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The various styles of metasomatism in the lithospheric mantle beneath SW Poland: the Krzeniów basanite case

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Abundant mafic rocks of Central European Volcanic Province (CEVP) occur in SW Poland. A Miocene basanite volcanic plug occurring near Krzeniów village encloses scarce peridotite (spinel harzburgite and spinel dunite) xenoliths, which are usually up to 4 cm in diameter. The peridotites are have protogranular to porphyroclastic textures. Clinopyroxene occurs in small amounts (< 4.5 vol. %) only in some of the xenoliths. The forsterite contents in olivine define two groups of peridotites: A – Fo90.4-91.7 and B – Fo88.2–89.8. The group A orthopyroxene is more magnesian (mg# 0.913-0.921) than that of group B (mg# 0.899-0.920). The major and trace element composition in clinopyroxene defines subgroups A1, A2 and A3 in the group A peridotites; the subgroup A3 comprises the clinopyroxene-free xenoliths. The A1 clinopyroxene is characterized by varying REE contents with relative enrichment of lighter REE and concave downward patterns. The most REE-poor clinopyroxene is highly magnesian (mg# 0.936-0.945) and impoverished in aluminium (Al 0.065 atoms pfu). REE-rich A1 clinopyroxene is also rich in magnesium (mg# 0.924-0.936), but the Al and Na contents are elevated in comparison to REE-poor clinopyroxene. All the A1 xenoliths contain low- Al orthopyroxene (0.055-0.090 a pfu). A2 clinopyroxene displays s-shaped REE patterns with increase from La to Nd and decrease to Lu. It is less magnesian than A1 clinopyroxene (mg# 0.918-0.924) and richer in Al and Na (0.148-0.158 and 0.079-0.098 a pfu, respectively). The Al content in A2 orthopyroxene is 0.102 a pfu while in A3 orthopyroxene varies from 0.021 to 0.095 a pfu. Major element composition of group B clinopyroxene is variable (mg# 0.903-0.924, Al 0.074 to 0.095 a pfu), but REE composition remains constant and mimics that of group A2. Orthopyroxene contains 0.035-0.074 atoms of Al pfu.

The trend of decreasing Ca-contents with increasing Al contents occurs in group A1 clinopyroxenes. In this group the clinopyroxene REE change gradually from the REE poor and spoon-shaped to REE richer and more flattened ones. The contents of REE and trace elements content of the REE-poor A1 clinopyroxene suggest that they were produced by reaction with the metasomatic fluid. The MREE and HREE patterns of A2 clinopyroxene are similar to those of the most REE-rich A1 patterns, but inflected at LREE. The inflection is typical for clinopyroxene which equilibrated its REE contents with silicate melt. The A2 clinopyroxene is less magnesian and is significantly enriched in Al and Na and depleted in Ca relative to the A1 one. This suggests that the A1 and A2 clinopyroxenes were affected to a different degree by silicate melt metasomatism. Thus, the REE-poor A1 clinopyroxenes probably represent compositions of the peridotites in the Krzeniów mantle section before silicate melt infiltration. The group B clinopyroxene is similar to the A2 one, but its major element composition is more variable and the forsterite content in coexisting olivine is lower than that in A group, suggesting that it was affected by silicate melt metasomatism (“Fe metasomatism”). This kind of metasomatism seems to be common in the lithospheric mantle beneath Lower Silesia.