ABSTRACT

Cenozoic volcanism of the Central European Volcanic Province is related to rifting in the foreland of Alps and occurs in most of the Variscan areas. Volcanic rocks locally carry peridotitic xenoliths of subcontinental lithospheric mantle (SCLM). Mantle xenoliths from Lusatian Volcanic Field - Steinberg (Saxony, Germany) and The Heldburg Dike Swarm – Feldstein, Bramberg, Kleiner Gleichberg (border between Thuringia and Bavaria, Germany) are the subject of this work. Studied xenoliths have the composition of spinel lherzolite (11), lherzolite (3), spinel harzburgite (11), harzburgite (3), dunite (2), spinel lherzolite/dunite (1) and wehrlite (1).

According to the different forsterite content in olivine three groups (A, B and C) of xenoliths have been defined. In studied xenoliths group A contains 88,9 – 91,6 of Fo in olivine. Forsterite content in group B varies in the range of 86,7 – 91,2, the overlap with group A is due to its reactive origin and some grains preserving characteristics of group A olivine. Group C exhibits 72.7 – 73.7 of Fo in olivine.

Peridotitic xenoliths of Lusatian Volcanic Field (Steinberg) represent depleted (harzburgitic) lithospheric mantle impoverished in alumina. Group A of the Lusatian xenoliths consists of olivine (90.5 – 91.6 Fo, 0.25 – 0.48 wt.% of NiO), orthopyroxene (Mg# 0.90 – 0.92, Al 0.04 – 0.13 a pfu), clinopyroxene (Mg# 0.92 – 0.95, Al 0.03 – 0.13 a pfu) and spinel (Cr# 0.47 – 0.54, Mg# 0.57 – 0.67). Group B dunite xenolith contains olivine (87.6 – 91.2 Fo, 0.33 – 0.46 wt. % of NiO), orthopyroxene (Mg# 0.89 – 0.91, Al 0.07 – 0.14 a pfu) and clinopyroxene (Mg# 0.89 – 0.90, Al 0.15 – 0.19 a pfu). Group C xenolith is a wehrlite and consists of olivine (72.7 – 73.7 Fo, 0.05 – 0.11 wt.% of NiO), orthopyroxene (Mg# 0.76 – 0.77, Al 0.15 – 0.20 a pfu) and clinopyroxene (Mg# 0.83 – 0.85, Al 0.18 – 0.26 a pfu).

Heldburg Dike Swarm xenoliths represent harzburgitic/lherzolitic lithospheric mantle richer in alumina relative to the Steinberg SCLM. Most of the xenoliths from Heldburg Dike Swarm (Feldstein, Bramberg, Kleiner Gleichberg) belong to Group A, only one sample represents group B. Group A consists of olivine (88.9 – 91.4 Fo, 0.24 – 0.53 wt.% of NiO), orthopyroxene (Mg# 0.89 – 0.93, Al 0.05 – 0.18 a pfu), clinopyroxene (Mg# 0.89 – 0.95, Al 0.06 – 0.26 a pfu) and spinel (Cr# 0.13 – 0.47, Mg# 0.55 – 0.78). Group B contains olivine (86.7 – 88.2 Fo, 0.33 – 0.39 wt.% of NiO), orthopyroxene (Mg# 0.88 – 0.89, Al 0.07 – 0.14 a pfu) and clinopyroxene (Mg# 0.89 – 0.93, Al 0.09 – 0.26 a pfu).

Studied peridotitic xenoliths experienced high degree of melt extraction. Peridotites from Steinberg in Lusatian Volcanic Field are characterized by ca. 15 – 25% of partial melting, whereas Heldburg Dike Swarm xenoliths exhibit ca. 4 – 22 % of melt extraction. After the episode of partial melting, the lithospheric mantle was affected by cryptic metasomatism. Lusatian Volcanic Field xenoliths record metasomatism by pure carbonatitic melt. Heldburg Dike Swarm xenoliths exhibit slightly different metasomatic history with chromatographic metasomatism by silicate-carbonatite melt.

The crystal preferred orientation (CPO) patterns of olivine, ortho- and clinopyroxene are similar in all studied xenoliths from Heldburg Dike Swarm (12 xenoliths) and Lusatian Volcanic Field (5 xenoliths). Olivine is coarse-grained with gently curved or straight grain boundaries and triple junctions at 120°, rare subgrain boundaries and negligible intracrystalline misorientations, which suggest its annealing. However, olivine records a weak CPO, which can be classified as having orthorhombic, [100]-fiber CPO symmetries. [010]-fiber symmetry is observed in one Heldburg Dyke Swarn xenolith (group B). Pyroxenes have irregular, highly lobated shapes and typically occur interstitially along olivine grain boundaries. Both ortho- and clinopyroxene have a very weak CPO with [001] axes at high angle to the [100] axis of olivine and, hence, define stretching lineation. These observations suggest that pyroxene formation postdates that of olivine.

Lithospheric mantle beneath studied areas is strongly heterogeneous. Peridotitic xenoliths record multiple stages of mantle evolution in different time scale.