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The Profile of Loesses at Korshov (NW Ukraine) in the Light of Heavy Minerals Analyses*

Profil lessów w Korszowie (Ukraina NW) w świetle analiz minerałów ciężkich

Abstract. The authors studied 39 samples of 0.06-0.02 mm fraction taken from loesses at Korshov near Luck; the total thickness of the sampled layers was 22 m. Statistically differentiated weight content of heavy minerals was analysed: content of opaque minerals; content of ferruginous and carbonate concretions and muscovite; content of transparent minerals which were divided into groups of different resistance. Two distinguishable layer units were singled out: 1) with considerable predominance of zircon and rutile over amphiboles, garnet and epidotes (younger and older loesses as well as interstadial soils); 2) predominance of zircon and rutile over garnets and epidotes (soils from the three last interglacials with accompanying layers). The results were compared with those obtained earlier for other loess profiles from the areas of NW Ukraine and SE Poland.

Key words: younger and older loesses, interglacial soils, assemblages of heavy minerals, NW Ukraine, SE Poland.

INTRODUCTION

The profile of Korhov loess is situated 18 km SW of Luck in the Volhynian Upland. This profile was briefly presented in the paper of V.N. Shelkoplyas et al. (1985) together with results of datings by the TL method. The simplified lithostratigraphic diagram presented here (Fig. 1) was prepared from an archival typescript of A. Bogucki (1993). The basic purpose of this paper is analysis of composition changes of heavy minerals

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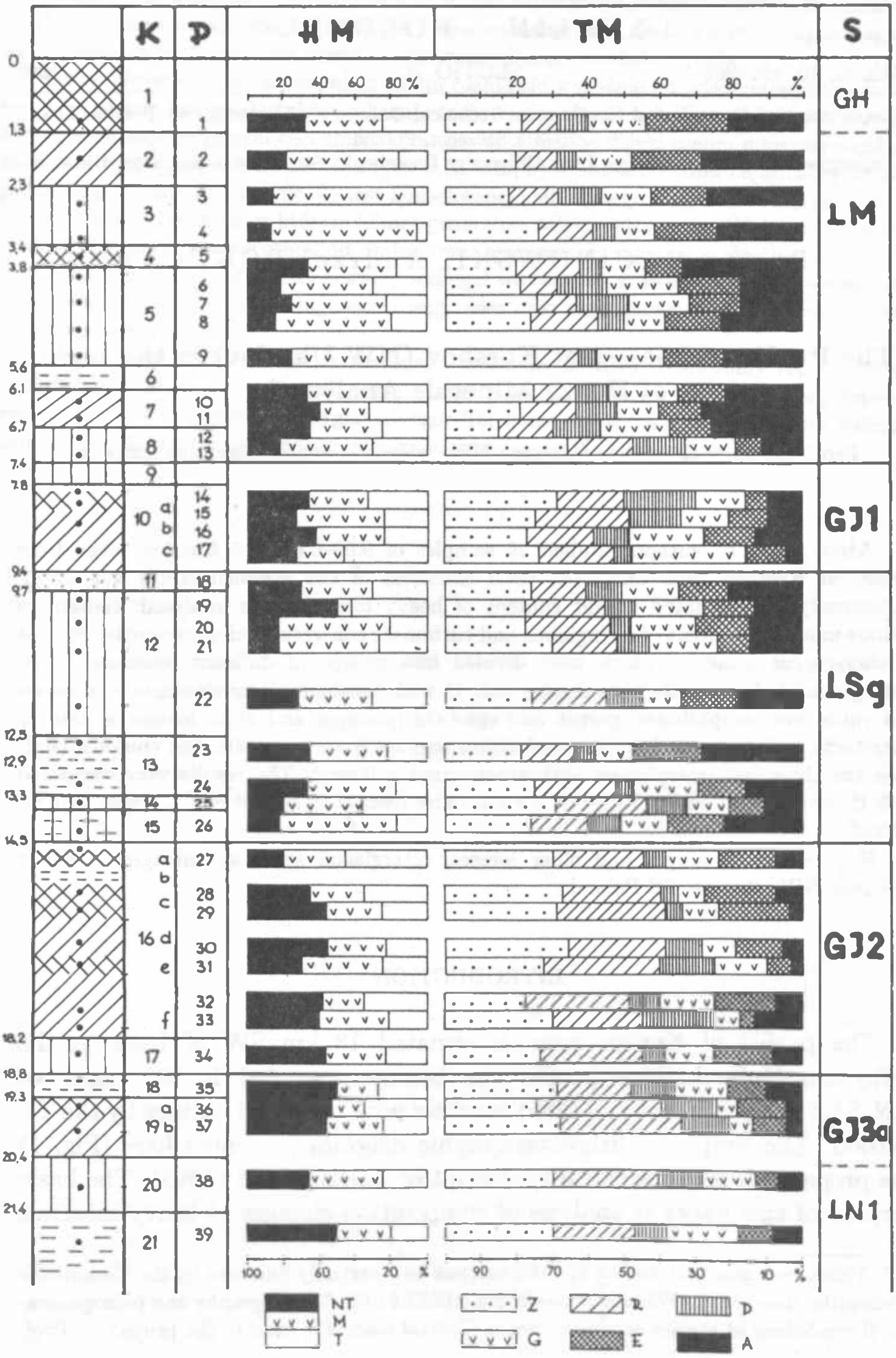
K
P
HM
TM
S
20 40 60 80 %
20 40 60 80 %
100 60 20 %
90 70 50 30 10 %
0
1.3
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3.8
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1 2 3 4 5 6 7 8 9 10 a b c 11 12 13 14 15 16 a b c d e f 17 18 19 a b 20 21
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
GH
LM
GJ1
LSg
GJ2
GJ3a
LN1
NT
M
T
Z
G
R
E
D
A

