Phase transition mediated mantle mixing: The influence of temperature dependent Clapeyron slope on the heterogeneity spectrum

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Mantle Phase Transitions and Convective Mixing

Although it was initially believed that the γ-spinel to Perovskite plus Magnesiowüstite phase transition had a significantly negative Clapeyrone slope, more recent experimental studies (e.g. Fei et al., 2004) have led to a claim that the Clapeyron slope for this transition was initially overestimated. This raises the question as to whether this interface could provide the strong barrier to mixing between the upper and lower mantle circulation that is apparently reqiured by trace element geochemical data. It needs to be understaood, however, that there exists a pressure coincident additional phase transition, namely that from Ilmenite to Perovskite, which also has a very negative Clapeyron slope. Even if the new experimental data on the nature of the primary transition were correct the seismic discontinuity at 660 km depth may still provide a strong barrier to vertcal mas flux. As discussed in detail by Vacher et al. (1998), however, the volume fraction of Ilmenite in the upper mantle is highly dependent on the temperature of the upper mantle material, meaning that the effective Clapeyron slope at the 660 km interface must be considered to be temperature dependent. Our purpose in this paper is to describe the impact that this physical effect will have upon the mixing process and thereby upon the expected spectrum of mantle heterogeneity.

The model that we have elected to employ for the purpose of providing an initial investigation of this effect is that previously developed by the Toronto group (Solheim and Peltier, 1994; Butler and Peltier, 2000). Our results suggest a view of the Earth's mantle such that it may be characterized as a"hot pass filter" a concept that we will describe in detail.

References

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Zonation of Ebelykh eclogite and peridotite diamonds: LAM ICP MS

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LAM ICP MS study of small gem quality diamonds from Ebelyakh showed zonation in TRE determined with LAM ICP MS using scanning of outer and inner parts with laser separately. Eclogite diamonds REE patterns (REE/PM ~ 0.1 - 10) reveal Eu anomalies often Zr-Hf humps Nb depressions (Ta vary). Rimes are more rich in TRE. Peridotite diamonds REE patterns are more flat slightly inflected. Rims are LREE rich higher La/Yb_n. Degreasing Yb suggests the garnet precipitation. Y dips in cores and Zr peak change to Hf peaks in rims. All diamonds have Pb peaks and Sr dips sometimes deep what do not allow carbonatite origin. Enrichment in Ba, Rb and small U peaks means the growths with the subduction related fluids or melts caused by subduction of the continental block.

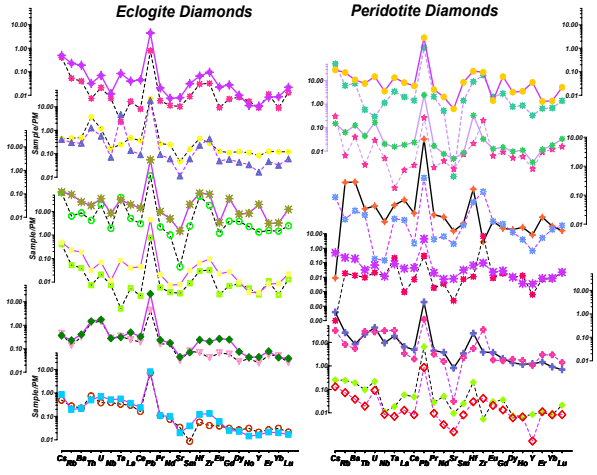

Figure 1. TRE for Ebelykh diamonds. Filled signs –rims

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Reference

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