nature portfolio

Peer Review File

The Indian Plate subducting below the Tibet Plateau is tearing apart

Corresponding Author: Professor Lin Liu

This file contains all editorial decision letters in order by version, followed by all author rebuttals in order by version.

Version 0:

Decision Letter:

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Dear Professor Liu,

Your manuscript titled "Indian lithospheric plate is tearing apart beneath Tibet" has now been seen by 3 reviewers, whose comments are appended below. You will see that they find your work of some potential interest. However, they have raised quite substantial concerns that must be addressed. In light of these comments, we cannot accept the manuscript for publication, but would be interested in considering a revised version that fully addresses these serious concerns.

We hope you will find the reviewers' comments useful as you decide how to proceed. Should additional work allow you to address these criticisms, we would be happy to look at a substantially revised manuscript. If you choose to take up this option, please either highlight all changes in the manuscript text file, or provide a list of the changes to the manuscript with your responses to the reviewers.

In the revised version, please make sure to:

a) Make a compelling case that your auto-picking method is adequate for the complexity of the region.

b) Consider and discuss alternative hypotheses for the observed complexity and clearly explain why you think your interpretation is better than the alternatives. Also, adopt a more neutral phrasing when contrasting your results with related literature.

c) Provide all the data and information needed for an independent evaluation of your results.

When resubmitting, please provide a point-by-point response to the reviewers' comments. Please submit your responses as a separate file, distinct from your cover letter where you can add responses to the Editors' comments that you do not want to be made available to the reviewers. Word files are preferred. We recommend that any figures, tables or graphs that are included in the response to reviewers are also included in the main article or Supplementary Information.

Please bear in mind that we will be reluctant to approach the reviewers again in the absence of substantial revisions.

If the revision process takes significantly longer than three months, we will be happy to reconsider your paper at a later date, as long as nothing similar has been accepted for publication at Communications Earth & Environment or published elsewhere in the meantime.

We are committed to providing a fair and constructive peer-review process. Please do not hesitate to contact us if you wish to discuss the revision in more detail.

Please use the following link to submit your revised manuscript, point-by-point response to the reviewers' comments with a list of your changes to the manuscript text (which should be in a separate document to any cover letter), a tracked-changes version of the manuscript (as a PDF file) and any completed checklist:

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** This url links to your confidential home page and associated information about manuscripts you may have submitted or be reviewing for us. If you wish to forward this email to co-authors, please delete the link to your homepage first **

Please do not hesitate to contact us if you have any questions or would like to discuss the required revisions further. Thank you for the opportunity to review your work.

Best regards,

Joao Duarte, PhD
Editorial Board Member
Communications Earth & Environment
orcid.org/0000-0001-7505-3690

Carolina Ortiz Guerrero, PhD
Associate Editor
Communications Earth & Environment

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REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

Liu et al. provide an investigation on lithospheric structure beneath southern Tibet by focusing on S-receiver functon(SRF) to determine the base of the lithosphere. The authors use a total of 4051 SRFs from 462 stations, although data from only 94 stations deployed in a E-W profile have not been exploited yet for this goal. Armed with a new lithospheric model, which is integrated with pre-existing geological, geochemical and geophysical information, it is argued that the subducting Indian plate is being warped or torn.
I see a number of critical shortcomings in the interpretation of the results and the assumptions made for the key findings, which raise significant concerns about the robustness of the conclusions. For example, while the authors present an auto-picking methodology for identifying the LAB as an advance, the fact that it relies on a single NVG per trace risks oversimplifying the structural complexity. This limitation, and the lack of consideration for alternative mechanisms such as interlayered lithospheric structures or partial melt zones, somewhat “dilute” the robustness of the interpretation. More on this below.

A central claim of the manuscript is the existence of a lithospheric tear at ~91–92°E, interpreted from depth discontinuities in LAB structure. However, this interpretation heavily depends on assumptions that the mapped NVGs unequivocally represent the LAB, while alternative explanations - such as compositional or thermal gradients within the lithosphere - are not really explored. One could argue that the abrupt depth change could equally reflect lateral variations in lithospheric rheology or thermal evolution rather than a tearing event. Additionally, the spatial correlation between the proposed tear and surface features such as grabens is somewhat speculative and lacks mechanical justification. Deep lithospheric processes are assumed to drive surface tectonics, but without integrating robust models of stress transfer, this connection remains weak. Also, to me it is still hard to understand how the Tibetan crust alone can supply buoyancy and mechanical strength to raise and support the Himalayas and Tibet.

The manuscript integrates helium isotopic anomalies from geothermal springs to support the inferred lithospheric tearing and

structures. This is an important integration, but it also raises several issues. Existing studies suggest a sharp boundary in helium isotopic signatures approximately 100 km south of the Indus-Yarlung Tsangpo Suture, marking a transition from Himalayan crustal helium to Tibetan mantle helium. This boundary has been interpreted as the juxtaposition of subducted Indian crust against the sub-Tibetan asthenosphere, indicating the Tibetan Plateau is supported by thickened Asian crust. Such a model it is difficult to reconcile with the limited syn-collisional shortening of the Asian plate, the Indian affinity of exhumed Himalayan units, and evidence for crust-mantle mechanical coupling. Furthermore, the assumption that geothermal spring systems extend to depths exceeding 70 km - where mantle sources are proposed – may not be physically viable given the physical limitations of fluid pathways at such depths. Could there be an interlayered mantle lithosphere at ~50 km depth between Indian and Tibetan that could explain the regional helium isotope patterns? Probably the SRF wouldn't allow for the relatively thin layer to be imaged, as don't many tomographic models. However, numerical simulations and recent high-resolution lithospheric tomographic models provide some hints.
The implications of lithospheric tearing for seismic hazards are mentioned but are weak. The authors speculate on a causal link between the inferred tear and the seismic gap near the Kopili fault, yet they fail to present convincing evidence to support this relationship. Intermediate-depth seismicity south of the inferred tear is notably absent, but this observation could be explained by mechanisms unrelated to tearing, such as variations in crustal composition or rheology. Without more rigorous exploration of these possibilities, the seismic hazard inferences remains speculative.
The manuscript makes a valuable attempt to address lithospheric dynamics in southern Tibet, but it's hindered by interpretative biases, insufficient consideration of alternative models, and speculative integration of supporting data. I'm sure that a more critical incorporation of existing geophysical and geochemical results would be essential to strengthen its conclusions.

