, the review allowed us to further develop our arguments and expand points that needed further explanation. In the new version, we have implemented an additional refinement method (h-refinement). This allows the users to choose what kind of refinement method they want. For this reason, the respective part was expanded and the text was modified. Regarding other minor/moderate points, please find our detailed answers below.

On behalf of the co-authors,
Annalena Stroh

Reviewer comments are written in black whereas our answers are given in blue.

Reviewer #2 (Lyudmila Khakimova)

The manuscript presents a new numerical framework aimed at simulating 1D diffusion, moving-boundary problems, and coupled diffusion–growth processes in mineral systems. This class of problems is central to geospeedometry and diffusion chronometry, where an accurate treatment of compositional discontinuities at mineral interfaces and time-dependent boundary conditions is essential. The paper is clearly organized and methodologically transparent, offering extensive benchmark comparisons against analytical solutions. The numerical formulation (Galerkin FEM, adaptive mesh, regridding and PCHIP interpolation) is described in sufficient detail for reproducibility. The examples convincingly demonstrate that the approach is robust and flexible, and the open-source implementation in Julia is a strong asset for the research community.

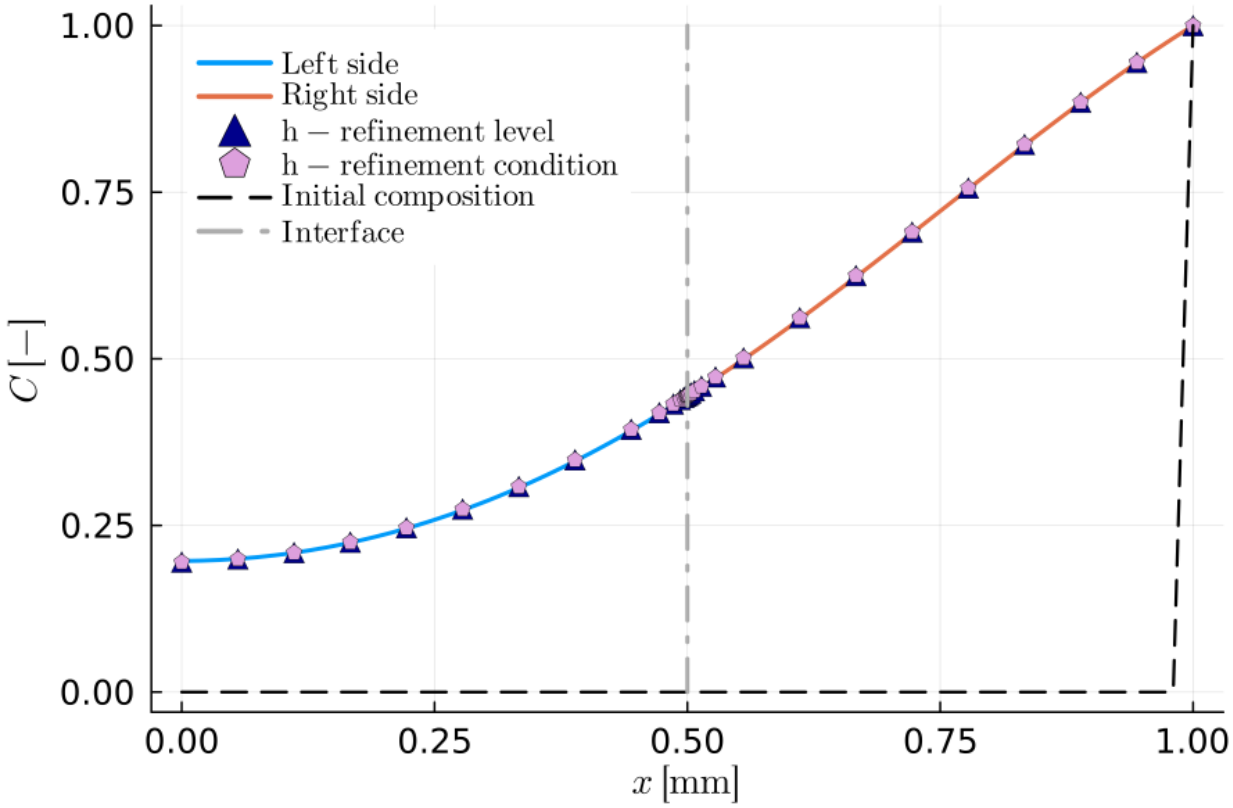
We thank the reviewer for the constructive criticism, and we have already implemented h-refinement as an additional option on the side of the user. We believe that this option makes the paper stronger and allows more flexibility in future development. Please find our response to the specific points below.

I have only a few suggestions that may further strengthen the manuscript.