assemblage in the lithostratigraphic loess units and in different genetic horizons of fossil soils. A. Bogucki took samples for mineralogical studies in 1993. Separation of heavy minerals from fraction 0.06–0.02 mm was done by dr J. Nowak in the Department of Geology, Maria Curie-Skłodowska in Lublin. Analyses of heavy minerals were made by R. Racinowski.

STRATIGRAPHIC DIFFERENTIATION OF LOESSES AT KORSHOV

The loess profile at Korshov is presented schematically in Fig. 1 including composition diagrams of heavy minerals assemblage in 39 analysed samples. Besides the profile diagram in column "K" stratigraphic complexes of the layers distinguished in Volhynia by A. Bogucki are numbered; the complexes are defined in the figure caption. In column "S", however, are stratigraphic indices according to the scheme for Polish loesses used by H. Maruszczak (1994; in this publication the correlation of schemes used for Ukrainian and Polish loesses is given). In the text the indices used by H. Maruszczak are given to facilitate comparison with papers concerning Polish loesses.

A lithostratigraphic diagram is given in a simplified form according to the character of the work. The situation of 39 samples taken for mineralogical studies at Korshov are denoted. For statistical analysis the samples

Fig. 1. Variability of the content of main heavy minerals at Korshov loess profile (fraction 0.06–0.02 mm); K — **deposits groups** after A. Bogucki (1993): 1 — present soil (chernozem); 2 — Krasilovsk subhorizon; 3 — typical loess; 4 — Rovno horizon; 5 — loess under Rovno horizon; 6 — Dubno solifluction deposit; 7 — strongly disturbed Dubno soil; 8 — lower level of Vistulian loesses; 9 — deposits over Horokhov soil; 10 — Horokhov pedocomplex (a — soil horizon A; b — soil horizon BI; c — soil horizon BII); 11 — silty sands; 12 — loess-like deposits; 13 — loams gleyed at floor; 14 — carbonate loess; 15 — Tarnopol subhorizon with solifluction layers at roof; 16 — Korshov pedocomplex (a — loams passing into soil horizon A; b — solifluction deposit; c — soil horizon A of second phase; d — soil horizon B of second phase; e — soil horizon A of first phase; f — soil horizon B of first phase); 17 — parent deposit of Korshov pedocomplex; 18 — solifluction silts with fauna; 19 — Luck soil (a — solifluction silts and soil horizon A; b — soil horizon B); 20 — loess under Luck soil; 21 — eluvial-deluvial deposits; P — **samples numeration** (location pointed with dots at the diagram of profile); HM — **heavy minerals composition**: NT — opaque minerals, concretions included; M — muscovite, together with chlorite; T — transparent minerals; TM — **composition of transparent heavy minerals**: Z — zircon and monazite; R — rutile; D — disthene, staurolite, andalusite, tourmaline and sillimanite; G — garnets; E — epidotes, zoisite and apatite; A — amphiboles, pyroxenes and biotite; S — **stratigraphy** after H. Maruszczak (1994): LM — younger loesses — Vistulian; GJ1 — interglacial soil — Eemian; LSg — upper older loesses — Wartanian; GJ2 — interglacial soil — Lublinian (= Saal.I/Saal.II); GJ3a — interglacial soil — Zbójnian (=Dömnitz = Schöningen?)

were grouped as follows: a) younger loess (LM), i.e. samples of loess and interstadial soils occurring in it, together with sample from the lower part of Holocene chernozem (in all 13 samples); b) upper older loess (LSg) and interstadial soils associated with it (9 samples); c-d-e) soils of interglacial rank (GJ1, GJ2, GJ3a), together with samples from directly overlying and underlying, pedogenetically changed layers (in all 17 samples).

In the lower part of the profile there are four complexes of the oldest layers: 21 — slope wash deposits with weathering products of upper Cretaceous bedrock; 20 — loess under Luck soil; 19 — solifluction muds turning into interglacial Luck soil; 18 — solifluction muds with fauna. They were jointly considered as representing the Mazovian (= Holsteinian) interglacial s.l.; in Fig. 1 they are denoted by index GJ3a by means of bold letters.

Layer complexes occur higher: 17 — loess under Korshov soil; 16 — multiple two-cycle Korshov pedocomplex with overlying muds. They represent lower and middle older loesses considerably changed by pedogenesis; most strongly transformed layers, correlated with the Lublinian (= Saal.I/Saal.II) interglacial, are denoted by index GJ2 in Fig. 1.

Another layer complex comprises: 15 — parent deposit of interstadial Tarnopol soil; 14 — carbonate loess; 13 — muds; 12 — loess-like deposit; 11 — silty sands. They are upper older loesses from the Wartanian (= Saalian II) glaciation, denoted by index LSg. Two layer complexes occur over them: 10 — interglacial Horokhov soil; 9 — sediment over Horokhov soil. They represent the last interglacial, i.e. Eemian s.l. (GJ1 in Fig. 1).

