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Interactive comment on "Tempo-spatial variation of the late Mesozoic volcanism in Southeast China testing the western Paleo-Pacific Plate subduction models" *by* Xianghui Li et al.

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Reply to Referee #1

We appreciate referee #1 for the many constructive comments and helpful suggestions. Below are point–to-point replies to the comments.

–While the data are plentiful and important, the interpretation of the data is presented in a non-scientific fashion, so the logic behind the conclusions and the importance of the data are lost. The combined dataset shows a spectrum of dates that range

mostly from ca. 150-160 Ma to 90 Ma with one well defined peak at 132.9 Ma and another subordinate peak at 99.9 Ma. A bimodal distribution in ages seems robust, but this simple message is lost by (1) trying to divide South China into sub-blocks and examining age distributions independently by block, (2) too finely discussing potential age-modes (up to five), and (3) over-interpreting the spatial and temporal distribution of the ages in a tectonic reference frame.

–(1) Splitting South China into two tectonic terrains, SHTB and CZ, for a Mesozoic problem is highly questionable. There is no difference in Nd model ages between the two, suggesting their basement histories are identical. If there is a difference, then it was inherited long prior to the Mesozoic, so the designation has little meaning for the present study. Like the authors show themselves in Figs 2a and 2b, there is no difference in the general age spectra between the two. I recommend taking this out completely, otherwise you need to justify it.

Reply:

We agree that there is no difference in Nd model ages between the two tectonic-basin units and both could have the same basement histories in the late Mesozoic. However, the SHTB (rifting strike-slipping / back-arc) and CZ (magmatic arc) have been widely used in the literature (e.g., Gilder et al., 1996; Chen et al., 2005; Shu et al., 2009; Jiang et al., 2011; Yang et al., 2012) . Therefore, we kept the SHTB and CZ description in both the "Geological setting" and the "Results" sections, and in Figure 1. We have deleted them in the "Discussion" section and figure 5 (age spatial distribution map) in the revised version.

–(2) I cannot understand why the ages were separated into five discrete populations. Is there any statistical reason for this? If you insist on so finely interpreting the data, then you need to have statistical grounds to defend it. If one had five dates that were distinct by 1 Ma each, could this be used to argue for five separate age populations? How much data are needed before designating that a single age population has meaning? What seems robust to me is that when enough (N = ?) data are acquired, one very robust peak appears at ca. 133 Ma and a secondary one at ca. 100 Ma. How much is this conclusion biased by arbitrary (geologically speaking) sample selection? What if you obtained 48 new dates from other basins? Applying more rigorous statistical methods would significantly improve the paper as a scientific contribution.

Reply:

We thank the reviewer for the constructive suggestion and advice. We did not discuss too finely about the age-models in the revision.

–Since southeast China had a basin and range-type setting in the Mesozoic, it seems likely the basins would preserve extrusive volcanic rocks, whereas these rocks would be eroded at the horsts (positive topography) to reveal the subterranean feeders (magma chambers) that fed the extrusive rocks. If true, can one also use the dates from the plutonic rocks to get an even better idea of the age distribution of volcanism + plutonism in South China? It would be very interesting if you could compare the two (volcanic vs. plutonic rocks) age distributions.

Reply:

In the late Mesozoic, the Shi-Hang tectonic belt (SHTB) in SE China is the zone that the rifting or back arc basin occupied, and the Coastal zone (CZ) is the region that range-type spread. It is sure that both of the basins (SHTB) and ranges (CZ) have preserved great numbers of extrusive volcanic rocks. It is extremely probable that the range-type (horst) volcanic rocks could have been eroded and the exposed plutonic rocks could have fed the basins. It is a great suggestion to combine the volcanic rocks with plutonic rocks to analyze the age distribution for the late Mesozoic volcanism in SE China. But some new issues would produce if we do as suggested.

Firstly, the revealed plutonic rocks in horst (CZ) could be mostly earlier than the extrusive rocks in basin (SHTB), because these plutons must have intruded into the host

rocks earlier than the covered extrusive rocks. Those coevally erupted pyroclastic matters and ashes related to plutonic magma would have already been fallen in basin and / or range in advance, and the revealed plutonic rocks must have fed the basins with weathered and transported terrigenous clastics/fragments when the covered rock are eroded.

Secondly, the probability distribution of the ages will become more complicated and even lead to the misunderstanding of the abundance as plutonic rocks could be different in age. Supposed that the revealed plutonic rocks are coeval with the extrusive rocks preserved in basins, the age distribution would become mixed and confused if we plot the ages of two kinds of rocks on the map.

