Geophysical Research Abstracts
Vol. 16, EGU2014-320, 2014
EGU General Assembly 2014

Various origins of clinopyroxene megacrysts from basanites from the eastern part of Central European Volcanic Province

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Clinopyroxene megacrysts up to few centimetres in size occur in Cenozoic alkaline lavas forming the north-eastern part of Central European Volcanic Province in Lower Silesia (SW Poland). The megacrysts occur, among other, in the Miocene basanite from Ostrzyca Proboszczowicka (bulk rock mg# 0.65-0.66) and in that from Lutynia (Pliocene, K-Ar age: 4.56 +/- 0.2 Ma; Birkenmajer et al. 2002; bulk rock mg# 0.64). The megacrysts typically consist of homogeneous core surrounded by patchy and spongy mantle, which is covered by a thin outermost rim of composition similar to that of the groundmass clinopyroxene occurring in the host basanite. The mantles of the megacrysts have been affected by melting, whereas the cores preserve their primary composition. We compare the core parts of megacrysts in the following.

The Ostrzyca clinopyroxene megacrysts contain euhedral apatite intergrowths. The clinopyroxene has the composition of Fe-rich diopside (mg# = 0.61 – 0.70), contain significant sodium (to 0.12 a pfu) and are calcium rich (0.89-0.92 a pfu). The Lutynia megacrysts have the composition of augite and diopside (mg# 0.80-0.83). The sodium content is also high (to 0.12 a pfu), but calcium varies from 0.68 to 0.77 a pfu.

The REE concentrations for Lutynia (1-10 x PM) are lower relative to Ostrzyca, enriched 10-100 times relative to PM. In both sites the megacrysts are strongly enriched in LREE relative to HREE and TE are characterized by positive Th, La and Ce anomalies, slight negative Sr and Y anomalies and strong Pb anomaly in the PM normalised patterns. The megacrysts from Ostrzyca reveal slight negative Ti and strong positive Zr and Hf anomalies, whereas those Lutynia have negative Zr anomaly and Ti anomaly is absent.

Major and trace element composition shows that the megacrysts from Ostrzyca formed as coarse-grained cumulate at significant depth (lower crust?) from the LREE enriched alkaline melt. That melt was very rich in phosphorous which enabled its saturation in apatite at the early stages of solidification. The Lutynia megacrysts also crystalized at significant depth (probably below the Moho discontinuity). Their relatively low Ca content suggests that in the magma source orthopyroxene was present. The study of megacryst compositions from various sites is a potential tool to understand the emplacement mechanisms of alkaline melts at or beneath Moho as well as the occurring crystal growing conditions.

Funding. This study is a part of MSc thesis of the first author and was possible thanks to the project NCN 2011/03/ST10/06248 of Polish National Centre for Science.

References:

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