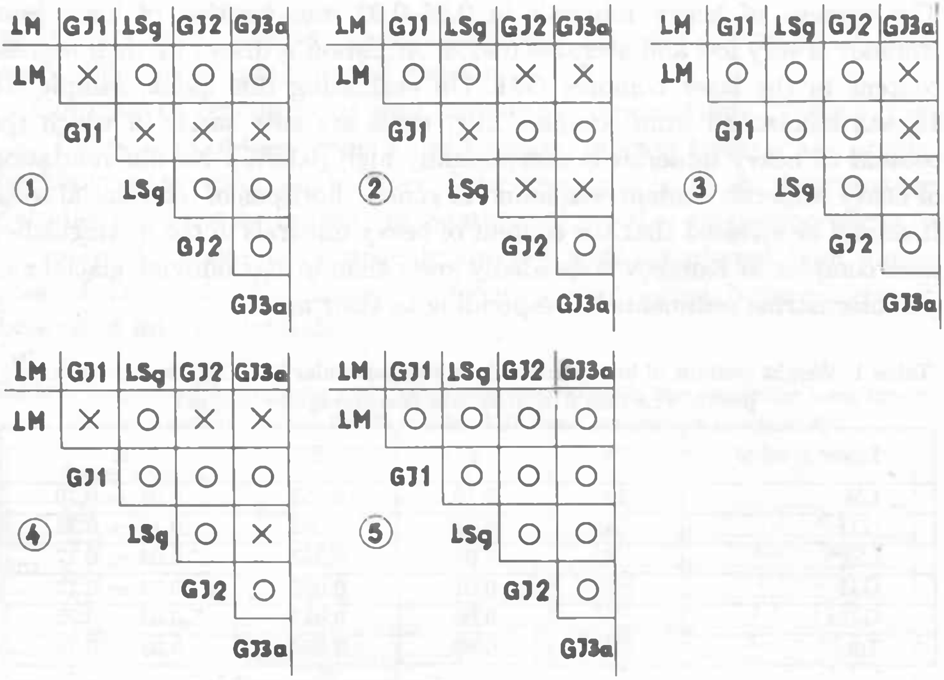
The upper part of the profile is constituted by the following layer complexes: 8 — lower layers of upper Pleistocene loess; 7 — interstadial Dubno soil; 6 — solifluction deposit; 5 — loess; 4 — interstadial Rovno soil; 3 — loess; 2 — gleyed loess of Krasilovsk subhorizon. Jointly with the parent deposit of Holocene soil (GH), forming layer complex 1, the upper part of the profile represents younger loess (LM) accumulated in the last glacial.

METHOD AND ANALYSIS RESULTS

Heavy minerals were separated in bromoform from fraction 0.06–0.02 mm. At first, opaque components, ferruginous and carbonate concretions, muscovite (together with chlorites) and transparent minerals were separated. The last group was analysed separately, epidotes being treated jointly with zoisites, whereas rutile with titanium minerals. Transparent minerals were determined for assemblages of about 300 grains; only in a few cases their number was 100–200 grains.

For five distinguished stratigraphic complexes of layers mean indices and standard deviation were calculated as well as extreme values of a given feature in assemblages were determined. The results are presented in Tables 1–11.

By Student's t-test the similarity or difference between the given features was determined in the particular layer complexes. If the calculation "t" is bigger than $t_{0.05}$ read from Student's table, for the number $(n_1+n_2^{-2})$ significant differences occur between mean values of the layers compared. This differentiation was presented also graphically (Fig. 2–3).



①

LM	GJ1	LSg	GJ2	GJ3a
LM	X	O	O	O
GJ1		X	X	X
LSg			O	O
GJ2				O
GJ3a				

②

LM	GJ1	LSg	GJ2	GJ3a
LM	O	O	X	X
GJ1		X	O	O
LSg			X	X
GJ2				O
GJ3a				

③

LM	GJ1	LSg	GJ2	GJ3a
LM	O	O	O	X
GJ1		O	O	X
LSg			O	X
GJ2				O
GJ3a				

④

LM	GJ1	LSg	GJ2	GJ3a
LM	X	O	X	X
GJ1		O	O	O
LSg			O	X
GJ2				O
GJ3a				

⑤

LM	GJ1	LSg	GJ2	GJ3a
LM	O	O	O	O
GJ1		O	O	O
LSg			O	O
GJ2				O
GJ3a				

Fig. 2. Similarities (O) and separatenesses (X) beetween basic features of heavy minerals determined by means of Student's t-test (fraction 0.06–0.02 mm); 1 — weight content of heavy minerals (percentage by weight); 2 — opaque heavy minerals (percentage by quantity); 3 — ferruginous and carbonate concretions (percentage by quantity); 4 — muscovite (percentage by quantity); 5 — transparent minerals (percentage by quantity). Stratigraphic symbols of layers explained in Fig. 1

Statistical analysis was applied to: a) weight content of heavy minerals in 0.06–0.02 mm fraction; b) content of opaque minerals in quantity %; c) content of ferruginous and carbonate concretions treated jointly in quantity %; d) content of muscovite together with chlorites in quantity %; e) content of transparent minerals in quantity %.