Reviewer #2 (Remarks to the Author):

This manuscript uses S-wave receiver functions (SRF) to map the lithosphere-asthenosphere boundary (LAB) beneath southeastern Tibet. The authors' auto-pick the maximum negative velocity gradient in the SRFs between 80 and 220 kilometers depth and associate this with the LAB. The authors have access to a spatially dense dataset for this region allowing them to map the LAB beneath Tibet at higher resolution than previously possible. Applying this approach, they discuss an ~30 km difference to the depth of the LAB (~160 km to ~130 km L99-100) across the study area. Arguing that the thicker lithosphere reflects the Indian plate and thinner lithosphere Tibet, the authors' draw on additional lines of evidence to suggest a tear in the Indian lithosphere beneath Tibet.

The India Asia collision remains the best place to study active continental collision. Those interested in the architecture of continental collision and/or vested in the structure of Tibet will find the results interesting though some may argue with the authors' interpretation. The paper is well written, the arguments the authors' make in support of their interpretation are clearly presented, and the figures and data presented provide sufficient detail for others to independently assess the authors' interpretation.

The analysis would be strengthened by taking into account dip, anisotropy, 3D velocity variations, and modeling of amplitudes. That said, these additional analyses are beyond the scope of work as presented and do not necessarily preclude publication of the current results. However, both the data product (SRFs), original waveforms, and metadata need to be made publicly available without restriction in an open access data archive. This is standard practice in seismology and is required to meet the journal's editorial and publishing policy regarding availability of data "to interpret, verify, and extend the research in the article." Open data access and reproducibility of results is essential for peer-reviewed science to be credible and to meet the standard of publication in Communications Earth & Environment, part of the Nature Portfolio.

Additional comments follow:

The manuscript title is quite specific in stating that the "Indian lithospheric plate is tearing apart beneath Tibet." The second sentence of the abstract modifies this statement to "tearing or warping of the Indian Plate". The authors focus their interpretation on a tear in the Indian slab but then again mention warping as a possible explanation of the SRFs toward the end of the discussion section (L263). The difference between a lithospheric tear or a continuous lithosphere that is warped is significant. The latter interpretation is plausible given the SRFs presented in the manuscript.

Specifying objective criteria for identifying positive and negative excursions as a basis for interpretation of receiver functions is a step forward. It serves as a good launch point for interpreting first order velocity discontinuities in Earth structure and linking these to structure and process.

The authors use objective criteria to identify the excursions they interpret as the LAB. Are there objective criteria to differentiate I-LAB and T-LAB and to map the transition between the two (gray bar Fig 2f)? The SRFs exhibit considerable complexity within the regions classified as I-LAB and T-LAB as well as in the area mapped as the transition between the two. Figs. S2, S3, and S4 show considerable complexity in the SRF themselves as well as the depth to the maximum NVG (especially figures S2 e and j). There is an apparent divergence between auto picks and "constraints" where profiles intersect (Figure 2). The west to east shift between blue and red at 92° is clear between ~28° to ~32° in Figure 2a, the jog to the northwest perhaps not as much. It may be an issue with the color palate but the northwestern most star which accentuates the jog seems to be in an area where there is no data. The depth to the LAB in figures S2 e and j (at higher resolution) show considerable lateral variation at smaller scale suggesting interesting and likely significant complexity not represented in Figure 2 or its smoothed version in figure 3 which forms the basis of interpretation.

Moveout corrected SRFs were stacked based on piercing points at 150 km depth using the 1D IASP91 velocity model. If the LAB depth varies laterally, so do the piercing points. IASP91 was also used to convert from time to depth. This study, and many other studies (every study?), and multiple tomography models for Tibet show that structure and velocity vary in 3D across Tibet. This needs to be taken into account stacking receiver functions and converting from time to depth. ±5% (L32-33) can make a difference and should be assessed. Using 1D models is often justified by investigators to avoid bias due to uncertainties in or between 3D models but when used in areas that clearly have significant 3D velocity variation introduces error. There are sufficient data available in Tibet to quantitatively assess the influence of velocity heterogeneity on receiver functions.

As the authors acknowledge (L351 354) a prominent negative excursion is observed above the auto-picked deep excursion with amplitudes close to those auto-picked. It would be useful to compare amplitudes of the prominent negative excursions within stacked SRFs to determine how much difference there is. It would also be useful to map amplitudes of the auto picked LAB across the study area to compare amplitudes of SRFs classified as I-LAB vs T-LAB. Amplitudes of the auto-picked maximum NVG in S3 and S4 seem to vary in similar ways regardless of whether they've been classified as I-LAB or T-LAB. As presented, those classified as I-LAB are not noticeably weaker than those classified as T-LAB.

It's worth considering the intervening Lhasa block and how structure at the base of the magmatic arc might influence present day structure as observed in receiver functions. The original geometry of Indian plate as it collided with Asia also needs to be considered. Depending on this geometry and post collisional evolution the leading edge of the slab could be long gone beneath the study area with present day variations in lithospheric structure reflecting the edge of the Indian indentor approaching the Eastern Syntaxis.

While perhaps unintentional, at multiple places in the manuscript the authors refer to prior studies as subjective, model driven, and/or glossing over complexity, implying potential implicit or explicit bias. This may not be the authors intent, but the phrasing potentially has this impact. Unless these statements are evidence based, adopting more neutral phrasing might be appropriate. Beyond this, as this manuscript illustrates, models are one of the tools used to explain the available evidence.

A few minor additional suggested modifications follow:

L14 – why are there quotes around underplating and subducting? Suggest removing.

L20 – the meaning of interposed in this context is unclear. Suggest rephrasing.

L 21 - nascent means just coming into existence, just beginning, or incipient. Perhaps use another word. Tibetan LAB is clearly labeled in every figure and discussed throughout the manuscript, so is presumably present not nascent.

L 91 – perhaps differentiate the 94 station west-east array (previously unpublished SRFs) on figure 1.

The depth scale in figure 2 appears mislabeled (red shallower LAB is labeled as I-LAB, deeper blue LAB is labeled as T-LAB, these should be reversed. Fig S6 is similarly mislabeled.

L 113-114 – add description of smoothing.

The link to seismic hazards in the last paragraph seems to come out of nowhere and lacks context. If this is a major point of the manuscript it needs to be better developed.

I don't follow the logic in L377-381. Just because previous studies have not interpreted mid-lithospheric discontinuities it doesn't necessarily follow that "it is therefore appropriate to call the deep converter the I-LAB."

Reviewer #3 (Remarks to the Author):

Comments:
The manuscript entitled "Indian lithospheric plate is tearing apart beneath Tibet" (Ref: COMMSENV-24-3417-T), authored by Lin Liu, Danian Shi, S. L. Klemperer, primarily emphasizes mapping depths to the Indian and Tibetan lithosphere-asthenosphere boundaries (LAB) across a substantial region of south-eastern Tibet. The authors use 3D S-receiver functions (SRF) to map LAB. The authors delineate a contrasting structure across a significant east-west transect, demonstrating orogen-perpendicular tearing and slab rollback of the Indian Plate. The manuscript integrates extensive seismic data and corroborates its findings with independent geochemical and seismotectonic evidence, contributing significantly to understanding lithospheric dynamics in the Himalayan-Tibetan orogeny. The study employs 4,051 SRFs from 462 broadband seismic stations and significantly improves the spatial resolution compared to previous studies.