Thirdly, this work focused on the volcanic eruption, and it would take much time and lots of pages to embody the extra rocks if we consider intrusive rocks in SE China. Another problem may arise if we do, that is, plutonic rocks are not representative as the extrusive rocks in age because some chamber rocks may have not been uplifted and exposed to air.

–I highly recommend that the authors examine the data, besides just the ages, (e.g., U and Pb concentrations, etc.) in more detail. Are there any trends in these variable trough time/place?

Reply:

Thank you for the high recommendation! We have carefully examined the original data of zircon U-Pb dating.

As you can see from the supplementary data Table RD2 and RD3 (zircon U-Pb isotope dating data in whole SE China), we not only carefully examined our data but also checked the concentrations and ratio of single zircon U and Pb isotopes from the cited references one by one. Particularly, we have marked and got rid of those ages with > 5% age error and abnormal U and Pb concentration and ratio that were used in those original references. In summary, we have been following the lab and data regulations (e.g., Klötzli et al., 2009; Solari et al., 2010; Li et al., 2015) of the precision and accuracy uncertainties. A figure is enclosed as attachment, showing the examination results by comparison of relative probability and histogram between single zircon 206Pb/238U ages and Th/U ratios. The examination results demonstrate the same pattern of the weighed-mean ages by rock sample.

Therefore, there are no artificial trends in age and place for both single zircons and rock samples.

–(3) Figures 5, 6 and 7, together with the text in sections 5.2 and 5.3, should be omitted. It completely detracts from the important message of the paper and has no justification.

Reply:

While it is an over-interpretation on model of the Paleo-Pacific Plate subduction by the spatial and temporal distribution of the ages from South China, the tempo-spatial variations represent an important observation of this study. So, we deleted figure 7 and section 5.3 in the revised version, and the title has been changed to “Tempo-spatial variation of the late Mesozoic volcanism in Southeast China”. We combined the previous figure 5 with figure 6 as the new figure 5. We have also made modification of both figures and text accordingly.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-76/se-2019-76-AC1-supplement.pdf

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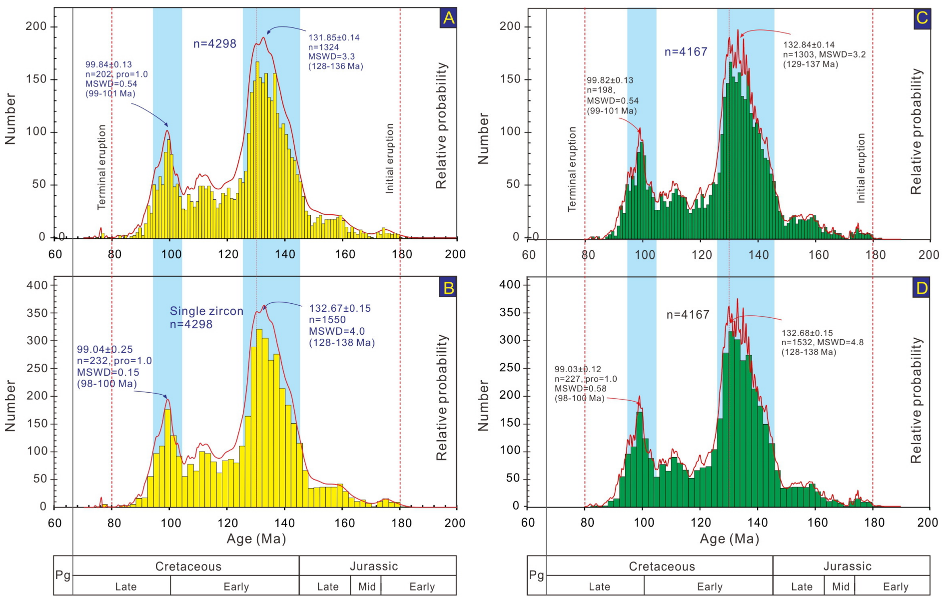
Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-76, 2019.



Comparative diagram of relative probability and histogram between single zircon $^{206}Pb/^{238}U$ ages and Th/U ratios of extrusive rock samples in SE China. A, zircon $^{206}Pb/^{238}U$ ages with 1 Myr bin; B, $^{206}Pb/^{238}U$ ages with 2 Myr bin; C, zircon Th/U ratios with 1 Myr bin; D, zircon Th/U ratios with 2 Myr bin. N = number of rock samples, n = total number of zircon grains.

Fig. 1.