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Petrology of mantle beneath Central Europe: a case study of the Lutynia (Sudetes, SW Poland) peridotite xenoliths

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The easternmost part of Central European Volcanic Province is located in SW Poland. Most of the lavas have an Oligocene/Miocene age. However, the small volcanic field situated in the vicinity of Lądek Zdrój (Poland) and Bruntal (Czech Republic) yields ages from 5.46 $\pm$ 0.23 to 0.8 $\pm$ 0.11 Ma. The Lutynia ("Szwedzkie szańce") lava occurring on the Polish/Czech border is the only one displaying peridotitic xenoliths and clinopyroxene megacrysts.

The majority of xenoliths varies in size from 3 up to 10 cm, while the megacrysts range from 1 to 3 cm. Our study is based on analyses of major and trace elements content in individual grains from 14 xenoliths and 2 clinopyroxene megacrysts.

The studied xenolith suite from Lutynia consists of lherzolites which are medium to coarse grained, sometimes weakly foliated. Zones dominated by finer grained crystals of Ol occur in three xenoliths. Very fine grained pockets ($<$2 mm across) filled with plagioclase (Pl), olivine (Ol), clino- and orthopyroxene (Cpx, Opx) and spinel (Sp) occur in some xenoliths. Thin interstitial veinlets consisting mainly of Pl laths occur locally.

Kink bands occur in some of Ol grains ($>$0.5–8 mm). Large Opx grains ($>$2 mm) show thin Cpx exsolutions, while smaller Cpx crystals (from first to 2 mm) contain fine angular crystals of brown Sp. Majority of xenoliths contain Sp–Cpx ($\pm$ Opx)

symplectites.

The Fo content in olivine (NiO 0.19–0.52 wt.%) varies from 89.5 to 91.7 %, the Ca content is from $<$200–1500 ppm, but values above 600 ppm occur only in olivine from fine grained patches. The Opx (#mg = 0.90–0.96) contains 2.61–5.27 wt.% of Al_2O_3. The Cr_2O_3content in Cpx from xenoliths (#mg = 0.92–0.97) ranges from 0.55 to 1.40 wt.%, while in megacrysts (#mg = 0.84–0.87) it ranges from 0.09 to 0.22 wt.%. Chromite forming symplectites is characterized by #mg ranging from 62.90 to 78.30 and #cr from 15.70 to 45.70, while composition of angular crystals occurring in Cpx is very variable: #mg from 74.20 to 91.50 and #cr from 0.85 to 21.20. The Pl occurring in interstitial veinlets contains 0–25% of An, with a gap between 2 and 8% of An.

Two major types of Cpx may be identified on the basis of their REE pattern. The first group is LREE enriched (La/Lu = 4.91–12.12) and displays flat HREE pattern. The second group is also LREE enriched (3.06–55.29) and has flat HREE pattern but it is characterized by steep La–Pr (Nd–Sm–Dy) inflection. Cpx from both groups displays trace element concentrations higher than those of pyrolite and characterized by negative Rb, Ba, Nb, Ta and Ti anomalies. The Zr negative anomaly is present only in some of the xenoliths. Cpx megacrysts are slightly LREE enriched (1.90–3.30) and has concave upward pattern: the REE concentrations increase from La to Eu. Trace elements concentration in megacrysts is higher than that in pyrolite (up to 10 times) and patterns display negative Rb, Ba and Nb anomaly.

Cpx REE composition enables the estimations of partial melting degree, which varies from 17 to 21 %, but it does not exceed 19% in xenolith containing Cpx with LREE inflection.

Two – pyroxene (Brey & Köhler algorithm) geothermometer gave two ranges of temperatures: 940–950˚C (majority of the xenoliths) and 860–885˚C (xenoliths with zones of reduced grain size). Low temperatures calculated for the second group of xenoliths may be due to deformation.

Since average composition of Pl from host basalt from Lutynia is Ca rich (An$\sim$ 57), the feldspar occurring in fine – grained patches must have been introduced into the xenoliths by melts different than the host one.

Xenoliths occurring in Lutynia are anhydrous, similarly to other localities in Lower Silesia. The Sp–Cpx symplectites, which are believed to form during garnet breakdown, suggest deep origin of the xenoliths. The symplectites, together with Cpx exsolutions in Opx suggests relatively slow ascent rate of the host magma.

The studied mantle xenoliths have probably firstly undergone relatively high degrees of partial melting and then at least two metasomatic events: one evidenced by the

LREE enrichment of the primary Cpx and the second one by the fine – grained patches.