The scientific content of the work is interesting, however, the manuscript needs some minor revisions before accepting for publication. Some of the suggestions and queries are mentioned below:

i) In Figure 2a, I can see the yellow stars but where is the grey boundary? The grey boundary is however visible in Fig. 2f.
ii) In the SRF plots, it is observed that I-LAB is dipper than T-Lab but the colour scale used in Fig. 2a is confusing where

deeper LAB (blue) is marked as T-LAB and shallow LAB (red) is marked as I-LAB.
iii) A large scattering of blue dots represents large variations of LAB depths even between two groups of consecutive piercing points. How can it be interpreted?
iv) Fig. S1 needs to be rechecked. For example, in Fig. 1 of Zhao et al., (2011), the coloured bars indicated LAB observations: blue=India, green=Asia, red=Tibet. These observations have not been portrayed correctly in Fig. S1.
v) The results and interpretations are well written, however, there are minor grammatical omissions, which require complete checking throughout the manuscript.
vi) The references given in the manuscript should be cross-checked with the reference list.

I found the manuscript interesting for understanding the detailed upper-mantle geometry of continental collision.
I recommend the manuscript for publication in the journal after a minor revision.

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Version 1:

Decision Letter:

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Dear Professor Liu,

Your manuscript titled "Indian lithospheric plate is tearing apart beneath Tibet" has now been seen by our reviewers, whose comments appear below. In light of their advice we are delighted to say that we are happy, in principle, to publish a suitably revised version in Communications Earth & Environment.

We therefore invite you to revise your paper one last time to address the remaining concerns of our reviewers. At the same time we ask that you edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

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We hope to hear from you within two weeks; please let us know if you need more time.

Best regards,

João Duarte, PhD
Editorial Board Member
Communications Earth & Environment

Martina Grecequet, PhD
Senior Editor,
Communications Earth & Environment

REVIEWERS' COMMENTS:

Reviewer #1 (Remarks to the Author):

Thank you to the authors for addressing all my comments in detail. The revisions and clarifications provided have fully resolved my concerns, and I recommend this manuscript for publication.

Reviewer #2 (Remarks to the Author):

The major claims of the revised manuscript remain the same as the previous submission. This manuscript uses S-wave receiver functions (SRF) to map the lithosphere-asthenosphere boundary (LAB) beneath southeastern Tibet. The authors' auto-pick the maximum negative velocity gradient in the SRFs between 80 and 220 kilometers depth and associate this with the LAB. The authors have access to a spatially dense dataset for this region allowing them to map the LAB beneath Tibet at higher resolution than previously possible. Applying this approach, they discuss an ~30 km difference to the depth of the LAB across the study area. Arguing that the thicker lithosphere reflects the Indian plate and thinner lithosphere Tibet, the authors' draw on additional lines of evidence to support their interpretation that the SRFs indicate a tear in the Indian lithosphere beneath Tibet.

Those interested in the architecture of continental collision and/or vested in the structure of Tibet will find the results interesting though some may argue with the authors' interpretation. The paper is well written, the arguments the authors' make in support of their interpretation are clearly presented, and the figures and data presented, including additional supplementary figures, provide sufficient detail for others to independently assess the authors' interpretation.

It is good that the data product (SRFs and metadata) are available, but also insufficient. The authors did not address the availability of the original waveforms and metadata. In order for this manuscript to be published, the original waveforms, and metadata must be publicly available, openly accessible without restriction in an open access data archive. A number of peer reviewed journals of similar stature would not have even sent this manuscript out for review without the raw waveforms and metadata being openly accessible at the time of publication. This is a standard that is applied uniformly across all countries. The raw waveforms and metadata must be openly accessible and available in an open access archive without restriction to meet the journal's editorial and publishing policy regarding availability of data "to interpret, verify, and extend the research in the article."

The SRFs are quite complicated. While the methods applied are well-described, other methods are required to unequivocally support the authors interpretation and conclusions. Readers familiar with receiver functions, analysis and interpretation will understand this. A risk is that readers without this expertise may not and therefore accept the interpretation/conclusions at face value. The authors interpretation is model driven. That's ok, but it remains essential that publication of this manuscript require the raw waveforms and metadata be openly accessible without restriction to allow for additional analysis. The Himalayan orogen and Tibetan Plateau provide an exceptional opportunity to study continental collision and evolution of continental lithosphere. To do so, requires that all options are open to explore the full potential of data to shed insight into these processes.

Response to Reviewers

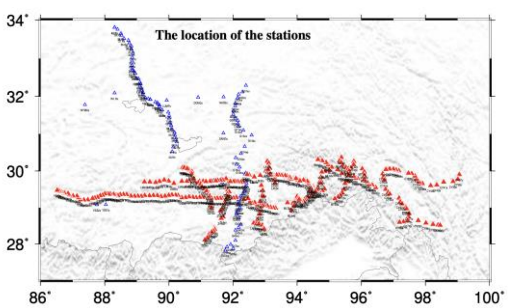
COMMSENV-24-3417-T: "Indian lithospheric plate is tearing apart beneath Tibet" by Liu et al. In the following, reviewers' comments are in normal font, and our responses are in **bold font**. The page and line numbers mentioned below are for the ***annotated*** (and not the 'clean' version of the) revised manuscript, unless otherwise specified.

REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

Liu et al. provide an investigation on lithospheric structure beneath southern Tibet by focusing on S-receiver function (SRF) to determine the base of the lithosphere. The authors use a total of 4051 SRFs from 462 stations, although data from only 94 stations deployed in a E-W profile have not been exploited yet for this goal. Armed with a new lithospheric model, which is integrated with pre-existing geological, geochemical and geophysical information, it is argued that the subducting Indian plate is being warped or torn.

Thanks to the reviewer for catching this: our previous description was wrong. We have now clarified that our study incorporates a total of 462 broadband seismic stations, of which fully 333 stations have not previously been utilized in any SRF studies in this region. See 333 red triangles in this figure:



; this information is now captured in our revised Figure 1. This represents a significant expansion of the seismic dataset compared to prior work, and proves essential for resolving the lithospheric structure beneath southern Tibet (see lines 82-84 and 92-94) (line numbers are referenced to the marked-up document with changes tracked).

I see a number of critical shortcomings in the interpretation of the results and the assumptions made for the key findings, which raise significant concerns about the robustness of the conclusions. For example, while the authors present an auto-picking methodology for identifying the LAB as an advance, the fact that it relies on a single NVG per trace risks oversimplifying the structural complexity.

