RESPONSE TO THE EDITOR AND THE REFEREES

We, the authors, would like to extend our sincere gratitude to the editor and the referees for their valuable time and efforts invested in reading the manuscript. We appreciate and acknowledge all the comments, feedback, and constructive suggestions provided for the further revision of the manuscript. We have responded to each of the comments with the best possible clarifications, as well as considering the feedback, we have carefully incorporated the required changes based on the suggestions of the reviewers in the revised manuscript. The responses to each of the specific comments and the corresponding figures for the clarifications are compiled below.

A. <u>Responses to the comments from the Topic editor:</u>

The authors are requested to take into account every reviewer's comment and address them properly. Particular attention needs to be paid to the sensitivity test and the way in which Zo was chosen. As it is a decisive parameter in determining the Moho depth, it cannot be taken using assumption (Line 188). Did the results of Spector and Grant's (1970) method reflected the mean depth to the Moho? If not why?
Additional private note (visible to authors and reviewers only): The authors are requested to accommodate the comments proposed by the reviewers and resubmit the manuscript.

Author's Response: We are thankful to the topic editor for summarizing the major comments of the reviewers thereby pinpointing the issues that need to be tackled in this revision. Accordingly, we have modified the text of the concerned sections in the present revised version of the manuscript.

We want to highlight here that the choice of the mean Moho depth (z_0) value for performing the Moho depth inversion was based on a trial-and-error approach with a series of z_0 values (at 2km interval) within the range as obtained from the present Radially averaged power spectral analysis and literature derived Moho depth of the region. As a result, we have now reframed our statement (Lines 230-233, in the present revised manuscript) by specifying the range of the mean Moho depth values utilized. Further to enhance the clarity, we have reported the sensitivity of the algorithm with respect to the variation in the z_0 values (Lines 236-239) and thereafter, indicated the rationale for selecting the mean Moho depth value of 36 km.

Spector and Grant (1970) noted that the average depth of the buried sources and the size of the map have influence over the power spectrum obtained for an ensemble of sources. It paved the way to show that the logarithm of the radially averaged power spectra of gridded magnetic anomaly data has several constant-slope segments related to statistical ensembles of sources, or equivalent source layers, at different depths. Since then, researchers commonly used this power spectrum-based approach to obtain a first-hand information on the average depth to the top of the source bodies from potential field data (e.g., Nabighian et al., 2005; Chouhan et al. 2020; Sahoo and Pal; 2021 etc.). These depth information act as the initial model for sophisticated inverse modelling and play an important role for applying constraints on different modelling approaches. In the present study, the deepest depth estimate of 30.3 km is used as the starting value of the mean Moho depth parameter in the inversion algorithm. The respective inverted Moho topography results deciphered shallower Moho than expected for this study area as observed in the previous literature. Thus, the depth estimates obtained for this study from the method given by Spector and Grant (1970) serve as a preliminary constraint for the further approaches like Moho depth inversion and forward modelling.

We have attempted to address and accommodate each of the comments as well suggestions presented by the reviewers to the best of our understanding. The necessary modifications are also incorporated in the text of the revised manuscript.

B. Responses to the comments from Reviewer 2:

I thank the authors for addressing the comments provided in the first round of the revision process, improving the manuscript quality and clarity as well.
I would like to iterate with minor comments on some points. I favor the publication of the manuscript, provided that these points are addressed:

Author's Response: We are thankful to Reviewer #2 for appreciating out work and continuously encouraging us towards improving the overall quality of the manuscript through constructive criticisms and valuable suggestions. We have logically replied to all the points raised here and accordingly incorporated the required changes in the text of the revised manuscript.

● *Line 157: Classical terrain correction calculations usually take into account all the topographic masses within a 166.7 km radius around each gravity observation point (e.g. Zahorec et al. 2021). Is it the same distance used for your terrain calculations? Please, specify if possible.*

Author's Response: We appreciate the observations made by the reviewer. The terrain correction is applied on the Bouguer corrected gravity anomaly using the 'Terrain correction' module available within the Gravity menu on the Oasis Montaj Geosoft software. The module by default takes the 'Local correction distance' as half of the size of the local DEM grid provided while computing the terrain correction on the software. This distance would approximately be 166.5km (as the local DEM was of 3°×3° dimensions, centred about the present study area), as per the requirements by this module (geosoft_gx_gravity_terrain_correction). So, the distance used for terrain calculations was considered by the software as default based on the local DEM grid dimensions. We have indicated our chosen module for the calculation of the Terrain correction in the present revised manuscript (Lines 157-158).

