Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-119-AC2, 2019


Solid Earth
Discussions
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# *Interactive comment on* “The formation of North-South Seismic Zone and Emeishan large igneous province in Western China: Insight from teleseismic tomography” *by* Chuansong He

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Received and published: 29 September 2019

Interactive comment on “The formation of North-South Seismic Zone and Emeishan large igneous province in Western China: Insight from teleseismic tomography” by Chuansong He Irene Bianchi (Referee) irene.bianchi@univie.ac.at Received and published: 22 September 2019

This study presents a teleseismic tomography of the North-South Seismic Zone in the eastern part of China, a region of high seismic hazard. The results illustrate the presence of a plate-like high velocity anomaly (at 400-500 km depth) and two low velocity anomalies (at 50-200 km depth) which are interpreted in terms of asthenosphere up-



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welling and absence of a rigid lithosphere. The manuscript submitted by C. He presents several relevant issues. First of all, and most important, there are already 5 publications of this author on the same area (approximately LON: 96-112E and LAT 26-40N) and with the same applied methodology (teleseismic tomography). I looked inside all these previous publications and found out that in this manuscript: (a) the investigated area overlaps about 80% with the area investigated in the previous papers; (b) few more stations (<30%) and (c) few more data(about 5%) have been added with respect to previous works. All these aspects have been totally overlooked by the author, in particular, the Data and Methods section did not mention if any of the used teleseismic data has been previously analyzed in the former studies. But, comparing the teleseismic distribution presented in Figure S1 with the event distribution shown in other papers (He et al., 2019, Figure 1 inset), it is clear that same set of data have been used (easy to recognize looking to the few events occurred in Europe). The author should have mentioned carefully the need of a further teleseismic tomography of the same region.

Response to reviewer's comments: Thank you for this comment. I have added the paragraph below to the introduction section: Although the data collected by this study have been used in previous tomographic analyses of the relatively small region, the comprehensive NSSZ data have been used for the first time. Specifically, a tomographic study has not been performed on the overall situation of the NSSZ, and such work is very important for understanding the formation and global characterization of the NSSZ. By performing a global tomographic study on the NSSZ, I can compare different parts of the NSSZ, such as its northern part, middle part and southern part, and obtain more information on deep structure.

I have added the paragraph below to the data and methods section: The time cross-correlation technique was used to select 89326 P-wave travel-time arrivals (VanDecar and Crosson, 1990), which is higher quantities compared with that of previous tomographic studies (e.g., He and Santosh, 2017a, b; He and Santosh, 2016; He and Zheng, 2018).





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Because I used data recorded by the China Seismic Network, the events may be similar to that of previous studies. However, the events recorded by the number of the seismic stations is different, which can be reflected in the difference in the P-wave arrivals. In this study, I selected 89326 P-wave arrivals (I apologize for writing 14492 P-wave arrivals in the previous manuscript, which was a mistake), which is far higher than that of previous topographic studies. A number of tomographic analyses have been carried out, including in our previous works; however, a tomography study on the overall situation of the North-South Seismic Zone has not been performed, and such work is very important for understanding its formation. Through the global tomographic study on the North-South Seismic Zone, I can compare different parts of the North-South Seismic Zone, such as its northern part, middle part and southern part and obtain deeper structural information.

The tomographic model presented here is the same tomographic model presented in the previous work (i.e. He et al., 2019),where the higher detail of the presented model might be due just to the higher damping value used in the current (submitted) version. In the presented figures, similar depth slices and same depth profiles as the previous work are shown, they carry a higher detail, which is not justifiable by the increased amount of data (just +5%) or increased amount of stations (due to the fact that the larger number of stations is given by the enlargement of the study area towards the South). Moreover, when previous work of the same author on the same area and with the same methodology exists, the good practice and the rigorous scientific method, impose to clearly and exactly state what are the differences that the current version of the work presents with respect to the previous work and the improvements need to be highlighted. In the actually submitted version of the manuscript this is lacking, and therefore this work wants to appear as completely new, while it is a replica of the many previous works of the same author. Such practice, which unfortunately is becoming diffuse in the scientific community has to be stopped.

Response to reviewer's comments: Thank you. Following the L-shaped curve norm (Hansen, 1992; Lei and Zhao, 2007; Lei et al., 2009), a damping value of 12.0 was selected to invert the 3-D velocity model (Fig. S3) rather than the higher damping value used in the current (submitted) version. In this study, I collected 89326 P-wave arrivals, which is higher quantities than that in previous local tomographic studies. Although tomographic studies have been conducted in this area, they are all small region tomographies, which cannot provide a global characterization of the North-South Seismic Zone. Specially, recent tomographic studies indicate that large-scale low- and high-velocity anomalies cannot be well defined by relatively small-region tomographies and some important and large velocity structures should be further checked by relatively large-region tomographies (Bastow, 2012; Chen et al., 2017).