We acknowledge that our auto-picking methodology, which identifies a single NVG per trace to identify the LAB, risks oversimplifying real structural complexity. The challenge is to balance the desire to interpret each individual SRF (with an individual piercing point defined by its unique back-azimuth and slowness) against the low signal-to-noise (S/N) of individual traces. Even when stacking ~100 traces in a single bin (Figure S2 k-o) coherence is not always achieved between adjacent bins (Figure S3) as seen also in CCP images with similar stacking fold (Figure S5). We have preferred to *under*-interpret the data by seeking a methodology that minimizes complexity (a single NVG per bin), to reduce the possibility over-interpretation, and to achieve a consistent and objective identification of the LAB across a large dataset.

This limitation, and the lack of consideration for alternative mechanisms such as interlayered lithospheric structures or partial melt zones, somewhat "dilute" the robustness of the interpretation. More on this below. A central claim of the manuscript is the existence of a lithospheric tear at ~91–92°E, interpreted from depth discontinuities in LAB structure. However, this interpretation heavily depends on assumptions that the mapped NVGs unequivocally represent the LAB, while alternative explanations - such as compositional or thermal gradients within the lithosphere - are not really explored. One could argue that the abrupt depth change could equally reflect lateral variations in lithospheric rheology or thermal evolution rather than a tearing event.

Just as in typical CCP images (e.g. Figure S5a) it is possible in our binned record-sections to identify multiple potential NVGs (e.g. Figure S5b) as now shown for the entire data-set in Figures S3 and S4 in which we highlight all potential NVGs with amplitudes exceeding 50% of the largest NVG on each trace, with color-coding normalized to the largest NVG amplitude.

It is then a subjective problem which of these converters to interpret, and as what. We have chosen the simple association of the largest-amplitude NVG with the LAB. If one is willing to entertain "alternative mechanisms such as interlayered lithospheric structures or partial melt zones” **or** “compositional or thermal gradients within the lithosphere” **then anything is possible (well, nearly anything: gradients would have to be steep enough (transitions sharp enough) to generate conversions of appropriate wavelengths, and equilibrium conductive thermal gradients do not meet this criterion).**

We agree that our interpretation of a tear relies on the underlying assumption that the mapped NVGs represent the LAB. In this we are following all previous studies (refs. 19-26). Although we cannot disprove “the abrupt depth change could equally reflect lateral variations in lithospheric rheology or thermal evolution rather than a tearing event”, **how else do we change the temperature by several hundred °C (or, even harder, change the composition by enough to change the rheology without changing the temperature)? We have chosen what we believe is the least astonishing hypothesis, that utilizes a known geodynamic behavior seen elsewhere in the world (lines 295-302, refs. 51-53) rather than offering a list of ad hoc possibilities.**

If instead we search for a single unifying interpretation, following widely published claims (e.g. refs. 8 10, 12, 17, 24, 32, 39, 40) of diverse evidences for a slab tear, then we are led to our single conclusion. Please see added lines 159-165. In Materials and Methods, please see added lines 424-432 justifying the interpretation of highest-amplitude NVGs as LAB, not MLD; and lines 473-475 acknowledging that the slab-tear interpretation relies on the interpretation of highest-amplitude NVGs as LAB.

Additionally, the spatial correlation between the proposed tear and surface features such as grabens is somewhat speculative and lacks mechanical justification. Deep lithospheric processes are assumed to drive surface tectonics, but without integrating robust models of stress transfer, this connection remains weak.

Our paper is about seismic observables, not about mechanical models of stress transfer. We provide examples of slab tears elsewhere that seem correlated with multiple surface effects (refs. 52-53), and present this as a likely corollary of our slab-tearing interpretation. Whether and how “Deep lithospheric processes … drive surface tectonics” **or whether surface tectonics drive deep lithospheric processes is not a debate we can resolve here – we cite ref. 33 that claims underthrusting mechanically drives the rifting; we cite ref. 39 that argued the upper-crustal rifts must be associated with “rifts” (tears) in the subducting Indian lithosphere, and analyses the strain-rate tensor and solves the stress-equilibrium equations for a four-layer**

mechanical system under plane-strain deformation; and to provide balance we also cite ref. 8 which claims (based on a supposed lack of spatial correlation between tomography and rifting) that surface tectonics and Indian underthrusting are mechanically decoupled.

Also, to me it is still hard to understand how the Tibetan crust alone can supply buoyancy and mechanical strength to raise and support the Himalayas and Tibet.

We appreciate this comment as it allows us to clarify an important aspect of our study. We wish to emphasize that our model does not suggest the Tibetan crust alone supplies buoyancy: the elevation of Tibet is ubiquitously associated with a hot mantle below a thick (~60-km) Tibetan crust where Indian crust is not part of the lithosphere, and with a "doubling" of crustal thickness (to 70 or even 80 km) where the Tethyan Himalaya or Lhasa block (and in some models even the Qiangtang block, see refs. 5, 6) is underthrust by Indian crust. Even where we argue the Indian mantle lithosphere is delaminated beneath SE Tibet and the eastern Himalaya (e.g. our Figure 4a) we clearly show Indian crust forming the lower crust well north of the Yarlung-Zangbo suture (our Figure 4c) as indicated by the Indian crustal front marked in Figure 4a. We would be happy to further clarify any aspects of this interpretation if needed.

The manuscript integrates helium isotopic anomalies from geothermal springs to support the inferred lithospheric tearing and structures. This is an important integration, but it also raises several issues. Existing studies suggest a sharp boundary in helium isotopic signatures approximately 100 km south of the Indus-Yarlung Tsangpo Suture, marking a transition from Himalayan crustal helium to Tibetan mantle helium.

We agree – this is our ref. 32.

This boundary has been interpreted as the juxtaposition of subducted Indian crust against the sub-Tibetan asthenosphere, indicating the Tibetan Plateau is supported by thickened Asian crust.

We appreciate the reviewer's comment, but wish to clarify that neither our study nor ref. 32 (as clearly shown in their Figure 4, that places Indian crust above the sub-Tibetan asthenosphere) have this interpretation. Here, as also in refs. 32 and 36, Indian mantle lithosphere detaches from Indian crust at the Moho, and Indian crust underlies the Lhasa terrane to about 30.5°N as indicated by multiple independent seismic observations of the

Indian crustal front (refs. 13–16), … While we don’t know to whose interpretation the reviewer is referring, we’d be happy to further discuss this interpretation if additional clarification would be helpful.

Such a model it is difficult to reconcile with the limited syn-collisional shortening of the Asian plate, the Indian affinity of exhumed Himalayan units,

Our model actually accommodates these important observations well: so Indian crust continues to provide isostatic support, extends far enough north to be reconciled with limited syn-collisional shortening occurs at the Moho and far enough north to provide Indian-affinity source material for the exhumed Himalayan units.

and evidence for crust-mantle mechanical coupling.