From among transparent minerals, treated jointly as 100% of grain number, 6 groups of components were tested according to their resistance degree: 1) zircon; 2) rutile together with other titanium minerals; 3) disthene + staurolite; 4) garnets; 5) epidotes together with zoisites; 6) amphiboles + pyroxenes + biotites.

DIFFERENTIATION OF MAIN FEATURES OF HEAVY MINERALS

Differentiation of weight content of minerals (Table 1, Fig. 2.1). The content of heavy minerals in 0.06–0.02 mm fraction of loess from Korshov is very low and averages 0.09%. Attention is drawn by their highest content in the layer complex GJ1. On evaluating this index, sample No 18 was eliminated from complex LSg; these are silty sands in which the content of heavy minerals is exceptionally high (0.50%). No differentiation of heavy minerals content was found in genetic horizons of interglacial soils. It should be stressed that the content of heavy minerals in the distinguished loess complex at Korshov is decidedly lower than in glaciofluvial, glacial and glaciolacustrine sediments corresponding to their age.

Table 1. Weight content of heavy minerals in the particular loess layers of the Korshov profile. Fraction 0.06–0.02 mm (percentage by weight)

Layer symbol	n	$\bar{x}$	S	R
LM	13	0.10	0.051	0.05 — 0.20
GJ1	4	0.21	0.086	0.14 — 0.34
LSg[a]	8	0.07	0.043	0.03 — 0.17
GJ2	7	0.07	0.030	0.04 — 0.13
GJ3a	5	0.06	0.027	0.03 — 0.10
Total[a]	38	0.09	0.064	0.03 — 0.34

Symbols of layers explained in Fig. 1; n — number of samples; $\bar{x}$ — arithmetic mean; S — standard deviation; R — extreme values. [a] without sample No 18 containing 0.50% of heavy minerals. Explanations of symbols for the Table 1–11.

Content of opaque heavy minerals (Table 2, Fig. 2.2). A tendency of the content of opaque minerals is observed to increase down the profile, i.e. with age increase of sediments. Complexes of LM and LSg layers are similar, distinguished by a relatively low content of opaque minerals. Complexes of layers comprising interglacial soils (GJ1, GJ2, GJ3a), containing more opaque minerals, are also similar. Their enrichment with minerals of this group must be associated with hypergenetic processes developing as a result of pedogenesis. This problem, however, was not analysed more closely. It

Table 2. Opaque heavy minerals content in the particular loess layers of the Korshov profile. Fraction 0.06–0.02 mm (percentage by quantity)

Layer symbol	n	$\bar{x}$	S	R
LM	13	20.0	8.43	9.2 — 35.0
GJ1	4	27.1	5.44	20.0 — 34.7
LSg	9	22.8	10.36	12.9 — 27.0
GJ2	8	30.1	9.39	14.2 — 42.0
GJ3a	5	35.7	6.64	25.8 — 43.9
Total	39	25.5	9.92	9.2 — 43.9

can be only noted that the particular genetic horizons of interglacial soils do not differ significantly in this respect.

Content of ferruginous and carbonate concretions (Table 3, Fig. 2.3). The content of these concretions increases in lower layers of the profile. Neighbouring samples can, however, differ considerably. At the present stage of studies it cannot be in every case estimated whether these concretions in the analysed fraction are autogenic, or they were transferred from source areas of loess silt. No distinct differences were found between genetic horizons of interglacial soils.