The new findings are presented below: The results identified by this study not only demonstrate a large-scale high-velocity anomaly with a plate-like appearance beneath the Songpan-Ganzi Block at a depth of 400-500 km but also identified another large-scale high-velocity anomaly under the Yangtze and Cathaysia blocks at a depth of 300-400 km, which is new findings. Tomographic images show two large low-velocity structures at a depth of 50-200 km in the western and southern parts of the study region. These findings imply the large-scale upwelling of the asthenosphere and the absence of the rigid lithosphere in these areas, which might be associated with the large-scale delamination. These findings provide new and important information for understanding the formation of the NSSZ and ELIP and do not represent a replica of the many previous works by the same author. Specifically, I have provided different models for the formation of the North-South Seismic Zone, such as its southern part, which has a distinctive earthquake formation mechanism, which is different than the mechanisms of the northern and middle parts. I further demonstrated that the formation of the Emeishan LIP might be associated with the mantle upwelling rather than the upwelling mantle plume. ——————————————————————————

The previous papers which I am referring (listed also in the references of the





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manuscript) are the following: He, C. S., and Santosh, M.: Crustal evolution and metallogeny in relation to mantle dynamics: A perspective from P-wave tomography of the South China Block, Lithos,263, 3-14, https://doi.org/10.1016/j.lithos.2016.06.021, 2016. He, C. S., and Santosh, M.: Mantle roots of the Emeishan plume: An evaluation based on teleseismic P-wave tomography, Solid Earth, 8, 1141-1151,https://doi.org/10.5194/se-2017-17, 2017. He, C. S., and Santosh, M.: Intraplate earthquakes and their link with mantle dynamics: 457 Insights from P-wave teleseismic tomography along the northernpart of the North–South Tectonic Zone in China, C. R. Geosci., 349, 96-105,24https://doi.org/10.1016/j.crte.2017.04.002, 2017. He, C. S., Santosh, M., and Yang, Q. Y.: Metallogeny linked to mantle dynamics in the Sanjiang Tethys region as inferred from P-wave teleseismic tomographic study, Ore Geol. Rev., 90, 1032-1041, https://doi.org/10.1016/j.oregeorev.2016.10.018, 2017. He, C. S., and Zheng, Y. F.: Seismic evidence for the absence of deeply subducted continental slabs in the lower lithosphere beneath the Central Orogenic Belt of China, Tectonophysics, 723, 178-189, https://doi.org/10.1016/j.tecto.2017.12.018, 466 2018. He, C. S., Dong, S. W., and Wang, Y. H.: Lithospheric delamination and upwelling asthenosphere in the Longmenshan area: insight from a teleseismic P-wave tomography, Sci. Rep., 9, 6967, https://doi.org/10.1038/s41598-019-43476-0, 2019.

Response to reviewer's comments: The above works are all focused on small region tomography, which cannot define the global features of the North-South Seismic Zone.

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Other issues of this work include the following: The methodology section is synthetic and does not allow evaluating the quality of the work. The author refers to previous publications about the methodology and lists them, but does not illustrate the steps done for obtaining the tomographic images. More details on the methodology are needed in order to evaluate this work.

Response to reviewer's comments: Thank you for this comment. In this version, I have provided the steps of the tomographic inversion.

â ÌĘA ÌĄIIt is not clear what is the reference velocity for the tomography images, the color-scale in the figures shows a dVp velocity anomaly, but does not say with respect to which values, which instead is critical for understanding the meaning of the perturbations. The labels in the figures are too small to be read (300% zoom is needed to read the labels).

Response to reviewer's comments: Generally, the velocity anomaly of the upper mantle inferred from tomography uses dVp rather than Vp. In this version, I have revised and redrawn all the figures and the labels were enlarged. ——————————————————————

Concerning the data, it is not specified which network was operating simultaneously with the other. 585 teleseimic earthquakes have been used, but it's not described which of the 5 networks has recorded them, simply a list of the networks used and when they were operating is given in the manuscript.

Response to reviewer's comments: In this version, I have added the space and time information for every seismic network. ——————————————————————

The resolution tests shown in the supplementary material are not meaningful. According to these, the model retains the same resolution at 50 as well as at 800 km depth (I mean that the resolution is all the same between 50 and 800 km depth). I cannot understand how this is possible. The teleseismic rays are crossing the medium beneath the station with different spacing at the different depth, therefore this makes me think that the checkerboard tests show an unrealistic resolution.

Response to reviewer's comments: In fact, the resolution is different at different depth sections. Specially, the resolution at depths of 50 and 800 km is poorer than that of the other depth sections. ——————————————————————

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