● *Line 231: Please, report the outcome of your sensitivity tests with respect to z0 and density contrast for the Parker-Oldenburg algorithm, and reformulate the sentence. The tests show that the outcome strongly depends on the choice of z0, while the Moho shape is better constrained. Hence, your z0 assumption does not "also correspond with" the Moho depth estimate after Kumar et al. (2012), but you need to assume the Moho depth after Kumar et al. (2012) as z0, to constrain the results of the inversion.*

Author's Response: Following the suggestion of the reviewer, we have restructured the statement in Lines 230-233 to report the basis for the range of mean Moho depth values for performing the inversion algorithm. We have also specified the range of the mean Moho depth values utilized here based on the RAPS depth estimates in this study and prior literature. The sensitivity of the algorithm to variation in the z_0 values is now reported in the modified manuscript (Lines 236-239). Based on the suggestion by the reviewer we have now stated the rationale for selecting the mean Moho depth value of 36 km, after the correlations of the respective inversion results and the observations of Kumar et al. (2012).

● *Line 323: remove "approximately".*

Author's Response: This has been addressed in the Line 328, in the modified manuscript.

● *Line 484 and/or Discussion: If I understand correctly, the 30 km depth estimate to the top of a deep dense structure from RAPS, is consistent with the outcome of the Moho 3D inversion above (provided the assumption of z0 after Kumar et al. 2012). However, these two methods are not able to resolve the discontinuity between the mantle below and the crustal underplated layer above, given the weaker density contrast.*
This means that, apart from literature review, the existence of the underplated layer relies only on the outcome of the 2D forward modeling.
Please, either in the discussion or in the conclusion, add a clear sentence on the limitations of this 2D forward modeling approach: the 2D forward modeling shows that the observed gravity data is compatible with the existence of an underplated layer above the Moho, although it cannot quantify the uniqueness of the proposed solution. An inversion framework will be necessary to assess the uniqueness of the solution proposing such a structure.

Author's Response: We agree with the observation made by the reviewer with respect to the existence of under plating layer and outcome of forward modelling. Following the suggestion by the reviewer, we have now included a statement observing this limitation (Lines 426-430) in the Discussion part of the modified manuscript.

<u>C. Responses to the comments from Reviewer 1:</u>

Minor technical corrections:

1. Figure 1a is of poor quality. the characters are not readable.

2. Gupta and Ramani (1980) is indicated in the text but is missing in the reference list.

Author's Response: We are thankful to Reviewer #1 for expressing utmost interest in our manuscript and always providing constructive suggestions. We have incorporated the above two technical corrections in the revised manuscript as described below:

1. The Figure 1a has been modified by increasing the font size as well as incorporating abbreviations for the geological features. The abbreviations are explained in the caption of the figure (Lines 714-716).
2. The missing reference for the mentioned citation has now been included in the modified manuscript (Line 580).

References

Chouhan, A. K., Choudhury, P., and Pal, S. K.: New evidence for a thin crust and magmatic underplating beneath the Cambay rift basin, Western India through modelling of EIGEN-6C4 gravity data, Journal of Earth System Science 129(1), doi:10.1007/s12040-019-1335-y, 2020.

Nabighian, M. N., Grauch, V. J. S., Hansen, R.O., LaFehr, T. R., Li, Y, Peirce, J. W., Phillips, J. D., Ruder, M. E.: The historical development of the magnetic method in exploration. Geophysics 70(6):33–61, 2005

Sahoo, S.D., Pal, S.K. Crustal structure and Moho topography of the southern part (18° S–25° S) of Central Indian Ridge using high-resolution EIGEN6C4 global gravity model data. Geo-Mar Lett 41, 3, https://doi.org/10.1007/s00367-020-00679-z, 2021.

Spector, A. and Grant, F. S.: Statistical methods for interpreting aeromagnetic data, Geophysics 35, 293–302, doi:10.1190/1.1440092, 1970.

Terrain correction module information for Oasis Montaj Geosoft:
https://help.seequent.com/Oasismontaj/2023.1/Content/gxhelp/g/geosoft_gx_gravity_terrain_correction.htm