Table 3. Content of ferruginous and carbonate concretions in the particular loess layers of the Korshov profile. Fraction 0.06–0.02 mm (percentage by quantity)

Layer symbol	n	$\bar{x}$	S	R
LM	13	4.5	2.12	1.7 - 8.1
GJ1	4	4.9	1.71	3.3 — 6.6
LSg	9	4.4	1.49	1.7 - 6.9
GJ2	8	7.0	3.87	1.7 - 14.7
GJ3a	5	8.5	2.54	5.7 — 12.4
Total	39	5.6	2.80	1.7 — 14.7

Muscovite content (Table 4, Fig. 2.4). The content of muscovite shows a tendency to increase down the profile. However, the differences between neighbouring samples are very big. This can be connected with aerodynamic features of lamellar muscovite grains. It seems that deposition conditions must have been relatively quiet; it favoured successive sedimentation of this component. Genetic horizons of interglacial soils do not differ significantly in their muscovite content.

Total content of transparent heavy minerals (Table 5, Fig. 2.5). It is 26.1% on average; however, the differences between neighbouring samples are considerable. The distinguished layer complexes do not show significant

Table 4. Muscovite and chlorite content in the particular loess layers of the Korshov profile. Fraction 0.06–0.02 mm (percentage by quantity)

Layer symbol	n	$\bar{x}$	S	R
LM	13	53.8	15.44	28.5 — 84.2
GJ1	4	36.5	10.09	24.3 — 48.5
LSg	9	45.4	16.11	9.1 — 63.0
GJ2	8	33.5	6.50	23.7 — 46.4
GJ3a	5	29.3	9.36	17.3 — 42.5
Total	39	42.8	15.64	9.1 — 84.2

Table 5. Transparent minerals content in the particular loess layers of the Korshov profile. Fraction 0.06–0.02 mm (percentage by quantity)

Layer symbol	n	$\bar{x}$	S	R
LM	13	21.5	8.33	4.7 — 31.4
GJ1	4	31.4	11.60	22.8 — 47.4
LSg	9	27.3	7.91	18.5 — 41.2
GJ2	8	29.3	8.79	22.0 — 46.3
GJ3a	5	26.5	5.39	20.5 — 34.5
Total	39	26.1	8.70	4.7 — 47.4

differences. There are no distinct differences between genetic horizons of interglacial soils.

CONTENT OF THE MAIN GROUPS OF TRANSPARENT HEAVY MINERALS

Zircon content (Table 6, Fig. 3.1). Zircon is characteristic as the main component of transparent minerals of local Tertiary and upper Cretaceous rocks. It occurs in much smaller quantities in Quaternary glacial, glaciofluvial and glaciolacustrine sediments. The mean zircon content in the

Table 6. Zircon content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	22.0	4.1	14.9 — 32.3
GJ1	4	25.5	3.1	21.4 — 30.1
LSg	9	23.8	3.2	20.2 — 29.8
GJ2	8	28.6	3.1	20.5 — 31.2
GJ3a	5	29.2	2.0	25.2 — 31.0
Total	39	25.1	4.5	14.9 — 32.3