We would be happy to consider any specific evidence the reviewer might wish to share about such evidence and its location that could further inform our interpretation, but we don’t know to what s/he is referring. As noted in our manuscript, “Detachment at the Moho is plausible because the Moho is the weakest intra-lithospheric zone in simple jelly-sandwich strength models, being the deepest/hottest quartz-/feldspar-dominated rocks[44]”.

Furthermore, the assumption that geothermal spring systems extend to depths exceeding 70 km – where mantle sources are proposed – may not be physically viable given the physical limitations of fluid pathways at such depths.

We wish to clarify that our study does not propose geothermal spring systems extending to mantle depths exceeding 70 km – nor does ref. 32 make such a claim, as the reviewer may be intending to imply. Our current understanding, supported by ref. 32’s supplementary materials, is that the spring systems circulate only to the base of the brittle crust, and there scavenge tiny amounts of mantle fluids that have infiltrated the crust driven by gravitational forces and interfacial energy of equilibrium geometries on the ductile crust.

Could there be an interlayered mantle lithosphere at ~50 km depth between Indian and Tibetan that could explain the regional helium isotope patterns? Probably the SRF wouldn’t allow for the relatively thin layer to be imaged, as don’t many tomographic models. However, numerical simulations and recent high-resolution lithospheric tomographic models provide some hints.

The reviewer's suggestion about a potential interlayered mantle lithosphere at ~50 km depth seems like a commentary on ref. 32 about helium isotope patterns. We speculate the reviewer is suggesting a relatively thin layer of mantle (of what affinity?) interdigitated (how?) above 20 km of Indian crust (as we know the Moho is at ~70 km depth). It is unclear to us how this could create the helium isotope patterns unless temperatures at 50 km approach the ultramafic wet-melting curve which in turn would imply extensive crustal melting both above and below this unusually hot layer, for which there is no evidence (no young volcanics). We would be interested to examine the "numerical simulations and recent high-resolution lithospheric tomographic models provide some hints**" the reviewer mentions, as these could provide valuable insights for future research directions; however, s/he does not cite these sources.**

The implications of lithospheric tearing for seismic hazards are mentioned but are weak. The authors speculate on a causal link between the inferred tear and the seismic gap near the Kopili fault, yet they fail to present convincing evidence to support this relationship. Intermediate-depth seismicity south of the inferred tear is notably absent, but this observation could be explained by mechanisms unrelated to tearing, such as variations in crustal composition or rheology. Without more rigorous exploration of these possibilities, the seismic hazard inferences remains speculative.

We appreciate the reviewer's comment regarding the connection between lithospheric tearing and seismic hazards. We agree the association between slab tearing and the Kopili fault is speculative, and we have more clearly flagged this, now writing: (lines 320–323): "We speculate that our observed slab tear, the Kopili strike-slip fault in the lower (Indian) plate, and the Cona-Sangri graben in the upper (Tibetan) thrust plate form a vertically coupled system." However, we believe that the spatial association justifies our speculation that the system is vertically coupled and may affect seismic hazard inferences.

The manuscript makes a valuable attempt to address lithospheric dynamics in southern Tibet,

Thank you for your affirmation.

but it's hindered by interpretative biases,

We agree that we have an interpretive bias – All scientific investigations inevitably involve some degree of interpretation when analyzing new data, and our conclusions reflect our current understanding of the evidence. While we recognize that alternative interpretations may exist, our findings appear consistent with and build upon the framework established in ref. 32, with which the reviewer seems to disagree. We welcome further discussion about how different interpretations might explain the observed data patterns, as this dialogue ultimately advances our collective understanding of southern Tibet's lithospheric dynamics.

insufficient consideration of alternative models,

We appreciate the reviewer's suggestions regarding alternative interpretations of our data. While we have carefully considered their suggested possibilities, we note that the proposed alternatives - such as "interlayered lithospheric structures or partial melt zones**" and "**compositional or thermal gradients within the lithosphere**" - remain conceptual and would require more specific parameterization to permit rigorous testing against our seismic observations. Regarding the particular suggestion of "**an interlayered mantle lithosphere at ~50-km depth between Indian and Tibetan that could explain the regional helium isotope patterns**", we note that this suggestion attempts to explain the helium isotope patterns in ref. 32, whereas our current study focuses specifically on seismic structures below 80 km depth that cannot be explained be a shallower structure. We would be very interested to consider any more detailed alternative models that could be directly compared with our seismic datasets.**

and speculative integration of supporting data. I'm sure that a more critical incorporation of existing geophysical and geochemical results would be essential to strengthen its conclusions.

We appreciate the feedback. While we believe our study has carefully considered a wide range of geophysical and geochemical evidence - including works that present alternative interpretations to our conclusions - we acknowledge there may have been room for clearer presentation of our arguments. In particular, we realize that our use of the term "delamination" may have caused some confusion, as some readers might interpret this to imply removal of both mantle and crust. To address this, we have now explicitly clarified in both the Abstract (line 19) and Conclusions (lines 337-338) that our model specifically proposes delamination of Indian mantle from Indian crust, with subduction rollback limited to the mantle portion. Regarding ref. 32, we note that while its conclusions remain subject to

ongoing scientific discussion, they have been extensively cited (~100 citations) without published rebuttals to our knowledge. We appreciate this opportunity to refine our manuscript and hope these clarifications help address the reviewer's concerns.

Reviewer #2 (Remarks to the Author):

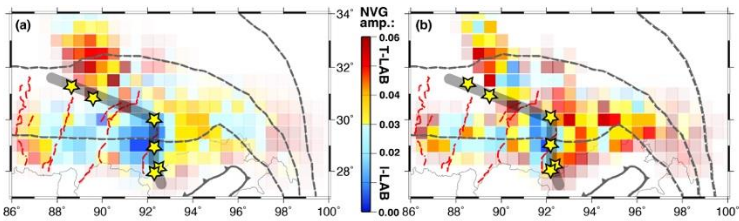
This manuscript uses S-wave receiver functions (SRF) to map the lithosphere-asthenosphere boundary (LAB) beneath southeastern Tibet. The authors' auto-pick the maximum negative velocity gradient in the SRFs between 80 and 220 kilometers depth and associate this with the LAB. The authors have access to a spatially dense dataset for this region allowing them to map the LAB beneath Tibet at higher resolution than previously possible. Applying this approach, they discuss an ~30 km difference to the depth of the LAB (~160 km to ~130 km L99-100) across the study area. Arguing that the thicker lithosphere reflects the Indian plate and thinner lithosphere Tibet, the authors' draw on additional lines of evidence to suggest a tear in the Indian lithosphere beneath Tibet.

