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### ENCLAVES OF BLACK CLINOPYROXENITE IN THE KSIĘGINKI NEPHELINITE NEAR LUBAŃ (LOWER SILESIA)

The Księginki nephelinite forms one of the biggest basaltoid bodies within the Lower Silesian part of the Tertiary Central European Volcanic Province. The nephelinite contains abundant enclaves of mantle peridotites (Białowska 1980; Kozłowska-Koch 1981) as well as rare clinopyroxenite enclaves and clinopyroxene megacrysts. Among peridotitic enclaves harzburgites and lherzolites are common, while wehrlites and dunites can be rarely met. Black clinopyroxenite enclaves are also scarce. They are built up of black isometric clinopyroxene grains, often riddled with tiny glassy inclusions and rimmed with glass (Fig. 1). Moreover, they usually contain subordinate olivine (up to 5 vol. %) and accessory spinels.

In the present study, the two black clinopyroxenite enclaves from the Księginki nephelinite have been investigated in details: the smaller, ball-shaped enclave, 2cm in diameter, and the bigger, oval-shaped one, having 7 x 9 cm in section parallel to elongation. Representative microprobe analyses of minerals of both the enclaves studied, together with clinopyroxene mega- and phenocrysts are given in Table 1.

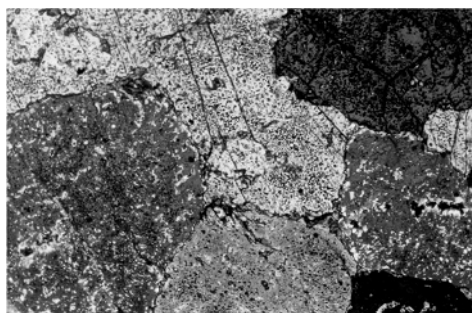


Fig. 1. Fine perforated clinopyroxenes in the black enclave from the Księginki nephelinite; picture length = 2.8 mm.

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Table 1. Representative microprobe analyses of minerals of clinopyroxenite enclaves from the Księginki nephelinites.

	smaller enclave				bigger enclave				mega-cryst	pheno-cryst
	cpx-c perfor.	cpx-r clear	ol	sp	cpx-c	cpx-r	ol	sp	cpx	cpx
	1	2	3	4	5	6	7	8	9	10
SiO <sub>2</sub>	47.12	42.99	39.10	0.18	47.82	47.70	38.21	0.00	48.85	46.45
TiO <sub>2</sub>	2.24	4.73	0.11	0.71	1.59	2.29	0.21	0.78	1.13	2.76
Al <sub>2</sub> O <sub>3</sub>	6.40	9.67	0.10	59.77	8.56	7.68	0.00	56.22	8.01	6.16
Cr <sub>2</sub> O <sub>3</sub>	0.31	0.00	0.20	3.13	0.18	0.04	0.07	1.65	0.55	0.11
Fe <sub>2</sub> O <sub>3</sub>				3.31				8.87		
FeO	5.27	7.48	17.84	15.54	6.59	5.89	19.98	15.28	5.52	6.66
MnO	0.03	0.10	0.44	0.55	0.19	0.17	0.41	0.06	0.86	0.11
NiO	0.00	0.00	0.60	0.05	0.11	0.00	0.29	0.28	0.00	0.00
MgO	12.97	10.26	40.19	17.19	12.71	12.72	39.40	16.93	13.45	11.75
CaO	24.01	24.29	0.49	0.00	20.88	23.49	0.53	0.00	20.52	23.92
Na <sub>2</sub> O	0.58	0.34			0.94	0.48			0.76	0.40
K <sub>2</sub> O	0.08	0.00			0.00	0.00			0.09	0.07
Total	99.01	99.86	99.07	100.43	99.46	100.46	99.10	100.07	99.74	98.39
Wo	53.1	55.7			48.0	51.7			47.1	53.2
En	39.9	32.8			40.5	39.0			43.0	36.4
Fs	7.0	11.5			11.5	9.3			9.9	10.4
Fo			79.7				77.5			
Ulv				1.4				1.6		
Cr #				3.4				2.0		

The black clinopyroxene of the studied enclaves is subsilicic diopside relatively rich in Al and Ti. It often displays rimward increase in Ca and Ti accompanied by decrease in either iron or magnesium. In the studied enclaves, perforated, full of glassy inclusions clinopyroxene grains predominate over the clear, homogeneous ones, that form sporadically rims around the fine perforated cores of grains. As to mineral chemistry, the perforated clinopyroxenes are richer in Si, Mg, Cr as well as poorer in Al and Fe than the clear ones. The perforated clinopyroxenes show closer chemical affinity to clinopyroxene megacrysts, while the clear ones resemble the phenocrysts found in the host nephelinite. The discussed clinopyroxenes from enclaves differ also from the HP augite megacrysts from basanites of the Łądek Zdrój area (Bakun-Czubarow, Białowolska 2001) in lower contents of SiO<sub>2</sub> and MgO as well as in distinctly higher content of CaO. Subordinate olivines of the clinopyroxenite enclaves are chrysolites (Fo<sub>≤80</sub>). Accessory greenish-black spinel from the enclaves is chromium- and titanium-poor pleonaste. Similar to the above described mineral assemblages, but different from those of the upper mantle peridotites, have been found in Quaternary alkali-olivine basalts of Minusa and Transbaikalian regions, Siberia (Kutolin, Frolova 1970).

As far as REE distribution patterns are concerned the bigger black clinopyroxenite enclave and clinopyroxene megacrysts from Księginki differ considerably from the host nephelinite in both REE contents and the shape of pattern (Fig. 2).

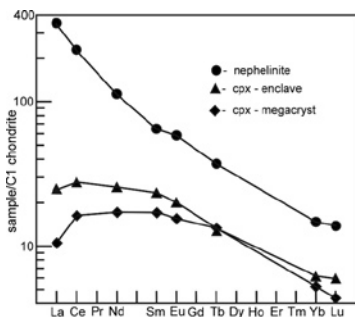


Fig.2. REE patterns for the bigger clinopyroxenite enclave, clinopyroxene megacryst and the host Księginki nephelinite

On one hand, the nephelinite is the material richest in all the REE and displays the highest degree of fractionation of the whole REE group ( $La_N/Lu_N = 25$ ). On the other hand, the clinopyroxene megacryst displays the lowest abundances of REE, distinct convex in the LREE part of distribution pattern ( $La_N/Sm = 0.65$ ) and considerable fractionation of HREE ( $Tb_N/Lu_N = 3.0$ ). The clinopyroxenite shows the REE pattern ( $La_N/Lu_N = 4.2$ ) similar to that for clinopyroxene megacrysts ( $La_N/Lu_N = 2.6$ ), but it is slightly richer in REE and displays a less pronounced LREE convex pattern ( $La_N/Sm_N = 1.04$ ) as well as lower fractionation of HREE ( $Tb_N/Lu_N = 2.2$ ) than the megacryst.

On the basis of mineral chemistry, textures, the affinity to the HP clinopyroxene megacrysts and the preliminary estimates of the olivine-clinopyroxene equilibration pressures, the hypothesis can be put forward that the black clinopyroxenite enclaves are cognate cumulates which originated within the Cr-poor and Ti-rich basaltic magma, at the depths of lower lithosphere similar to those characteristic of the crystallization of the HP megacrysts. During the uprise of the host, continuously changing basaltic magma, at a halting stage, primary black clinopyroxenes became unstable and were perforated by fluid-rich melts, then, in some places, rimmed with  $SiO_2$ -poorer clear clinopyroxene.

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