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Clinopyroxene crystal chemistry of texturally heterogeneous upper mantle xenolith series from the Carpathian-Pannonian Region (Hungary): what does crystal structure message about xenolith petrogenesis and mantle pressure conditions?

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Crystal structural characteristics provide significant information about the composition and PT conditions of the mantle xenoliths. Most of the crystal structural analysis have been carried out on xenoliths showing undeformed texture and only a few measurements have been made on deformed or texturally heterogeneous xenoliths.

Upper mantle xenolith series hosted in Plio-Pleistocene alkaline basalts from the Carpathian-Pannonian Region (Hungary) have been studied from petrologic, petrogenetic and thermobarometric point of views for decades. Therefore, these mantle rocks offer a unique subject for a crystal structural analysis and for crystal chemical, geochemical and petrologic comparison. In addition, xenoliths with special mosaic and poikilitic textures also occur relatively often in this region. Our major goals are: 1) to reveal crystal structural and chemical variation in xenolith series with textural and deformation variety, 2) to estimate equilibrium pressure conditions of the mantle xenoliths, and 3) to contribute to understand the petrogenesis of the special group of poikilitic and mosaic textured xenoliths.

Xenoliths studied, collected from the Bakony-Balaton Highland Volcanic Field (central part of the Carpathian-Pannonian Region), show wide textural variety: the dominant textural types (protogranular, porphyroclastic, equigranular) compose the main

series, whereas the rarer poikilitic and mosaic textured samples form a special group. The main series samples represent common textural evolution of the upper mantle, governed by polimetamorphic process and increasing deformation in the progressive protogranular - porphyroclastic - equigranular series. Mosaic and poikilitic textured xenoliths form special groups, several authors proposed their cumulate character and mantle derived melt origin. Clinopyroxenes of these mantle xenoliths were studied by means of single crystal X-ray diffraction and electron microprobe analysis. Also, previous crystal chemistry studies on mantle xenolith clinopyroxenes have shown that crystal structure depends only partly on the degree of mantle depletion whereas relations between cell and site (especially M1 and M2) volumes are indicative of different equilibrium pressures. These significant observations allow us to use structural parameters as a useful and chemically partially independent estimation of equilibrium pressure of mantle xenoliths even for spinel peridotite facies.

Our results suggest that protogranular, porphyroclastic and equigranular xenoliths define the main trend of chemical, structural and textural changes in the suites. This trend is characterized by the progressive increase of deformation in proportion with the decrease of equilibrium pressure. Protogranular xenoliths record pressure near to garnet stability field, whereas equigranular xenoliths were equilibrated at the lower pressure, near to plagioclase stability field. Poikilitic and mosaic xenoliths are detached in crystal chemistry from the main trend, suggesting that their origin and evolution may not be explained by the continuous deformation/depletion of the main series xenoliths. They likely were formed at low pressure conditions, near to or within the plagioclase stability field, in accordance with works which link them to percolating melts in the lithospheric mantle. Inverse proportion of pressure and deformation of the main series geodynamically can be explained by the mantle diapir beneath the Carpathian-Pannonian Region, which could cause significant deformation and lithosphere thinning in the center of the basin.