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Petrography and geochemistry of volcanic rocks from the Niemodlin area (SW Poland)

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The Tertiary volcanic rocks of the Opole Silesia (SW Poland) belong to the easternmost part of the Central European Volcanic Province (CEVP). Various volcanic rocks occur in the Opole region including melanephelinites, melabasanites, nephelinites and nephelinite basalts. Radiometric ages (K – Ar method) of these rocks range from 21,2 to 30,5Ma [1]. Here, we characterize volcanic rocks from two active quarries "Gracze' and "Rutki – Ligota".

According to the TAS diagram, the rocks from "Gracze" classify as nephelinites and those from "Rutki-Ligota" as basanites. Mineral composition is very similar in both groups of rocks. Nephelinite consists of olivine, clinopyroxene, nepheline, Ti-Fe oxide and apatite. Basanite consists of olivine, clinopyroxene, nepheline, plagioclase, Ti-Fe oxide and apatite. Phenocrysts in both groups are olivine and clinopyroxene.

The nephelinites from "Gracze" contain more MgO (12,7 – 13,8 wt%) than the basanites from "Rutki-Ligota" (MgO 10,8 – 12,0 wt%). However, chemical composition of minerals in the basanites and nephelinites is similar, though minerals in the nephelinites are more homogenous. Olivine phenocrysts in the nephelinites show compositional variations from $Fo_{73}$to Fo_{87}(ΔFo = 14), Ca = 100-4600 ppm and Ni = 500-4700 ppm. In contrast, olivine phenocrysts in the basanites span a wider compositional range from Fo_{63}- Fo_{88} (ΔFo = 25), Ca = 1000-6350 ppm and Ni = 400-3150 ppm.

In both groups of rocks the forsterite and Ni content is higher in the cores (Fo_{78} –Fo_{88},Ni = 500 – 3800ppm in nephelinites, Fo_{75} - Fo_{88}, Ni = 500 – 3200ppm in basanites) and lower in the rims (Fo_{73} –Fo_{81},Ni = 550 – 4750ppm in nephelinites, Fo_{66} - Fo_{84}, Ni = 300 – 2350ppm in basanites) while Ca content is lower in the cores (Ca = 100 – 3700ppmin nephelinites, Ca = 1000 – 3150ppm in basanites) and higher in the rims (Ca = 1850 – 4600ppm in nephelinites, Ca = 1400 – 5450ppm in basanites). However, the lowest contents of Ca (100 – 1000 ppm) were observed only in a few olivine phenoctrysts from the Gracze quarry. The Fo content in the olivine cores is in equilibrium with whole rock Mg/(Mg+Fe) ratio.

The similarity of mineral and chemical whole rock compositions of the rocks from "Rutki-Ligota" and "Gracze" indicate that they were derived from the same source. Slight differences in chemical composition are consistent with different degrees of differentiation and/or melting in the source. Basanite records a larger span of differentiation than nephelinite. The low Fo in olivine (up to 88%) and Ni (up to 3800ppm) content are consistent with the magmatic origin for most of the olivine phenocrysts [2,3]. Two stages of olivine crystallization are recorded in the chemical composition of olivine:

(1) a protracted, early stage when a few grains crystallized in equilibrium with melt and the melt composition did not varied during that stage;

(2) an abrupt crystallization consistent with a rapid change in crystallization conditions, most probably during the eruption.

[1] Birkenmajer, Pécskay, 2002,: *Biulletin of the Polish Academy of Sciences Earth Sciences* Vol. 50, pp.33-50

[2] Cvetkovič et al, 2004 Contr. Min. Pet. Vol. 148 pp. 335-357

[3] Pearson et al. 2003, Treatise on Geochemistry . Vol. 2.05