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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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The manuscript "Global Distribution of the Lithosphere-Asthenosphere Boundary: A New Look" by V.M. Hamza and F.P. Vieira addresses a very basic issue in Solid Earth geophysics: namely the heat emissions from the surface and how this connected to behavior of the mantle.

General comments. To address the issue of surface expression of mantle heat flow requires quantifying thickness of the upper boundary layer from a thermal perspective and also understanding what physical processes control the heat flow and thus the thickness. Part of the paper involves an improved analysis of the oceanic crust. Another component of the paper involves striping away the continents, which do not contribute to the mantle circulation, in order to constrain the emissions from the mantle

alone. Until the surface expression of the mantle is understood, we really cannot make much progress in delineating the deeper processes. The present paper provides an important constraint by providing depths to the aesthenosphere.

Specific comments. In a very concise manner, the paper provides a clear summary of the issues being addressed, and previous work, including disagreement as to values of basal temperature of the lithosphere, and the assumptions behind the previous models of cooling of the oceanic crust. A recent cooling model of Hamza and colleagues is summarized. This accounts for release of latent heat during melting and recrystallization, which is a huge contribution to thermal processes, but has heretofore been ignored. This model needs more exposure because it provides a substantial improvement.

The paper provides useful data relevant to the solid Earth, namely, an improved map of global heat flow data, which is spotty. From this, and using recent and more accurate geographic information, the authors derive heat flow across the earth. This is an important map because it is not convoluted with the half-space cooling model, or its derivatives, as has been employed previously, in contrast to what is expected for the scientific method. The present contribution fixes this problem and will of use to others interested in heat flow.

The oceanic and continental regions are treated in different fashions, as necessary. The authors cooling model well represents the oceanic regions, permitting establishing the thickness of the lithospheric thermal boundary layer. This aspect of the paper is robust.

Handing data on the continents is more difficult. The authors have removed the radiogenic component, which is needed because this has no relevance to mantle heat flow. To ascertain the thickness of the continents requires using a thermal model. That employed by the authors uses constant thermal conductivity/diffusivity. This approach needs improving. Variations of thermal diffusivity or conductivity with temperature need to be taken into account, e.g., Whittington et al., (2009) have shown that the depths are much warmer when measured properties are used in thermal models. Mafic rocks behave similarly (Nabelek et al. 2010). As a consequence, the thicknesses derived set an upper limit. One must also recognize that tradeoffs exist between the amount of radioactivity and the thermal profiles, so that a detailed thermal model is needed, exploring the trade-offs. This is beyond the scope of the present work. The results presented on the boundary layer thickness below the continents make inroads into this difficult problem.

Technical corrections. The paper is very well prepared. A few details need attention. Table 2 needs a reference. Fig. 3 needs to explain the source of the data points (how averaged). Fig. 10 is important: I am wondering if it is possible to provide some sort of parameterization for others to use.

References Whittington AG, Hofmeister AM, Nabelek PI (2009) Temperature-dependent thermal diffusivity of Earth's crust: Implications for crustal anatexis. Nature 458, 319-321. Nabelek, P. I., A. G. Whittington, and A. M. Hofmeister (2010) Strain heating as a mechanism for partial melting and ultrahigh temperature metamorphism in convergent orogens: Implications of temperature-dependent thermal diffusivity and rheology, J. Geophys. Res., 115, B12417, doi:10.1029/2010JB007727.

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