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**MORPHOLOGICAL AND TYPOLOGICAL STUDY OF ZIRCONS FROM
THE LIPOWE HILLS GNEISSES (EASTERN PART OF THE FORE -
SUDETIC BLOCK): PRELIMINARY PETROGENETIC DATA**

The Lipowe Hills massif (*LHM*) is located in the eastern part of the Fore-Sudetic Block (*in the East/West Sudetes boundary zone*). It represents an isolated outcrop of metamorphic basement exposed between the Strzelin crystalline massif on the east and the Niemcza - Kamieniec metamorphic complex on the west, about 40 km south of Wrocław. The *LHM* consists of three main rock groups: gneisses, schist series (amphibolites, mica schists, calc-silicate rocks and marbles) and Variscan granitoids.

Four principal varieties of gneisses are exposed in the Lipowe Hills massif (Oberc-Dziedzic 1995): 1) light, laminated or augen gneiss (the light Stachów gneiss - *LSg*), 2) dark, fine-grained migmatitic, sillimanite gneiss (the dark Stachów gneiss - *DSg*) - both varieties of gneisses are exposed in the northern part of the *LHM* 3) light, migmatitic gneiss with sillimanite nodules (the Nowolesie gneiss - *Ng*), which is common in the middle part of the *LHM* and 4) mylonitic, chlorite gneiss (the Henryków gneiss - *Hg*) - in the southern part of the *LHM*.

The *LSg* is rich in quartz, plagioclase and microcline. Biotite is less common. Muscovite and sillimanite (fibrolite) occurs as minor constituents. Accessory minerals are represented by zircon, apatite and garnet. The *DSg* is composed of biotite, quartz, K-feldspar, plagioclase and sillimanite. Muscovite is less common. Accessory are apatite, zircon and opaque minerals. The *Ng* consists of quartz, plagioclase (albite, oligoclase), microcline, biotite, muscovite and sillimanite. The sillimanite and quartz form nodules. Accessory phases comprise zircon, apatite, titanite and opaque minerals. The *Hg* is composed of quartz, K-feldspar, plagioclase (albite, oligoclase) muscovite and chlorite (two generations). K-feldspar and plagioclase are often strongly sericitised. The first generation of chlorite comprises plates replacing biotite, the second one fills in brittle joints. Apatite, zircon and opaque minerals present as main accessories.

In this study we use the morphology, morphometry and typology of zircon grains to determine a petrogenesis of the gneisses and their petrological connections with the rocks of adjacent geological units. In addition, we take into account the result obtained by Wierdak-Choroś (2001) in her MSc thesis. Five samples of principal varieties of the Lipowe Hills gneisses were taken under examination. (SA 3.1 (Sadowice) – corresponding to the *DSg*, WL 5.81

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(Nieszkowice) and WL 6.11 (Stachów) - corresponding to the *LSg*, WL 3.151 - corresponding to the *Ng* and HR 1.11 (Henryków) - corresponding to the *Hg*). For the sample symbols, location and characteristic of zircon from the investigated gneisses see Table 1.

Table 1. Morphology, morphometry and typology of zircons from the gneisses from the Lipowe Hills massif.

Morphology, morphometry and typology of zircons	Gneisses from the Lipowe Hills massif				
	SA 3.1	WL 6.11	WL 5.81	WL 3.151	HR 1.11
Sample					
Quantity of investigated zircons	100	100	100	100	100
Euhedral and subhedral crystals, %	41	49	68	47	31
Subrounded and rounded grains, %	53	49	25	46	53
Angular forms, %	6	2	7	7	16
Broken zircons, %	11	17	4	22	21
Fractured zircons, %	0	2	0	5	3
Zircons with "extinction angle", %	0	0	4	3	0
Mean length, mm	0.08	0.17	0.12	0.10	0.14
Standard deviation of length, mm	0.05	0.06	0.03	0.05	0.05
Mean width, mm	0.06	0.09	0.06	0.06	0.09
Standard deviation of width, mm	0.03	0.04	0.02	0.02	0.03
Mean elongation	1.6	1.9	2.0	2.0	1.7
Standard deviation of elongation	0.4	0.6	0.6	0.8	0.5
Main typological forms	S ₄ , S ₃	S ₇ , S ₂	S ₂ , S ₇	S ₁ , S ₂	S ₂ , S ₇
Subordinate typological forms	S ₂ , G ₁	S ₄ , S ₅	L ₂ , L ₁	S ₆ , S ₄ , L ₁	S ₆ , S ₅

From the basic morphological and morphometric and typological characteristic (Table 1), it is evident that:

1. The greatest part of zircons from all investigated samples are colourless and light gray, only the sample of the Henryków gneiss (HR 1.11) contains of the dark gray grains (Wierdak-Choroś 2001).
2. The sample (WL 5.81) of gneiss from Nieszkowice comprises the most euhedral and subhedral zircon crystals (70%).
3. The rounded and subrounded and angular grains of zircon most often occur in the gneisses from Sadowice (SA 3.1) and Henryków (HR 1.11). Small content of zircons is typical of the Henryków gneiss.
4. The remaining samples of gneisses (WL 6.11, WL 3.151) contain almost the same number of the euhedral and subhedral as subrounded and rounded zircons (Tab. 1).
5. Examined zircons, extracted from gneisses of the Lipowe Hills, showing considerable diversification on the typologic frequency distribution diagram of Pupin (1980), but at the majority of them prevail subtypes S₂, S₇, S₁, S₃, which are typical as component of crustal anatectic origin (e.g., Pupin 1980).

The gneisses from Nieszkowice, Wilamowice Ząbkowickie and Stachów vicinities were formed from S-granite protoliths (Pupin 1980). The same type of protolith of the light Stachów gneiss is suggested as a result of geochemical investigation (Madej 2002). The Sadowice gneiss may be orto- or paragneiss, altered by migmatitization. The Henryków gneiss with the small amount of crustal zircon crystals may represent poor in zircon protolith. The great diversification of the types and subtypes among of zircons from this sample (Table 1) and a lot of rounded, subrounded and angular grains may be interpreted as the evidence of the formation from a suite of sedimentary rocks or, alternatively, they represent primary magmatic zircons deformed during mylonitization.

The preliminary results of zircons studies from gneisses of the Lipowe Hills massif suggest that all of the gneisses were formed from a crustal affinity protoliths (Pupin 1980). There are a lot of similar features of zircons from the Lipowe Hills gneisses to zircon crystals from gneisses of the Strzelin crystalline massif (Klimas et al. 2001). The petrographic similarity theirs gneisses underlined earlier Oberc-Dziedzic (1995).

An investigating more samples and application of other techniques (e.g. cathodoluminescence imaging) could highlight the problem in more detail.

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