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**GABBROIC ENCLAVES FROM BASALTOIDS OF THE LUBAŃ  
 AND ZŁOTORYJA REGIONS, LOWER SILESIA**

Basaltoids of the Lubań and Złotoryja regions belong to the Tertiary Central European Volcanic Province characterized by considerable deficiency of silica in relation to alkalis as well as by high degree of depletion of basaltoid volcanics (Blusztajn, Hart 1989). In the discussed regions, the volcanic activity occurred, most likely, in the Early Miocene (Birkenmajer *et al.* 2002). Apart from the upper mantle peridotite enclaves and pyroxenite cumulates, there have been found in the basaltoids rare gabbroic enclaves, being usually smaller than peridotitic ones (Białowska 1993).

In the present study the gabbroic enclaves from nephelinites in the vicinity of Jałowiec and of the Księginki quarry in the Lubań region as well as from basanites of the Trupień and Łysanka hills in the Złotoryja region were investigated. The size of

Table 1. Representative microprobe analyses of olivine and spinel from gabbroic enclaves from basaltoids of the Lubań and Złotoryja regions.

	Księginki quarry		Trupień hill						basalt	
	enclave		enclaves							
	K		T 14			T 51				T
	ol	sp	ol	ol agg.	sp	ol	ol agg.	sp		ol
	1	2	3	4	5	6	7	8	9	
SiO <sub>2</sub>	36.05	0.27	37.51	37.38	0.14	35.88	38.43	0.24	39.37	
TiO <sub>2</sub>	0.00	21.67	0.00	0.05	16.76	0.00	0.05	20.56	0.08	
Al <sub>2</sub> O <sub>3</sub>		3.15			1.86			2.45		
Cr <sub>2</sub> O <sub>3</sub>		0.20			2.78			0.38		
Fe <sub>2</sub> O <sub>3</sub>		22.41			32.52			26.74		
FeO	34.92	49.02	25.78	26.64	41.94	30.79	25.86	43.94	21.29	
MnO	0.68	0.49	0.75	0.82	0.64	0.69	0.66	0.57	0.23	
NiO	0.12	0.00	0.21	0.00	0.13	0.00	0.18	0.30	0.29	
MgO	28.38	1.39	34.38	33.80	2.76	31.81	34.71	3.55	38.73	
CaO	0.33	0.02	0.39	0.37	0.08	0.36	0.32	0.28	0.31	
Total	100.48	98.62	99.48	99.06	99.61	99.53	100.20	99.01	100.30	
Fo	58.7		70.1	68.7		64.3	68.4		76.2	
Ulv		60.5			46.4			56.5		

gabbroic enclaves varies from relatively small, e.g. ball-shaped enclave T51 has only 5 cm in diameter and spindle-shaped T14 one is 17 cm long, to the unusually large,

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loaf-shaped enclave K (28x19 cm big and up to 16 cm high). The studied enclaves are built up mainly of olivine gabbro, being composed of labradorite plagioclase, diopside, orthopyroxene (ferrohypersthene), Fe-rich olivine (hyalosiderite and chrysolite), titanomagnetite, interstitial glass and rare biotite surrounding titanomagnetite grains. The gabbroic rocks have mainly cumulus-like texture, excluding enclave K, that has subophitic one. The representative microprobe analyses from selected gabbroic enclaves are given in Tables 1 and 2.

Table 2. Representative microprobe analyses of pyroxenes and feldspars from gabbroic enclaves from basaltoids of the Lubań and Złotoryja regions.

