Water content of abyssal peridotites: implications for melt transports beneath mid-oceanic ridges

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Melt generated by upwelling mantle is fundamental to the creation of oceanic crust at mid-ocean ridges (MORs). A major question has been how melt is transported from the melt production in the board melting region to the narrow axis that still remains challenging for geophysical observations. Such melt flow through the shallow mantle has been evidenced readily by vein lithologies and metasomatism in peridotites exposed at MORs. It is suggested to also occur in a more cryptic way, leaving depleted residual peridotites with enrichment of water, a highly incompatible and fast-diffusing component. However, origin and distribution of the secrete melt at the shallow mantle beneath the axis remain puzzles. Here, we determined H_2O content of clinopyroxene (cpx) and orthopyroxene (opx) in depleted mantle peridotites from a continuous lithospheric section created at a segment of the Mid-Atlantic ridge (MAR), showing an "equilibration" hydration by late-stage melt in the mantle. The retrieved melt H_2O content is from 2.5 to 7.4 wt%, and from 1.8 to 5.8 wt% beyond Vema[1][2], suggesting a global existence of the "ghost" mantle melt, with an average of 4.1±1.4 wt% H_2O, beneath the axis. Therefore, divergent melt transports is proposed that small volumes of low-degree melts, produced off-axis by incipient melting, are channeled along the base of the sloping thermal lithosphere to the axis, segregated from melt transport by dunite conduits to the axis occurring in the molten region. Our findings argue against melts produced in the vicinity of MORs as lateral supply for the Lithosphere and Asthenosphere Boundary melts observed away from ridges.

[1] Goldschmidt, Warren et al. (2014), J. Geophys. Res. 119, 1851–1881.
[2] Goldschmidt, Hesse et al. (2015), Lithos 232, 23–34.

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