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# Various depths of origin of clinopyroxene megacrysts from Cenozoic alkaline lavas of occurrences in Lower Silesia (SW Poland)

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The Polish part of Central European Volcanic Province consists of more than 300 outcrops of Cenozoic volcanic rocks (Badura et al., 2006). Some of these alkaline lavas contain mantle xenoliths and megacrysts of clinopyroxene and plagioclase. We studied clinopyroxene megacrysts from three sites in Lower Silesia: (1) the Księginki nephelinite (Lubań-Frydlant volcanic complex, dated at 34.6 [U+F0B1] 3.1 Ma), (2) the Ostrzyca Proboszczowicka basanite (Złotoryja-Jawor complex, probably of Miocene age) and (3) the Lutynia basanite (Lądek Zdrój volcanic complex, dated at 4.56 [U+F0B1] 0.2 Ma; K-Ar datings after Pécskay & Birkenmajer, 2013). We determined major (electron microprobe) and trace (LA-ICP-MS) element compositions, Fe3+/Fe (Mössbauer spectroscopy), as well as 87Sr/86Sr and 143Nd/144Nd isotopic ratios.

The megacrysts from Księginki are typically up to 5 cm and have the composition of diopside and augite (Puziewicz et al., 2011), Mg# 0.79 – 0.87, Fe3+/Fe 0.31 – 0.36, 87Sr/86Sr 0.703323 – 0.703496 and 143Nd/144Nd 0.512890 – 0.512904. Typical REE concentrations are 0.78 – 10.5 x PM, TE patterns show strong negative Pb and weaker Sr, Zr anomalies. The megacrysts from Ostrzyca are up to 3 cm, have the composition of diopside (Lipa et al., 2014), Mg# 0.61 – 0.70, Fe3+/Fe 0.38 – 0.45, 87Sr/86Sr 0.703221 – 0.703226 and 143Nd/144Nd 0.512906 – 0.512911. Typical REE values range from 1.81 to 22.9 x PM, TE patterns show strong negative Pb and weaker Ti anomalies and characteristic positive Ta, Zr, Hf anomalies. Megacrysts from Lutynia, up to 4 cm, have the composition of augite and diopside, Mg# from 0.77 – 0.97, Fe3+/Fe 0.33 – 0.37, 87Sr/86Sr 0.703261 – 0.703295 and 143Nd/144Nd 0.512898 – 0.512910. REE concentrations vary from 0.52 to 7.8 x PM, but one megacryst shows strong depletion in LREE (to 0.01 x PM). TE patterns reveal strong negative Pb and weaker Sr, Zr, Y anomalies and the LREE depleted megacryst has positive Pb anomaly.

The knowledge on Fe3+/Fe allowed to use the geobarometer of Nimis & Ulmer (1998), which yielded the following pressures of crystallization: Księginki 1.05 – 1.23 GPa, Ostrzyca 0.06 – 0.19 GPa, Lutynia 1.08 – 1.13 GPa. The pressure of crystallization of the Księginki megacrysts fits well the interpretation of Puziewicz et al. (2011) who considered the megacrysts to come from syn-volcanic host magma cumulates formed in lava batches temporarily residing at uppermost mantle depth. By analogy, we are of the opinion that the Lutynia megacrysts are of similar origin, except the “LREE depleted” one. The Ostrzyca megacrysts were interpreted by Lipa et al. (2014) to crystallize from the host lava at mid-crustal depths. The 87Sr/86Sr and 143Nd/144Nd isotope ratios of the Ostrzyca and Lutynia megacrysts are identical to those of the European Asthenospheric Reservoir and are consistent with their proposed syn-volcanic origin, except the “LREE depleted” megacryst, for which isotopic ratios have not been analysed. The 87Sr/86Sr and 143Nd/144Nd isotope ratios of the Księginki megacrysts are slightly enriched in radiogenic Sr.
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