	Księginki quarry		Trupień hill							basalt	
	enclave		enclaves								
	K		T 14			T 51					T
	cpx	fld	cpx	fld-c	fld-r	opx	cpx	fld-c	fld-r		cpx
	1	2	3	4	5	6	7	8	9	10	
SiO <sub>2</sub>	50.42	53.13	50.86	54.68	65.05	52.55	51.75	56.31	65.26	43.70	
TiO <sub>2</sub>	1.56	0.04	1.65	0.00	0.22	0.18	0.54	0.01	0.48	4.70	
Al <sub>2</sub> O <sub>3</sub>	2.21	28.60	2.23	27.61	19.94	1.75	3.06	27.18	19.77	9.39	
Cr <sub>2</sub> O <sub>3</sub>	0.00		0.05			0.02	0.06			0.00	
FeO	9.65	0.30	8.38	0.21	0.22	24.96	10.25	0.15	0.41	7.68	
MnO	0.30		0.26			0.68	0.26			0.16	
MgO	14.02	0.00	13.28	0.00	0.00	18.88	11.91	0.00	0.00	11.43	
CaO	22.05	13.06	21.67	11.57	2.23	0.49	21.94	10.61	1.90	22.60	
Na <sub>2</sub> O	0.36	4.06	0.63	4.77	7.55	0.52	0.68	5.24	7.04	0.49	
K <sub>2</sub> O	0.03	0.36	0.07	0.36	3.73	0.06	0.00	0.40	4.08	0.00	
Total	100.60	99.55	99.08	99.20	98.94	100.09	100.45	99.90	98.94	100.15	
Wo	45.8		46.4			1.1	47.2			51.7	
En	40.5		39.6			56.8	35.6			36.3	
Fs	13.7		14.0			42.1	17.2			12.0	
An		62.6		56.1	11.0			51.6	9.8		
Ab		35.3		41.8	67.2			46.1	65.3		
Or		2.1		2.1	21.8			2.3	24.9		

From among the studied enclaves, only the biggest enclave K from the Księginki nephelinite is conspicuous by its Fe-richer olivines, Ca-richer plagioclases and by slight alteration of minerals. Equilibration conditions of the cumulate type gabbroic enclaves from the Złotoryja region basanites have been tentatively estimated by means of conventional mineral geothermobarometers (including pyroxene thermometer of Wells, 1977) for 1100 °C under the pressure of about 10 kbars. The minerals within the enclaves underwent high-temperature metasomatic alterations caused by both fluid and magmatic agents of varying composition. On one hand, during these alterations Ca-richer clinopyroxene grains suffered stronger corrosion than the Ca-poorer ones. On the other hand, orthopyroxenes underwent wet, incongruent melting accompanied by crystallization of olivine aggregates and formation of anorthoclase rims around plagioclase crystals.

The gabbroic enclaves are distinctly diversified as far as contents and fractionation patterns of REE in relation to host basaltoids are concerned. On one hand, nephelinites of the Księginki quarry (in the Lubań area) are the richest in REE from among

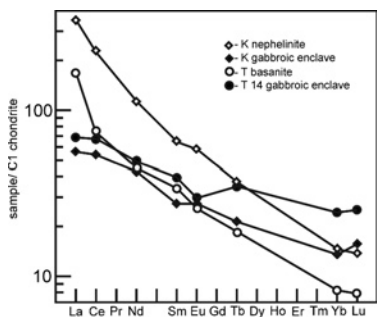


Fig. 1. REE patterns for selected gabbroic enclaves and host basalts

of HREE is much weaker ( $Tb_N/Lu_N = 1.3$ ). On the other hand, the gabbroic enclave from the Trupień hill (in the Złotoryja region) is richer in majority of REE as compared to the host basanite, which shows markedly higher degree of fractionation ( $La_N/Lu_N = 21$ ) than the enclave ( $La_N/Lu_N = 2.8$ ), where both LREE and HREE are only slightly fractionated ( $La_N/Sm_N = 1.7$  and  $Tb_N/Lu_N = 1.4$ ).

On the basis of texture, the degree of alteration, mineral chemistry and REE geochemistry, the hypothesis can be put forward that the majority of the studied gabbroic enclaves found in basalts (from Trupień and Łysanka hills as well as from Jałowiec) are cognate and reflect the magma crystallization prior to eruption. The only exception is the big gabbroic enclave from the Księginiki nephelinite which may represent a hypabyssal country rock or a fragment of doleritic dike.

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