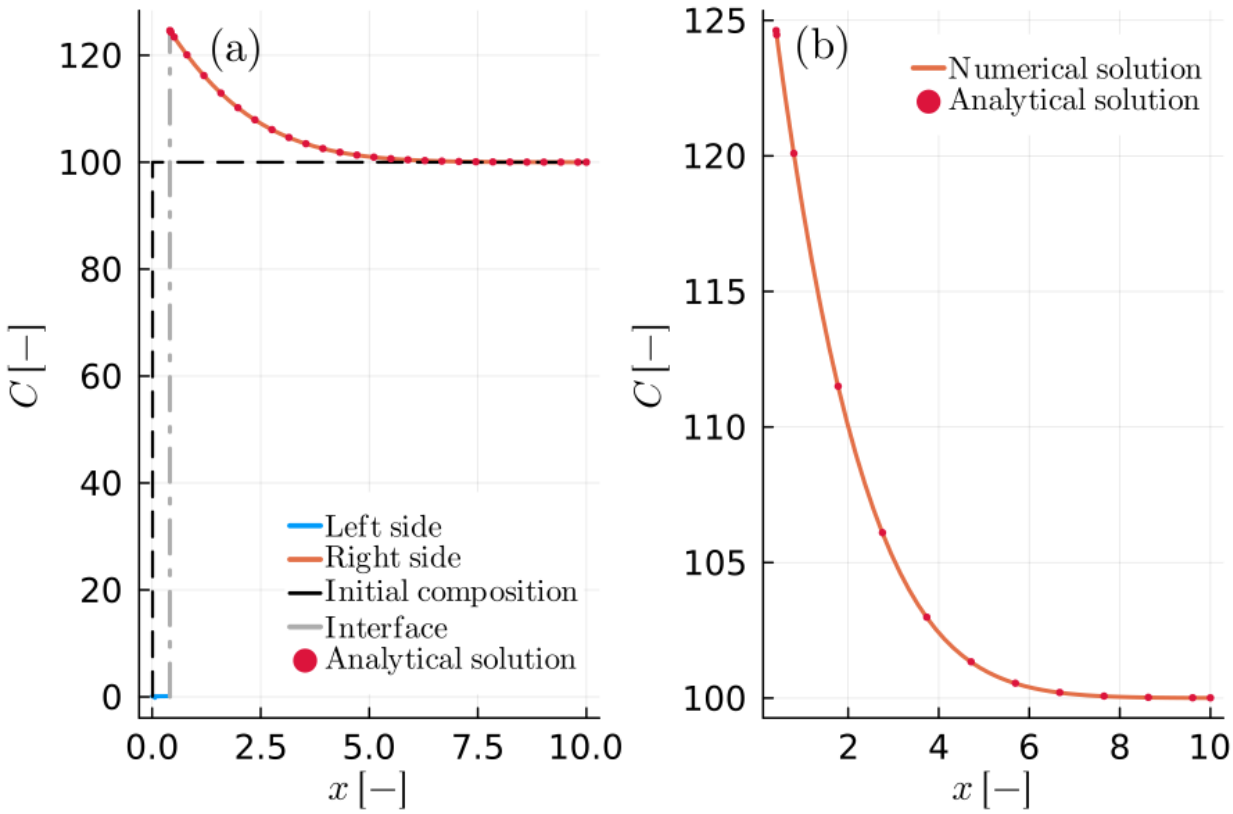
The geometric-progression–based interface refinement is elegant; however, a brief comparison with more conventional h-refinement criteria (e.g., gradient-based error indicators commonly used in FEM) could help readers understand why the chosen approach is particularly advantageous for resolving sharp compositional discontinuities.

As previously mentioned, we have now implemented the h-refinement approach as it is commonly done in FEM analysis. We have also expanded the text accordingly. However, we have chosen not to implement an error-driven refinement approach (i.e. the level of refinement would be given by an error estimator) since this would result to the change of the number of elements according to the magnitude of gradients/errors. We would like to avoid this approach since it would make the code much slower due to the many allocations needed. For that reason, we have implemented two strategies for h-refinement (explained also in the text). In the first strategy the user can specifically choose the refinement levels whereas in the second strategy the user choses the length ratio between the largest and the smallest element. Both approaches lead to a fixed number of elements/nodes during the simulation that offers a computational advantage.

Please see below two cases, one continuous (B1), and one discontinuous (B5) that were calculated with our h-refinement approach. The results show that the solutions can be also reproduced in that case.



Example B1 solved for the case of the two h-refinement approaches (see main text for more details). In the "h-refinement level" solution we performed the refinement by choosing a fixed number of refinement levels. In the "h-refinement condition" we performed the refinement until the length ratio of the largest to the smaller element is the same as the one that was chosen by the user. The solid lines indicate our original refinement approach (m-refinement).



Same calculation as for example B5 (Fig. 7 in the new version of the manuscript). This example was calculated with the h-refinement approach using initially 50 nodes and 3 refinement levels.

Our previous results show that we can obtain the same solutions as in the original approach.

It would be interesting to comment on how well the adaptive grid and interpolation strategy can resolve extremely steep concentration gradients at mineral interfaces. Are there specific requirements or constraints on the numerical scheme to ensure conservation and consistency when gradients approach discontinuous behavior?

We have not investigated in detail the performance of the adaptivity. It should be noted that the optimal refinement depends on the particular problem that is under investigation. For example, in case of no-growth where the size of the crystals remains the same and the gradients are concentrated at the interphase boundary, the h-refinement will be the optimal choice (since it targets the gradient specifically). In more general cases though, the m-refinement approach offers a compromise on the resolution of compositional profiles.

These are minor points, and I offer them in the spirit of further enhancing an already strong manuscript.

We thank the reviewer and we really appreciate the opportunity to enhance the code and the manuscript.

In conclusion, I would like to sincerely thank the authors for this carefully executed and clearly presented study. I truly enjoyed reading the manuscript and appreciate the effort that went into developing this contribution.

Finally, we would like to thank Lyudmila Khakimova. Her points were considered, and we hope that the editor will find our changes appropriate.

On behalf of the co-authors,
Annalena Stroh