Geophysical Research Abstracts
Vol. 12, EGU2010-9711-1, 2010
EGU General Assembly 2010

Melt transport and compositional heterogeneities of oceanic mantle: evidence from ophiolites

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Numerous studies of ophiolitic and abyssal peridotites published in last two decades convincingly demonstrate that compositional heterogeneities observed in mantle rocks have been largely produced by two main processes: partial melting and melt migration (e.g. [1]). While the effects and degrees of partial melting are more or less easy to decipher by use of petrologic indicators, the compositional changes of mantle peridotites resulting from the magma migration are highly variable and depend on various factors, among which the more important are the mechanisms of melt transport and composition of migrating magmas.

Thermo-mechanical modeling suggests that porous flow of melt is the dominant mode of melt migration in the mantle (e.g. [2]). On the other hand, it is widely accepted that melt extraction from the mantle beneath mid-ocean ridges occurs as a focused flow via chemically isolated channels. In their pioneering works P. Kelemen and co-authors have shown, that mantle dunites mark such highly permeable channels and were formed by complete dissolution of pyroxene in peridotite during reactive melt flow (e.g. [3]). It is assumed that focusing of diffuse porous melt flow into the channel flow may occur as a result of reactive infiltration instability or/and under the influence of stress (e.g. [3, 4]). Focused magma ascent does not rule out a diffuse porous flow of small amount of melts in shallow mantle, resulted in refertilization of mantle peridotites [5].

For the spreading in supra-subduction zone (SSZ) settings (fore-arc, immature island arc or back-arc setting), where many of ophiolites were formed [6] one should consider that melt transport processes should have specific features due to thermal structures of SSZ and influence of fluid and/or melt flux derived from the subducted slab and induced the melting in the wedge.

We illustrate the current state of issues discussed above by the examples of the mantle section of Voykar ophiolite, Polar Urals, where several stages of plastic deformation and melt migration event are documented [7]. Numerous dunite channels were formed as a result of focused melt flow driven by stress. The latest stage of melt migration is marked by pyroxenite veins formed by SiO_2- rich slab-derived melts or fluids, which predominantly moved by cracks under conductive cooling in lithospheric mantle. Following from mineral chemistry, these melts also migrated by diffuse porous flow around crack-channels, impregnating and refertilizing harzburgites.

References: 1. Bodinier & Godard, 2003,Treatise Geochem., Elsevier, 2, 103-107; 2. McKenzie, 1984, J. Petrol., 25, 713-765; 3. Kelemen et al., 1997, Phil. Trans. R. Soc. London; 355, 283-318; 4. Batanova & Savelieva, 2009, Rus. Geol. Geoph, 50, 763-778; 5. Brunelli et al, 2006, J. Petrol., 47, 745-771 6. Dilek, 2003, Geol. Soc. Amer. Spec. paper, 373, 1-16; 7. Savelieva et al, 2008, Geotectonics,42, 430-447.