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Solid Earth Discussions

Interactive comment on "Permian plume beneath Tarim from receiver functions" *by* Lev Vinnik et al.

Lev Vinnik et al.

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In this paper, the authors expand on the discussion presented in Kosarev et al., 2018 by focusing on the depressed 410km discontinuity under the Tarim Basin. Correlating this depression with the location of 300Myr old basalts, they argue for a tectosphere style interpretation in which the upper 400km translate coherently over 300Myr and 2000km. This represents a controversial view as typical thought is that the mechanical lithosphere is limited to 100 – 250 km. The additional evidence, beyond the seismic data of Kosarev et al., 2018, they provide is a pair of simple models for 1D and 2D heat diffusion from a plume, suggesting the interpreted temperature perturbations are consistent with 300Myr of cooling from a 300Ma plume. We appreciate comments from the reviewer. In response to the critical comments we have made numerous changes in the manuscript.

The primary weakness of the paper is the reliance on a spatial correlation between basalts and seismic observations of a warm upper mantle and I don't feel they've done a rigorous enough job of evaluating and eliminating alternative hypotheses. We propose a causal relation between the Permian basalts and the anomalous transition zone. Alternatively the anomaly of the MTZ may be caused by another, relatively young thermal event. This is less likely because only one significant thermal event in Tarim is known since the Permian (lines 133 - 139).

A secondary weakness in the paper is the frequent use of approximate phrases where a more specific quantification is warranted. For example, line 68 they state that about 100 broadband stations were used rather than listing the actual number of stations. I assume these shortcuts were taken as the interested reader can see the Kosarev et al., 2018 reference, but much of the method section uses the same loose language in Kosarev et al., 2018. In response to this comment we made many changes. For example for the number of stations we have given precise number (64), see line 69.

A few additional citations are required. We have added 7 additional citations.

"Siberian LIP drops by a few percent": quantify "a few" We have changed it to 4-5

Line 37-39: Expand on evidence used for "partial melt" and alternatives. Not all low velocity mantle anomalies are partial melt. To our knowledge, melting is the only explanation for the low velocity atop the 410-km discontinuity that was discussed in the literature.

Line 68: "about 100 stations": how many were actually used? Precise number is 64 (see line 69).

"corner at around 6 s: what were the actual period limits? We have removed "around" (line 70).

Line 83-86: Why was this stacking method used rather than the more traditional CCP?Kosarev et al., 2018 does briefly discuss it, but rephrasing it here would be use-

ful for analysis of the data presented here. We have added lines 84-96. This should minimize the effect of lateral heterogeneity of the earth's medium above the 410-km discontinuity.

Line 87-88: What is the event coverage? Perhaps reproduce Kosarev et al., 2018 figure2 with figure 1 or 2 here. We have added lines 97-99 and Table 1.

Line 89-90: How is a confidence interval of 66It was determined by Bootstrap resampling (see lines 106, 107).

Line 91: Citation for IASP91 model?Also I assume that the thickness perturbations are based on that same model. We have added the reference (Kennett and Engdahl, 1991) at the first IASP91 model in Line 38. Of course, the thickness perturbations are based on that same model. For details see Kosarev et al., 2018.

Line 93-97: Somewhere in here, it would be useful to label the anomalous boxes (a,b,c) for referencing. Done, see line 111 and new fig. 3.

Citation needed for high heat flow and uplift during the Permian. Done, see references in line 132 (Zhang et al., 2008, 2010).

"Coherence" should be "correlation". Corrected everywhere.

Citation is needed for heat diffusion equation and choice of parameters. Done, see lines 147 and 150 (Zharkov et al, 1969; Morgan and Sass, 1984).

Line 137-138: What is the relation between increased Mg content and partial melting (citation). Done, see line 159-161.The depleted composition and increased Mg are commonly interpreted as effects of melting (e.g., Boyd, 1989).

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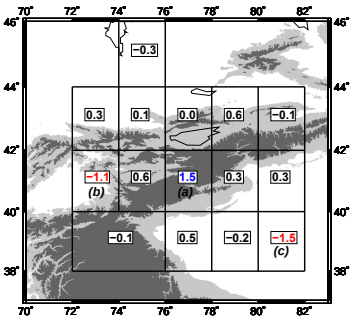

Fig. 1.