The India Asia collision remains the best place to study active continental collision. Those interested in the architecture of continental collision and/or vested in the structure of Tibet will find the results interesting though some may argue with the authors' interpretation. The paper is well written, the arguments the authors' make in support of their interpretation are clearly presented, and the figures and data presented provide sufficient detail for others to independently assess the authors' interpretation.

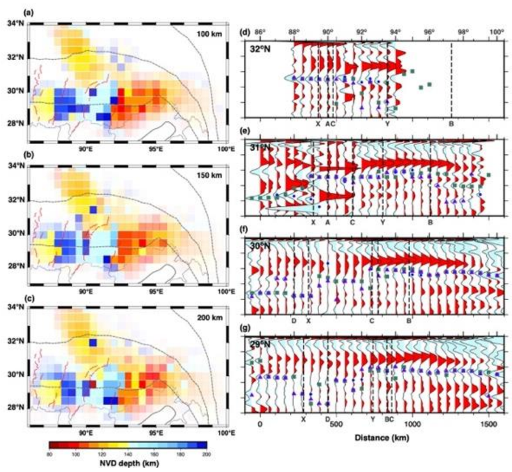
Thank you!

The analysis would be strengthened by taking into account dip, anisotropy, 3D velocity variations, and modeling of amplitudes. That said, these additional analyses are beyond the scope of work as presented and do not necessarily preclude publication of the current results.

We agree. Modelling dip, anisotropy 3D wavespeed, and amplitudes would lead to a far longer paper. However, we have added a new Supplementary Figure S10 showing that the NVG amplitudes are consistent with our interpretation;



and a new Supplementary Figure S11 implying that our conclusions are unchanged even with very significant velocity variations.



However, both the data product (SRFs), original waveforms, and metadata need to be made publicly available without restriction in an open access data archive. This is standard practice in seismology and is required to meet the journal's editorial and publishing policy regarding availability of data "to interpret, verify, and extend the research in the article." Open data access and reproducibility of results is essential for peer-reviewed science to be credible and to meet the standard of publication in Communications Earth & Environment, part of the Nature Portfolio.

We absolutely support release of data, and have now, even in advance of acceptance of our paper, uploaded all metadata and all SRFs to an open data repository https://doi.org/10.25740/tw217zv1829, linked from the revised manuscript (lines 508-509).

Additional comments follow:

The manuscript title is quite specific in stating that the "Indian lithospheric plate is tearing apart beneath Tibet." The second sentence of the abstract modifies this statement to "tearing or warping of the Indian Plate". The authors focus their interpretation on a tear in the Indian slab but then again mention warping as a possible explanation of the SRFs toward the end of the discussion section (L263). The difference between a lithospheric tear or a continuous lithosphere that is warped is significant. The latter interpretation is plausible given the SRFs presented in the manuscript.

Thank you, Reviewer#2, for requiring us to be more specific. We have added a short section to Materials and Methods ("*Is the LAB torn, or only warped?*", lines 472-486). We calculated the minimum dip angles of the LAB if the lithosphere is warped, not torn, between adjacent observations of Indian and Tibetan LAB. Although there certainly places in the data-set where the LAB could have a dip as small as 15° (50-km vertical step across 100-km data gap) that could represent a warp, in the best-sampled areas (along 31°N, Figure 2c) we measure a 100-km vertical step across a 50-km trace spacing, for a minimum dip of 60°, implying an impossibly tight radius of curvature for a mechanical lithosphere, hence surely a tear. We have therefore strengthened our language throughout, starting with the abstract, lines 25-26: "the subducting Indian Plate is torn along the convergence direction". We modified Figure 4 to say Slab Tear, as opposed to Tear or Warp?.

Specifying objective criteria for identifying positive and negative excursions as a basis for interpretation of receiver functions is a step forward. It serves as a good launch point for interpreting first order velocity discontinuities in Earth structure and linking these to structure and process.

Thank you!

The authors use objective criteria to identify the excursions they interpret as the LAB. Are there objective criteria to differentiate I-LAB and T-LAB and to map the transition between the two (gray bar Fig 2f)? The SRFs exhibit considerable complexity within the regions classified as I-LAB and T-LAB as well as in the area mapped as the transition between the two. Figs. S2, S3, and S4 show considerable complexity in the SRF themselves as well as the depth to the maximum NVG (especially figures S2 e and j). There is an apparent divergence between auto picks and "constraints" where profiles intersect (Figure 2). The west to east shift between blue and red at 92° is clear between ~28° to ~32° in Figure 2a, the jog to the northwest perhaps not as much. It may be an issue with the color palate but the northwestern most star which accentuates the jog seems to be in an area where there is no data. The depth to the LAB in figures S2 e and j (at higher resolution) show considerable lateral variation at smaller scale suggesting interesting and likely significant complexity not represented in Figure 2 or its smoothed version in figure 3 which forms the basis of interpretation.

We thank the reviewer for their detailed comments on the complexity of the SRF data and the interpretation of the LAB. We appreciate the opportunity to clarify our methodology and address the concerns raised.

Regarding the objective criteria for differentiating I-LAB and T-LAB, we have used a combination of depth, amplitude, and spatial continuity to distinguish between the two. Specifically, I-LAB is identified by deeper NVGs (typically >160 km) and weaker amplitude with consistent spatial patterns, while T-LAB is characterized by shallower NVGs (typically <130 km) and greater amplitude. We have added figures showing the NVG amplitudes (Figure S10) and the variation in NVG depths when stacking with different piercing-point depths (Figure S11). All those are consistent the gray line in Figure 2. In addition, Figures S3 and S4 have been updated with the second and third largest NVGs. The transition between I-LAB and T-LAB is mapped based on the gradual change in NVG depth and amplitude, as indicated by the gray bar in Figures 2a,f and S10. We acknowledge that the SRF data exhibit considerable complexity within these regions, as highlighted by the reviewer, but now explicitly state in the manuscript (lines 116-118) that we have preferred to under-interpret the data.

Moveout corrected SRFs were stacked based on piercing points at 150 km depth using the 1D IASP91 velocity model. If the LAB depth varies laterally, so do the piercing points. IASP91 was also used to convert from time to depth. This study, and many other studies (every study?), and multiple tomography models for Tibet show that structure and velocity vary in 3D across Tibet. This needs to be taken into account stacking receiver functions and converting from time to depth. ±5% (L32-33) can make a difference and should be assessed. Using 1D models is often justified by investigators to avoid bias due to uncertainties in or between 3D models but when used in areas that clearly have significant 3D velocity variation introduces error. There are sufficient data available in Tibet to quantitatively assess the influence of velocity heterogeneity on receiver functions.

