Geophysical Research Abstracts
Vol. 19, EGU2017-7227-1, 2017
EGU General Assembly 2017

Petrology and deformation style of lithospheric mantle beneath the Heldburg Dike swarm (Central Germany) subset of Central European Volcanic Province

Anna Kukuła (1), Jacek Puziewicz (1), Károly Hidas (2), Theodoros Ntaflos (3), Magdalena Matusiak-Małek (1), and Ralf Milke (4)

(1) University of Wroclaw, Institute of Geological Sciences, Wroclaw, Poland, (2) Instituto Andaluz de Ciencias de la Tierra, Armilla (Granada), Spain, (3) University of Vienna, Department of Lithospheric Research, Vienna, Austria, (4) Free University Berlin, Germany

The Heldburg Dike swarm is a set of Cenozoic alkali basalt dikes occurring in the central part of Germany at the border between Thuringia and Bavaria. We studied xenoliths from Strauf, Feldstein, Bramberg and from the active quarry in Zeilberg. The peridotites from Strauf, Feldstein and Bramberg have the composition of spinel lherzolite (15), spinel harzburgite (9) and dunite (3). They vary in size from 1.5 cm (Strauf) up to 20 cm (Zeilberg).

We distinguish groups (A, A- and B) of peridotites based on different forsterite content in olivine. Group A consists of olivine (89.6 – 91.8 Fo), orthopyroxene (Mg# 0.90–0.93, Al 0.05-0.18 a pfu), clinopyroxene (Mg# 0.87-0.95, Al 0.06–0.26 a pfu) and spinel (Cr# 0.13–0.65, Mg# 0.54–0.78). Clinopyroxene rare earth elements (REE) patterns are S-shaped (Feldstein, Bramberg) or U-shaped (Strauf); spoon-shaped patterns occur occasionally. Trace element (TE) patterns show negative Nb, Ta, Zr, Hf, Ti and positive Th, U anomalies. The most magnesian clinopyroxene (xenolith 3140, Feldstein) is strongly aluminous and LREE depletedwith weak anomalies in TE patterns. Group A- is contains olivine (88.9–89.5 Fo), orthopyroxene (Mg# 0.89–0.90, Al 0.10-0.13 a pfu) and clinopyroxene (Mg# 0.90-0.92, Al 0.10-0.17 a pfu). Clinopyroxene is increasingly enriched in REEs from Lu to La. TE patterns are similar to those of group A but with less pronounced anomalies. Group B (3 xenoliths only) consists of olivine Fo 86.7-88.9, orthopyroxene (Mg# 0.88-0.89, Al 0.07-0.19 a pfu), clinopyroxene (Mg# 0.88-0.90, Al 0.10-0.26 a pfu). Clinopyroxene is enriched in LREE, concave upward in Pr. TE patterns are similar to those in group A. One of group B harzburgites contains grains (up to 0.5 mm) of Ca-Mg carbonate located in interstices.

The clinopyroxene chemical composition plots away from the melting trend in the MgO-Al2O_3 diagram of Upton et al. (2011), suggesting a later addition of the clinopyroxene. The composition of orthopyroxene corresponds to ca. 15-30 % of melting of primitive mantle, which was overprinted by silicate and/or carbonatite metasomatism. The xenolith 3140 seems not to be affected by metasomatic overprint.

Based on the EBSD analyses of 15 xenoliths, olivine grains are characterized by relatively strong CPO (crystal preferred orientation) with J indices 4.4 – 13.3, and they have orthorhombic (8 xenoliths) or [100]-fiber CPO (6 xenoliths) symmetries except for one [010]-fiber symmetry observed in group B (Tommasi et al., 1999). Pyroxenes have weaker CPO and the distribution of their crystallographic axes is inconsistent with their coeval deformation with olivine. We propose that their CPO postdates that of olivine, hence strongly support a later origin for pyroxenes.

Funding. This study was possible thanks to the project NCN UMO-2014/15/B/ST10/00095 of Polish National Centre for Science to JP

Tommasi, A., B. Tikoff, and A. Vauchez (1999). Upper mantle tectonics: three-dimensional deformation, olivine crystallographic fabrics and seismic properties, Earth Planet Sc Lett,168, 173-186.
Upton, B.G.J., Downes, H., Kirstein, L.A., Bonadiman, C., Hill, P.G., Ntaflos, T. (2011). The lithospheric mantle and lower crust-mantle relationships under Scotland: a xenolithic perspective. J Geol Soc, 168, 873-886.