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Solid Earth Discussions

Interactive comment on "Mantle flow under the Central Alps: Constraints from non-vertical SKS shear-wave splitting" *by* Eric Löberich and Götz Bokelmann

Anonymous Referee #2

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This manuscript uses the non-vertical propagation of SK(K)S phases along with previous shear wave splitting observations to model anisotropy beneath the Alps. The authors find that beneath the northern portion of their study region, anisotropy can best be modeled with a b-up olivine alignment indicative of flow in the asthenosphere. In the southern half of the study area, the slab seems to be in the way complicating the observations and producing less well-fit model results.

Comments in no particular order:

1) Are there any restrictions placed on the delay time errors used in the high quality splitting dataset like the 20deg restriction placed on fast direction? a. What are average

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errors on dts and Phis of the original splitting dataset? and the restricted dataset?

2) The manuscript would benefit from an expanded discussion of the 1-layer of anisotropy assumption. a. I think a supplemental figure of baz for the stations before restricting the dataset would help. It is important to make sure that by restricting the dataset you are not removing some of the BAZ variability. b. There seems to be large variances in dt, which can be indicative of layered splitting

3) Why are there fewer BAZs represented at stations above the slab (e.g. figure 5)? Slab stations seem to have fewer 225-360deg baz splits. If this is due to dataset error restriction, it could be an indicator of layers of anisotropy. Layered splitting measurements often have larger errors at BAZs where the largest variations in phi and dt occur.

4) How are the BAZs of 45 and 135 around which things are stacked chosen? Is it based on average fast directions? Or because of BAZ coverage? Or some initial assumption about olivine axes?

5) Figure 5 – change the colors of the cross section lines. It is very hard to see B-B'

6) Does the 70% of fully aligned olivine assumption make sense given the observed delay times? Wouldn't a $\sim$100km layer with 70% alignment yield far larger delay times than the 1-2s dts that are measured?

7) It would be helpful to add a discussion of how b-up and c-up olivine relate (or translate) to the more traditionally used A-, B-, C-, D-, E- type fabrics. a. A-, C- and E-type fabrics have all been proposed for the asthenospheric mantle and all have general properties where phi aligns with strain. But A-type and C-and E-types have different b-up and c-up relationships to shear strain. So how do you distinguish between them, or do you have to assume A-type?

8) Figs 8 and 9 and text – It would be useful to discuss and show a null test of the models. It looks to me like a flat line model would match the data just as well as the varying BAZ model.

Technical: P1L1 and throughout – “e.g.” is used throughout the text in cases where it is not needed. P1L2 – “constraint” to “constrain” P4L18 – “till” to “until” P14L33 – “first site” to “first sight”

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