

Interactive comment on “Study on the limitations of travelttime inversion in the presence of extreme velocity anomalies” by I. Flecha et al.

Anonymous Referee #2

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This paper treats the limitation of travelttime inversion for a case with extreme velocity anomaly. The problem treated in this paper has been studied for many years, but this paper tackles this issue using modern and sophisticated techniques. Because the scientific importance of this paper is clear from the geophysical point of view, I think it is acceptable for “Solid Earth” after minor/moderate revision.

My comments for this paper are described below. I worked on the “Final Typesetting File uploaded on 20 Mar 2013.

(1) Sec.2 Geological setting and imaging problem (page 3 to 5) : The authors describe in detail the geological/geophysical structures of “basalt covered areas” such as “Faroe Shelf”. For readers unfamiliar with the passive margin tectonics, it is very helpful to provide a schematic figure of a structure model as treated in this paper and show

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which part of the structure causes difficulties in obtaining a reliable velocity model.

(2) Sec.2 Geological setting and imaging problem (page 4 to 5) : The authors describe difficulties for determining velocity model for a case with a strong anomaly. I think that more explanations are necessary on the former researches for the “basalt covered area”, particularly on the practical methodologies. How did the former researchers determine the velocity model? What (serious?) problems arose in their studies? Providing these descriptions, the authors can make clear their originality and novelty in this paper.

(3) Sec.4 Tomographic inversion (page 6-9) : I think that description on the starting model is insufficient. For example, what starting model was adopted to obtain the result in Fig.3. How does the result change if the inversion starts from a different initial model?

(4) Sec.4 Tomographic inversion (page 6-9) : In the results in Figs.3, 4 and 8, unresolved parts of the model should be eliminated (masked).

(5) Sec.4 Tomographic inversion (page 6-7) : The authors pointed out the structural similarity between Figs.3 and 4. But, we see significant difference in velocity just below the sea water.

(6) Sec.4 Tomographic inversion (page 9) : The authors describe that well data at $x=10$ and 50 km were added as prior information for the inversion process. What information was actually added to the inversion? Velocity or thickness of the high velocity basalt layer was fixed? Or both of the velocity and thickness were fixed? If all the phases are used but the prior information of the well data are excluded, then how does change the final result?

(7) Sec.4 Tomographic inversion (page 9) : The recovery of the velocity structure below the basaltic layer is also interesting because it forms “a low velocity zone” between the basaltic layer and the basement. How well is this part determined? If the inver-

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sion starts from another initial model, then how does the final result change? There remains a well-known problem of “trade-off” between the velocity and thickness of the low velocity zone?

(8) Sec.4 Tomographic inversion (page 6 to 9) : The authors carried out the inversion taking three steps (Sec.4.1-4.3). It is understandable for readers to show a “flow chart” together with a “starting model” to the individual step.

(9) Sec.4 Tomographic inversion (page 6 to 9) : I understand the inclusion of later phases as well as first arrivals in the inversion analysis. I recommend that the authors discuss the reliability of the final model (Fig. 8), including initial model dependence and resolving power of the used data (checker board test?).

(10) Conclusions (page 13-14) : The authors describe the limitation of travel time inversion in a case with significant velocity anomalies. Their conclusions are understandable, but they seem to be negative. The authors may present more “positive ideas” to overcome the difficulties. Actually, in the last part of Sec. 6, the authors are saying “this could be achieved” I think that it is possible to develop this discussion in more concrete way based on the results obtained in this paper.

Interactive comment on Solid Earth Discuss., 5, 189, 2013.