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The really “stealth” mantle metasomatism

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The Lower Silesian/Upper Lusatian domain of European subcontinental lithospheric mantle is dominated by two kinds of harzburgites: A – not affected or slightly affected by silicate melt metasomatism related to migration of lavas during formation of Cenozoic Central European Volcanic Province, and B – strongly overprinted by those lavas (Puziewicz et al. 2015, IJES, DOI 10.1007/s00531-014-1134-2). The study of Matusiak-Małek et al. (2014, J Petrol 55, 1799-1828) shows that the A harzburgites untouched by metasomatic events contain no clinopyroxene. Part of the A harzburgites contains clinopyroxene which has “primary” appearance but was added to the host during metasomatic event(s) overprinting the primary mineral assemblage. The metasomatic nature of this clinopyroxene can be recognized by its major and trace element chemical composition, and the mineral is a good example of the “stealth” metasomatic phase (O’Reilly & Griffin 2013, Springer). One of the typical features of this kind of clinopyroxene are LREE enriched REE patterns.

We have discovered single xenoliths containing clinopyroxene with LREE depleted patterns in Steinberg near Görlitz (Lower Silesian/Upper Lusatian Region) and in Feldstein near Suhl (Heldburger Gangschar in Thuringia). Usually these kind of REE patterns is considered to be a relic of primary mineral assemblage subjected to strong melt-depletion. However, clinopyroxene from Steinberg is texturally late phase. Its major element chemical composition suggests that it is not a residue after partial melting, but a late silicate-melt metasomatic addition to the host rock which preceded the xenolith entrainment in the erupting lava. Thus, the metasomatising melt must have had characteristics enabling the precipitation of LREE depleted clinopyroxene. The existence of such the melts is clearly shown by the clinopyroxene from websterite cumulate from Dobkovičky in Eger Rift (Ackerman et al. 2012, J Geosci 58, 199-219), which has LREE depleted patterns similar to those occurring in the harzburgitic xenoliths from Steinberg and Feldstein.

The LREE depleted patterns of the described clinopyroxene can be the result of its equilibration with/precipitation from tholeiitic melt. The tholeiites related to Cenozoic rifting event in Alpine foreland in Europe occur scarcely in the Vogelsberg in Germany (Bogaard & Wörner 2003, J Petrol 44, 569-602). They originate due to melting of lithospheric mantle during mostly asthenosphere-derived alkaline magmatism. Therefore, we suggest that at least part of the LREE depleted clinopyroxene occurring in peridotites of European subcontinental lithospheric mantle records the Cenozoic tholeiitic melt metasomatism.

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