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Petrology and thermobarometry of mantle xenoliths from the Poiana Rusca (W Romania)

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Mantle xenoliths from Late Cretaceous - Paleogene alkali basic rocks from the Poiana Rusca (W Romania) were previously described more than a decade ago (Downes et al., 1995). Recently collected xenoliths show new petrologic and thermobarometrical aspects of the pre-Neogene subcontinental lithospheric mantle beneath the southeastern part of the Carpathian-Pannonian Region.

The samples widely vary between wehrlitic, lherzolitic and olivine websteritic composition. The most distinctive feature of the modal composition is the high variability in orthopyroxene content (1-45 vol%). No OH-bearing minerals have been found in any xenoliths. Texturally, they are rather uniform, most are coarse-grained and contain notable amount of silicate mineral inclusions (mostly olivine) in other silicates (mostly orthopyroxenes), therefore, we classified them as poikilitic textured xenoliths. Some samples, however, seem to be sheared in texture.

Xenoliths are rather homogeneous in composition, but show distinct features from other mantle xenoliths from the region. Clinopyroxene has notably high Al_2O_3 (6-7 wt%) and Na_2O (1.5-2 wt%) content. Spinel is always Al-rich, cr# are low (0.08-0.18). Mg# of pyroxenes varies between 0.89-0.91. In fact, the major element chemical composition of minerals shows rather fertile composition and low degree of melt extraction (approx. 8-10%) from the mantle.

Clinopyroxene single crystal X-ray diffraction measurements were carried out on the same samples. Structural data show that clinopyroxenes have rather low cell (432.9-433.6 $Å^3$) and M1, M2 site volumes. Previous crystal chemistry studies on mantle xenolith clinopyroxenes have shown that cell and M1, M2 site volumes depends mainly on the different equilibrium pressures, and such low cell volumes are indicative of high equilibrium pressure. Their structural data are rather similar to data from garnet-bearing lherzolites worldwide, therefore, we suggest that the Poiana Rusca xenoliths can be equilibrated at high depths, near to garnet stability field, at pressure near to approx. 20-22 kbar. Thermometry, using several widely accepted thermometers, indicates a homogeneous equilibrium temperature for the xenolith series, between 950-1010˚C.

Xenoliths of similar unusual composition were reported also by Downes et al. (1995) but not treated as a separate group. We suggest that these unusual xenoliths suggest the existence of a rather homogeneous, fertile mantle segment, equilibrated at high pressure and temperature. Chemistry and textural evidences (common occurrence of poikilitic texture and abundance of orthopyroxene-enriched samples) suggest that the mantle might have undergone interaction with an alkali silicic melt. Continuous increase in orthopyroxene content (1-45%) in the series indicates different degrees of interaction with the melt. Comparing this series to other xenoliths from the region, which were described as reaction products of lherzolitic mantle and silicic melt interaction (Cvetkovic et al., 2004; Bali et al., 2007), we suggest that none of these xenoliths/metasomatic agents are similar to those found in Poiana Rusca xenoliths.

The lithospheric mantle segment, represented by these xenoliths, now is situated beneath the southeastern periphery of the Carpathian-Pannonian Region. However, geodynamical reconstructions proved that the terranes, now composing this region, were amalgamated only during the Neogene basin formation and the southern Apuseni Mts (including the Poiana Rusca) were part of the Dacia block before. So these xenoliths can provide important information about the pre-Neogene physical-chemical conditions of the lithospheric root of the Dacia block.

References

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