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MINERALOGICAL CHARACTERISTICS OF LOESSES FROM BIAŁY KOŚCIÓŁ (NIEMCZAŃSKO-STRZELIŃSKIE HILLS) BASED ON HEAVY MINERALS ANALYSIS

Abstract: Analysis of transparent heavy minerals in loesses indicates the domination of two mineral groups: amphiboles and garnets. They are derived from residua of local metamorphic and magmatic massifs building the western part of the Sudetes, what is testified mainly by amphiboles being indicators of short transport. The eolian transport was from western directions.
Keywords: heavy minerals, loesses, Sudetes

INTRODUCTION

The exposure of loesses in Biały Kościół lies within a closed down clay-pit near the Strzelin-Ziębice road, on the western slope of the Oława river valley at ca.

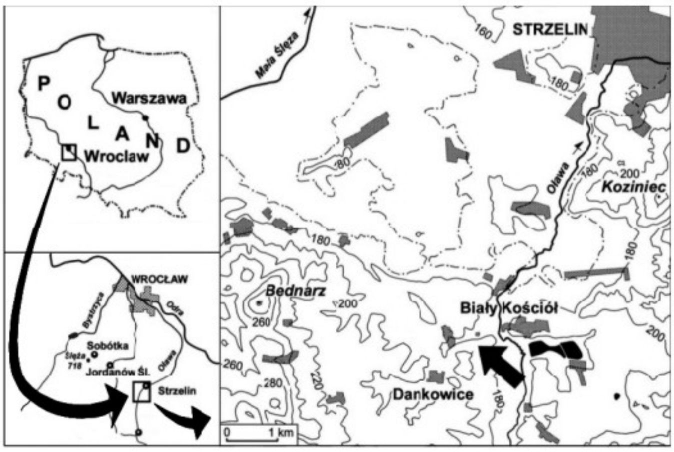

Fig. 1.
Location map of the loess section in Bialy Kosciol.

180 m a.s.l. (Fig.1). Loesses in the vicinity of Biały Kościół were investigated by e.g. Raczkowski (1960), Ciszek (1997), Ciszek et al. (2001). The loess section is represented by loesses and palaeosols developed during the last interglacial-glacial Eemian-Early Vistulian cycle. Distinguishing lower younger loesses (Lmd) and upper younger loesses (Lmg) in the studied section, according to sub-divisions of

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Maruszczak (1976) enables comparison with loesses from other successions within the Sudetes and their foreland (Chlebowski et al. 2004).

MINERALOGICAL ANALYSIS

Samples (11 in total) from the entire exposed section, from all lithological units (a – g on Fig. 2) were collected for mineralogical analysis.

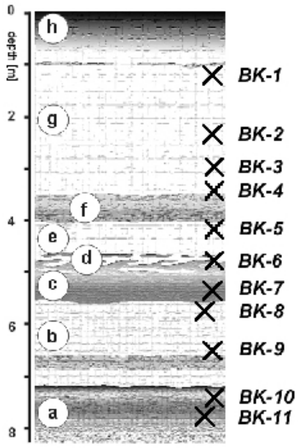

Fig.2. Lithological column of the loess exposure in Bialy Kosciol:
a - pedocomplex of the eemian and early vistulian age
b - lower younger loesses (LMd)
c - set of tundra-gley soils of the middle pleniglacial age developed on lower and middle younger loesses (LMd + LMs)
d - cryoturbations/solifluction layer
e - upper younger loesses (LMg) - lower horizon
f - weak developed tundra-gley soil
g - upper younger loesses (LMg) - upper horizon
h - recent soil
BK-1 - BK-11 - samples collected for mineralogical analyses.

Detailed analysis of transparent heavy minerals was carried out, and subsequently, following Chlebowski et al. (2002), they were sub-divided into 5 groups (Table 1).

RESULTS

The following regularities can be observed:

1. The heavy mineral content in all loess samples from beds "b – g"(samples BK-1-BK-9) is identical, whereas samples BK-10 and BK-11, representing bed "a", show a similar content, however distinctly different from the former.
2. The mineral content of beds "b – g" is dominated by minerals from group II (mainly garnets) and group III (mainly amphiboles); bed "a" in turn is dominated by minerals from group I (zircon and rutile), and to a smaller degree from group III (mainly amphiboles) and group II (mainly garnets).
3. The distinct diversity in the composition of the assemblage of transparent heavy minerals in bed "a" (samples BK-10 and BK-11) in relation to the upper parts of the section, consisting of a distinct decrease of garnets is most probably strongly linked with the different lithology of the deposits in this part of the section (palaeosol).