We agree with the reviewer that the use of 1D velocity models for stacking SRFs and converting from time to depth deserves more comment – see added lines 436-440 in Materials

and Methods. We acknowledge that the IASP91 model may introduce errors in regions with significant 3D velocity variations, such as Tibet. To address this concern, we additionally stacked SRFs at different piercing point depths (100 km, 150 km, and 200 km) and compared the results (Figure S11). These analyses show that the overall patterns of LAB depth variations are robust, although there are minor differences in the absolute depths. Because of the trade-off between wavespeed and depth, this analysis is equivalent to showing that our images are robust to large absolute velocity changes, and is a proxy for a full 3D analysis.

Certainly, using the correct 3D velocity model would provide a more accurate representation of the subsurface structure, but there is still considerable disagreement within the seismic-tomography community about the correct 3D structure. We believe that our current approach, combined with the additional analyses described above (stacking at different piercing-point depths), provides a sensible foundation for interpreting the LAB depth variations.

As the authors acknowledge (L351 354) a prominent negative excursion is observed above the auto-picked deep excursion with amplitudes close to those auto-picked. It would be useful to compare amplitudes of the prominent negative excursions within stacked SRFs to determine how much difference there is.

We have now done this in Supplementary Figures S3 and S4, plotting all negative trace excursions that have amplitudes up to 50% of the maximum amplitude on each trace. This process shows us that the "prominent negative excursion observed above the auto-picked deep excursion**" is the most sensible interpretation of the LAB here, despite the deeper maximum amplitude NVG (see lines 398-400).**

It would also be useful to map amplitudes of the auto picked LAB across the study area to compare amplitudes of SRFs classified as I-LAB vs T-LAB. Amplitudes of the auto-picked maximum NVG in S3 and S4 seem to vary in similar ways regardless of whether they've been classified as I-LAB or T-LAB. As presented, those classified as I-LAB are not noticeably weaker than those classified as T-LAB.

We've now done this mapping, and added Supplementary Figure S10 (see also lines 420-423). It is clear that the deeper I-LAB trends to lower amplitudes than the shallower T-LAB, particularly when using the 1° radius bins (Figure S10a) but also for 0.5° bin (Figure S10b).

It's worth considering the intervening Lhasa block and how structure at the base of the magmatic arc might influence present day structure as observed in receiver functions.

We appreciate these suggestions as showing that we need to do a better job in describing how we had already ruled out alternative hypotheses. We believe the present-day structure at the base of the Gangdese arc in the Lhasa block corresponds to the SRF boundary between underthrust Proterozoic lithosphere and active rollback/delamination of Indian mantle lithosphere. Figure 2 shows the presence of a doublet above I-LAB west of the SRF boundary, but not above T-LAB east of the SRF boundary. This doublet, characterized by two prominent negative excursions, is widely held to be an eclogite layer requiring refrigeration by subjacent Proterozoic mantle, and cannot exist directly above Tibetan Neogene mantle. Although we discussed this in lines 191-206, we have added one sentence (lines 206-208) clarifying that the disappearance of the doublet is not likely to be related to the structure of the much older magmatic arc. We also annotated Figure 4c with this point.

The original geometry of Indian plate as it collided with Asia also needs to be considered. Depending on this geometry and post collisional evolution the leading edge of the slab could be long gone beneath the study area with present day variations in lithospheric structure reflecting the edge of the Indian indentor approaching the Eastern Syntaxis.

We certainly agree that the leading edge of the subducting slab is long gone, as oceanic subduction of the Neo-Tethys Ocean has been underway at least since the Triassic (e.g. our ref. 1). But a large west-to-east change in the northern limit (leading edge) of the Indian cratonic indentor cannot be the cause of the changing LAB signature, if we accept prior mapping of the Indian crustal front as a continuous smoothly varying boundary at 30–31°N (Figure 4a), and we have added a sentence to this effect (lines 211-214).

While perhaps unintentional, at multiple places in the manuscript the authors refer to prior studies as subjective, model driven, and/or glossing over complexity, implying potential implicit or explicit bias. This may not be the authors intent, but the phrasing potentially has this impact. Unless these statements are evidence based, adopting more neutral phrasing might be appropriate. Beyond this, as this manuscript illustrates, models are one of the tools used to explain the available evidence.

In the revised manuscript, we have carefully revised these statements to adopt more neutral phrasing, ensuring that our critique is evidence-based and fair.

A few minor additional suggested modifications follow:

L14 – why are there quotes around underplating and subducting? Suggest removing.

We have removed the quotes.

L20 – the meaning of interposed in this context is unclear. Suggest rephrasing.

We have rephrased the sentence to clarify the meaning of interposed (Lines 20-21).

L 21 - nascent means just coming into existence, just beginning, or incipient. Perhaps use another word. Tibetan LAB is clearly labeled in every figure and discussed throughout the manuscript, so is presumably present not nascent.

We understand the reviewer's comment regarding "nascent." While we agree that the Tibetan LAB is always present, we emphasize that the Tibetan lithosphere is nascent – gradually coming into existence and growing thicker as asthenospheric mantle is cooled by the refrigerating signal propagating downwards from the overlying crust.

L 91 – perhaps differentiate the 94 station west-east array (previously unpublished SRFs) on figure 1.

We have updated Figure 1 to highlight the new stations used in this study, and not included in previously published SRF studies; and we have corrected the erroneous "94 station" statement (lines 92-94) with the correct number of new stations (333).

The depth scale in figure 2 appears mislabeled (red shallower LAB is labeled as I-LAB, deeper blue LAB is labeled as T-LAB, these should be reversed. Fig S6 is similarly mislabeled.

Thank you so much for catching this! We have corrected the labeling in Figures 2 and S6.

L 113-114 – add description of smoothing.

We have added a description of the smoothing process (Lines 120-122).

The link to seismic hazards in the last paragraph seems to come out of nowhere and lacks context. If this is a major point of the manuscript it needs to be better developed.

We thank the reviewer (and editor) for highlighting the need to better integrate the seismic hazard discussion. We have added more details, and we hope improved the logical flow in the revised manuscript (Lines 303-326).

I don't follow the logic in L377-381. Just because previous studies have not interpreted mid-lithospheric discontinuities it doesn't necessarily follow that "it is therefore appropriate to call the deep converter the I-LAB."

We have now spelled out our logic, in lines 424-435, explaining that if our I-LAB was actually an MLD then the real I-LAB would be far deeper than all previous estimates using surface waves and tomography, that are regarded as more reliable than SRF alone.

Reviewer #3 (Remarks to the Author):

Comments:

The manuscript entitled "Indian lithospheric plate is tearing apart beneath Tibet" (Ref: COMMSENV-24-3417-T), authored by Lin Liu, Danian Shi, S. L. Klemperer, primarily emphasizes mapping depths to the Indian and Tibetan lithosphere-asthenosphere boundaries (LAB) across a substantial region of south-eastern Tibet. The authors use 3D S-receiver functions (SRF) to map LAB. The authors delineate a contrasting structure across a significant east-west transect, demonstrating orogen-perpendicular tearing and slab rollback of the Indian Plate. The manuscript integrates extensive seismic data and corroborates its findings with independent geochemical and seismotectonic evidence, contributing significantly to understanding lithospheric dynamics in the Himalayan-Tibetan orogeny. The study employs 4,051 SRFs from 462 broadband seismic stations and significantly improves the spatial resolution compared to previous studies.

