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Solid Earth Discussions

Interactive comment on "Global distribution of the lithosphere-asthenosphere boundary: a new look" *by* V. M. Hamza and F. P. Vieira

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Final Author Comments

General Aspects We thank reviewers 1 and 2 for their comments and suggestions. These have been of considerable help in improving the quality of the manuscript and in preparing the revised version.

Reply to Reviewer 1 We appreciate the general comments at the initial part of review, where comments are made on the essence of the work and also about the approaches employed in deriving mantle heat flow in continental and oceanic regions. We also appreciate the part of specific comments where the reviewer makes reference to the earlier work on the finite half-space (FHS) model and to its use in analysis of the ther-

mal field of the oceanic lithosphere. The review points out that the newly derived global heat flow map is not convoluted with half-space cooling (HSC) model, as has been done in some earlier works. The review also recognizes the robustness of the approach employed in the present work, which includes explicitly the effects of latent heat in the cooling history of the oceanic lithosphere. Following this the review draws attention to a limitation in the thermal models of the present work, arising from the assumption of constant thermal diffusivity of the medium. We recognize this limitation but point out that at shallow depth levels of the upper crust phonon component of thermal conductivity decreases with temperature. At intermediate depths phonon and radiative components cancel each other and thermal diffusivity remains nearly the same. Only at large depths of the mantle lithosphere diffusivity variations arising from radiative heat transfer can introduce systematic errors. This problem is likely to have only a limited impact on the final results of LAB estimates as most of the temperature variations (and consequently variations in thermal diffusivity) occur in the upper parts of the lithosphere. Mantle lithosphere is nearly isothermal and errors associated with variations in diffusivity are likely to appear as relatively small systematic errors in the depth to LAB. A model with depth or temperature dependent thermal diffusivity introduces considerable difficulties in the formulation of an analytical solution to the heat transfer problem. As recognized by the reviewer this aspect of the problem is beyond the scope of the present work. The revised version of the paper makes reference to the works by Whittington et al (2009) and Neblek et al (2010) on the problem of non linear variations in thermal diffusivity. We agree that this problem should be taken up as part of future studies. In the part on Technical corrections appropriate references are now included in the revised version of Table (2). Also the work of Stein and Stein (1992) is cited as reference to the data on mean values heat flow and bathymetry, in Figure (3). As for Figure (10) we are also of the opinion that the relevant data base should be included as part of the present work so that it is convenient for readers of SE Journal who might want make use of it. However, parameterization of the data set is difficult at this stage while reproduction of data sets as ASCII text files would be cumbersome

and limited practical value as there are a total of 32400 lines of data. We suggest that the relevant electronic data files be made available as supplementary material at the website of the SE Journal. If this alternative is acceptable we plan to upload the data files as supplementary material along with the revised version.

Reply to Reviewer 2 We appreciate reviewer 2 for the positive replies to the initial fifteen items in the evaluation procedure of the manuscript. As for the comments in the 16th item we agree with suggestions of reviewer 2 and have introduced the following modifications; a) Fig 3, Page 306: Larger fonts are now employed in Figure 3 in titles of model curves, to improve the readability. Also same size fonts are used in vertical and horizontal axes; b) Thermal model of continental crust, Page 293: Lines 11 – 12: Corrected version now reads the word as “dependent”; c) Mantle heat flow, Page 294: Lines 4 – 5: The number 5 in between the words “thermal” and “conductivity” refers to line numbers inserted by the editorial process; d) Global distribution of LAB depths? Page 296: Line 11: The word is now corrected as “San Francisco”; e) References, Page 301: Line 5: Corrected version reads as “. . .in: Terrestrial Heat Flow Studies and. . .”; f) References Line 11: Corrected version reads as “Sclater, J. G., Lawyer, L. A.,. . ..”; g) References Line 19: Corrected version reads as “. . .Earth Planet. Sci. Let. . ..”.

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