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Interactive comment on "Structure of the Central Sumatran Subduction Zone Revealed by Local Earthquake Travel Time Tomography Using Amphibious Data" *by* Dietrich Lange et al.

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Dear anonymous reviewer,

We thank you for your careful and constructive review. In the accompanying revision notes below we listed in detail on how we incorporated your helpful comments and suggestions. Your original review text is shown in black and our answers in blue colour.

Yours sincerely,
Dietrich Lange and co-authors

This is an excellent study of the velocity structure of a significant section of the Sumatran subduction zone including a transition from strong to low coupling. The inclusion of offshore and onshore seismic stations provides good imaging capability, and the tomography is carried out in a careful manner to produce reliable results. They show basins and variation in the lower crustal structure of the overlying plate.

Specific comments focus on aspects of the interpretation:

1. P 2 geodetic discussion. Add more discussion of Chlieh 2008 heterogeneous coupling, including some simple line (maybe 0.4 coupling) on Figures 1-2. Then the 3D velocity for the upper plate can be compared to coupling heterogeneity, which varies from 0 to 1 in the study area.

We superimposed the plate coupling (Chlieh et al., 2008) with red contours onto the ray coverage (Figure 2).

We modified the sentence on page 2:
"Sieh et al. (2008) estimate the slip deficit below Siberut Island since the large ruptures of 1797 and 1833 to be 8 m and a reduced slip deficit of 5 m for the Batu Islands due to the lower degree of coupling in the region of the Batu Islands (Fig. 2 and Chlieh et al, 2008)."

2. P14, L13-14 Add more discussion and consideration of the process of accretion, and how the IFZ and other fracture zones could influence. With the difference in angle between the IFZ and the trench-megathrust, and the partitioned slip, it seems that for a specific forearc plate-interface depth, the location of the IFZ would move southeast with time as the subducted plate descends, and thus could create margin-parallel accreted features.

We agree and added to the discussion of P14:

"On geological time scales the intersection of the IFZ with the marine forearc migrates southeast as the subducted plate descends, and thus might have created margin-parallel accreted features north the current intersection of the IFZ with the trench (e.g. north of Siberut Islands). However, we cannot find significant along-strike variations of vp between the Mentawai Islands and the trench (e.g. labelled a in Fig. 10 and 11) which might equally be explained by accretion of seamounts (Fig. 1, 99.5° E/4.5° S)."

3. P14, L18-24 and conclusions. High-velocity feature d (Fig 10) is interesting in that it seems correlated with the region of low coupling. The 3D Vp shows that it is a spatially distinct feature. Is there actually some localized process of crustal thinning at that location? Since the forearc crust is considered to be assembled through accretion, it seems more likely that it is mafic block that has been accreted.

We completely agree that this might serve as an alternative explanation and added this sentence:
"Alternatively, this trench parallel velocity anomaly of higher vp velocities (labelled d) might be explained by an accreted mafic block."

4. P18 and conclusions, Vp/Vs. If the high Vp/Vs is related to the Mentawai fault backthrust, then it might be a zone of releasing and transporting subduction fluid into and through the upper plate crust. If the crust is permeable, then the subduction fluid would not be trapped in the mantle wedge corner and thus the lack of serpentinization.

Technical corrections:

5. P2, L20 change 'is undebated' to 'unabated'

Corrected.

6. P2, L27-29. Add specific depths for the Moho summary.

We added the specific Moho depths:
"...... on gravity surveys and wide-angle refraction and local earthquake tomography (Siberut: Simoes et al. 2004, Kieckhefer et al. 1980, 30 km Moho depth; Aceh basin

and Simeulue: Dessa et al. 2009, Klingelhoefer et al. 2010, Tilmann et al. 2010, 21-25 km Moho depth; Southern Mentawai Islands: Collings et al. 2012, less than 30 km Moho depth)."

7. Figure 1. Green for Mentawai is poor color choice because same as land. Add box for area of Figures 2, 9.

We now show the Mentawai fault in yellow colour and added two boxes for the locations of Figure 2:
"Black boxes indicate locations of Figures 2,6,7 and 9."

8. P4, L20. Change 'targets' to 'target'

Done.

9. Figure 4 caption, P11 L16, and elsewhere. Put in the specific spread cutoff value.

We added to the caption of Figure 4 (2D spread values):
"Cut-off spread values are 2.1 and 1.9 for vp and vp/vs, respectively."
and we modified the captions of Figures 9 10:
"Red line encircles regions of good resolution defined by a cut-off spread value of 1.5."
Additionally, we labelled the contours with the cut-off spread (Figure 8).

9a.: P10, L2. Remove '(Fig. 5)' which is not the checkerboard.

Done. Previous Figure 5 is now Figure 8 and Figures 8,7 and 6 were renamed to Figures 7,6 and 5.

11. Figure 9. Make this bigger so that it takes up the full page. It is too hard to see.

We enlarged Figure 9 onto one page.

12. Figure 10. Use the same Vp color scale for this and for Figure 5 so that readers can compare. Mark the Mentawai fault.

We changed the colour scale in Figure 8 (Previous Figure 5). Now the 2D and 3D vp models show the same colour scale. We marked the Mentawai fault in Figure 8 and 10.

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