The scientific content of the work is interesting, however, the manuscript needs some minor revisions before accepting for publication. Some of the suggestions and queries are mentioned below:

i) In Figure 2a, I can see the yellow stars but where is the grey boundary? The grey boundary is however visible in Fig. 2f.

Apologies; we have modified Figure 2a and added the grey boundary as in Figure 2f.

ii) In the SRF plots, it is observed that I-LAB is dipper than T-Lab but the colour scale used in Fig. 2a is confusing where deeper LAB (blue) is marked as T-LAB and shallow LAB (red) is marked as I-LAB.

Apologies; we marked the color scale in error and Figure 2 has now been corrected.

iii) A large scattering of blue dots represents large variations of LAB depths even between two groups of consecutive piercing points. How can it be interpreted?

Most authors simply draw a manually smoothed interpretive line through their preferred LAB converter. We added a preliminary stage – auto-picking the highest negative amplitudes – which leads to the large scatter in Figure 2, before carrying out our interpretive smoothing. We have now modified Figures S3 and S4 to show also the second and third highest negative amplitudes where these have amplitudes >50% of the most negative peak. Close inspection of Figures S3 and S4 shows that where there are "large variations of LAB depths even between two … consecutive piercing points**" it is common to find only slightly lower-amplitude negative excursions at depths far more consistent with the regional LAB depth. During our interpretive smoothing (Figure 2 transparent pink and blue overlay; Figure 3) we utilize these slightly lower-amplitude NVGs instead of believing the most scattered auto-picked results. Additional variability of LAB depths will be created by unmodelled effects of dip, anisotropy and 3D wavespeed variation, as we show in Figure S11by re-stacking the data with different assumed piercing point depths.**

iv) Fig. S1 needs to be rechecked. For example, in Fig. 1 of Zhao et al., (2011), the coloured bars indicated LAB observations: blue=India, green=Asia, red=Tibet. These observations have not been portrayed correctly in Fig. S1.

Figure S1 has been corrected.

v) The results and interpretations are well written, however, there are minor grammatical omissions, which require complete checking throughout the manuscript.

We have thoroughly revised the text to address grammatical issues.

vi) The references given in the manuscript should be cross-checked with the reference list.

We have cross-checked the in-text citations and the reference list carefully.

I found the manuscript interesting for understanding the detailed upper-mantle geometry of continental collision.

I recommend the manuscript for publication in the journal after a minor revision.

Excellent! Thank-you!

REVIEWERS' COMMENTS:

Reviewer #1 (Remarks to the Author):

Thank you to the authors for addressing all my comments in detail. The revisions and clarifications provided have fully resolved my concerns, and I recommend this manuscript for publication.

We sincerely appreciate the reviewer's recognition of our revisions. We are grateful for the constructive feedback during the review process, which has significantly strengthened the rigor and clarity of this work.

Reviewer #2 (Remarks to the Author):

The major claims of the revised manuscript remain the same as the previous submission. This manuscript uses S-wave receiver functions (SRF) to map the lithosphere-asthenosphere boundary (LAB) beneath southeastern Tibet. The authors' auto-pick the maximum negative velocity gradient in the SRFs between 80 and 220 kilometers depth and associate this with the LAB. The authors have access to a spatially dense dataset for this region allowing them to map the LAB beneath Tibet at higher resolution than previously possible. Applying this approach, they discuss an ~30 km difference to the depth of the LAB across the study area. Arguing that the thicker lithosphere reflects the Indian plate and thinner lithosphere Tibet, the authors' draw on additional lines of evidence to support their interpretation that the SRFs indicate a tear in the Indian lithosphere beneath Tibet.

Those interested in the architecture of continental collision and/or vested in the structure of Tibet will find the results interesting though some may argue with the authors' interpretation. The paper is well written, the arguments the authors' make in support of their interpretation are clearly presented, and the figures and data presented, including additional supplementary figures, provide sufficient detail for others to independently assess the authors' interpretation.

It is good that the data product (SRFs and metadata) are available, but also insufficient. The authors did not address the availability of the original waveforms and metadata. In order for this manuscript to be published, the original waveforms, and metadata must be publicly available, openly accessible without restriction in an open access data archive. A number of peer reviewed journals of similar stature would not have even sent this manuscript out for review without the raw waveforms and metadata being openly accessible at the time of publication. This is a standard that is applied uniformly across all countries. The raw waveforms and metadata must be openly accessible and available in an open access archive without restriction to meet the journal's editorial and publishing policy regarding availability of data "to interpret, verify, and extend the research in the article."

The SRFs are quite complicated. While the methods applied are well-described, other methods are required to unequivocally support the authors interpretation and conclusions. Readers familiar with receiver functions, analysis and interpretation will understand this. A risk is that readers without this expertise may not and therefore accept the interpretation/conclusions at face value. The authors interpretation is model driven. That's ok, but it remains essential that publication of this manuscript require the raw waveforms and metadata be openly accessible without restriction to allow for additional analysis. The Himalayan orogen and Tibetan Plateau provide an exceptional opportunity to study continental collision and evolution of continental lithosphere. To do so, requires that all options are open to explore the full potential of data to shed insight into these processes.

Thank you for your positive comments on our work and for your thoughtful emphasis on data accessibility.

As previously noted, we fully support the principle of data sharing and have taken steps to make our derived datasets publicly available. We have uploaded all metadata and SRFs to an open data repository at https://doi.org/10.25740/tw217zv1829, as detailed in the revised manuscript. These datasets are fully accessible to the scientific community to facilitate reproducibility and further analysis.

Regarding the original waveform, we regret that we are unable to publicly share these due to the terms of our data-sharing agreement with the data providers. The journal Communications Earth & Environment does not mandate the public release of original waveforms as a condition for publication. However, we remain committed to facilitating scientific collaboration and are willing to assist interested researchers in accessing the raw waveforms through appropriate channels, subject to the terms of our agreements with the data providers.

We understand the importance of original waveform for alternative analyses, and we believe that our derived datasets provide a robust foundation for exploring the lithosphere-asthenosphere boundary beneath Tibet. We have also taken care to thoroughly describe our methodology to ensure that our approach is transparent and reproducible.

We hope that this clarification addresses your concerns and appreciate your understanding. We remain dedicated to advancing open science and enhancing the accessibility of our work within the constraints of our data-sharing agreements.