Table 1. Content of transparent heavy minerals in percent and the content of carbonates and microfossil remnants in loesses from Biały Kościół

Minerals	Samples											Groups
	BK1	BK2	BK3	BK4	BK5	BK6	BK7	BK8	BK9	BK10	BK11	
Anatase	0,0	0,2	0,0	0,0	0,0	0,2	0,2	0,2	0,0	0,7	0,5	
Andalusite	0,2	0,0	0,0	0,0	0,8	0,0	0,2	0,0	0,2	0,0	0,5	
Kyanite	1,2	0,7	1,8	1,1	1,0	1,9	0,5	1,4	1,0	3,9	1,2	
Monazite	0,2	0,2	0,2	0,3	0,0	0,2	0,2	0,0	0,2	0,0	0,2	
Rutile	3,0	7,3	5,0	4,6	2,6	7,2	9,2	8,0	8,5	12,0	20,8	I
Sphene	0,0	0,0	0,0	0,0	0,2	0,2	0,0	0,0	0,2	0,0	0,0	
Staurolite	0,8	0,7	4,7	2,4	4,4	1,4	0,5	0,7	0,8	0,5	1,0	
Topaz	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Tourmaline	1,5	1,2	0,7	1,4	4,7	1,9	1,2	1,6	2,2	3,0	7,8	
Zircon	7,0	2,9	7,1	4,0	4,2	8,1	8,5	9,6	6,2	14,9	30,1	
Apatite	0,8	1,0	0,9	0,5	0,8	0,2	0,5	0,9	1,0	1,4	0,5	
Epidotes	8,8	2,6	3,3	2,7	11,2	11,7	5,6	5,5	10,4	7,2	8,1	II
Garnets	49,2	46,1	43,0	46,5	39,6	32,9	44,0	50,3	44,4	20,2	5,9	
Sillimanite	0,2	0,5	0,4	0,5	0,5	0,5	0,0	0,0	1,2	0,0	0,5	
Amphiboles	14,7	26,7	21,4	26,8	20,3	26,7	19,8	11,2	17,0	29,7	13,8	III
Pyroxenes	0,8	0,7	1,8	1,4	1,3	0,7	1,7	1,6	0,5	2,3	4,4	
Glauconite	0,8	0,7	0,7	0,3	0,8	0,0	0,0	0,7	0,0	0,5	1,5	IV
Biotite	4,0	3,3	2,4	1,9	2,1	1,4	2,9	3,7	1,2	0,9	1,5	
Chlorite	0,8	0,7	0,4	0,5	0,8	0,7	0,2	0,2	1,0	0,5	0,2	V
Muscovite	5,2	3,8	5,8	4,6	3,9	3,1	4,3	3,7	3,2	1,6	0,5	
Others	0,8	0,7	0,4	0,5	0,8	1,0	0,5	0,7	0,8	0,7	1,0	
Carbonates	-	+	+	-	-	-	-	+	-	-	-	
Foraminifers	-	-	+	-	-	-	-	+	-	-	-	

CONCLUSIONS

The mineralogical characteristics of the investigated loesses and the geomorphologic analysis of the studied section allow to draw conclusions on the origin of the loess-forming material, thus on the source areas, as well as on the directions of winds transporting this material.

1. The domination of two mineral groups (amphiboles and garnets) in all samples from the section univocally point to the local character of these components, particularly amphiboles – minerals typically undergoing short transport, and defining the so-called "local material vector" (Chlebowski et al. 2002). They are the main components of metamorphic and igneous rocks, such as amphibolites, biotite-hornblende granites, gneisses and mica-garnet schists, volcanics, etc., building the surrounding rock massifs of e.g. Sowie Mts., the Strzegom-Sobótka region, Ślęża and vicinities. Rocks occurring in this area are the main source of the loess-forming material.

2. The unchanged mineral composition of the loesses throughout the analysed section points to the fact that during the long interval of the sedimentation of lower, middle and upper younger loesses the sources of the loess-forming material remained the same.
3. Constant sources of loess-forming material supply indicate also the unchanging main wind directions. The position of rock massifs being the most probable source areas for the mineral material in relation to places of loess deposition indicate that the winds blew from westerly directions. Sporadically other directions could also be active.
4. The fact of sporadic occurrence of microfossils (foraminifers) in the studied loesses, which are good indicators of the local origin of the material (Paruch-Kulczycka et al. 2003) points to incidental changes in wind directions and the additional supply of material from other sources.
5. The distinct mineralogical variability, particularly the drastic decrease of garnets content in the soil bed at the base of the analysed loess section points to the destructive activity of organic matter from the soil on these minerals, causing in some cases even its total destruction.

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