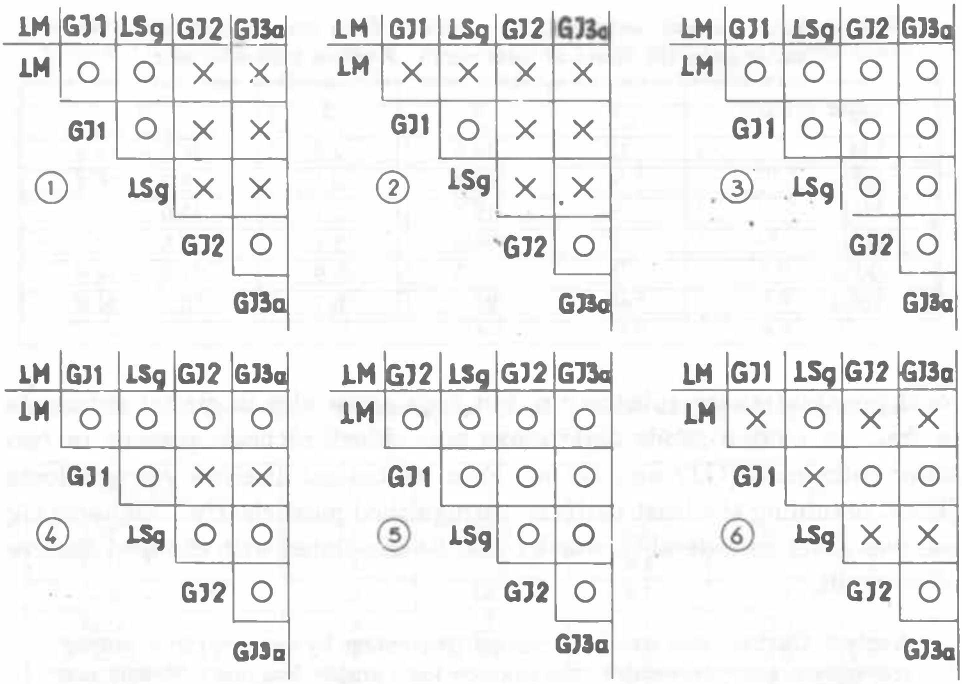


Fig. 3. Similarities (O) and separatenesses (X) between main groups of transparent minerals determined by means of Student's t-test (fraction 0.06–0.02 mm); Contents of components expressed in percentage by amount of grains were the subject of assessment: 1 — zircon; 2 — rutile; 3 — staurolite and disthene; 4 — garnets; 5 — epidotes; 6 — amphiboles, pyroxenes and biotite. Stratigraphic symbols of layers explained in Fig. 1

Korshov profile is 25.1%; it increases from top to bottom of the profile. Bigger differences between neighbouring samples are particularly distinct in the complex of LM layers. Younger loesses (LM), Horokhov soil (GJ1) and upper older loesses (LSg) are similar with respect to zircon content. They differ from the complexes (GJ2, GJ3a) occurring below which contain more zircons. There are no significant differences between genetic horizons of interglacial soils. It seems that a higher content of zircons in two lower, i.e. older complexes, could be interpreted by a higher content of components coming from local Tertiary and upper Cretaceous than from Quaternary rocks. Such an interpretation seems to be contradicted by the fact that the discussed area was probably in closest vicinity of the ice sheet front only during the Dnieperian (= Odranian = Saalian I) and Okanian (= Sanian II = Elsterian II).

Rutile content (Table 7, Fig. 3.2). The content of this group of minerals is 20% on average. They are characteristic largely for rocks of

Table 7. Rutile content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	14.5	2.8	10.5 — 18.9
GJ1	4	21.3	3.1	18.2 — 26.4
LSg	9	19.6	3.7	15.0 — 25.9
GJ2	8	28.0	2.4	24.8 — 32.9
GJ3a	5	28.5	5.9	21.0 — 34.8
Total	39	20.9	6.7	10.5 — 34.8

local pre-Quaternary substratum, but they occur also in glacial sediments in fraction of fine sands and coarse silts. Most rutile is present in two lower complexes (GJ2 and GJ3a). From statistical analysis younger loess (LM) containing the least rutile is distinguished most clearly. Neighbouring samples differ considerably, which could be associated with changed sources of loess silt.

Table 8. Disthene and staurolite content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	5.4	2.3	2.0 — 10.1
GJ1	4	9.6	3.9	4.1 — 15.2
LSg	9	6.4	3.1	3.3 — 9.5
GJ2	8	6.5	4.3	2.1 — 14.7
GJ3a	5	8.5	2.6	6.1 — 12.6
Total	39	6.8	3.5	2.0 — 15.2

Disthene and staurolite content (Table 8, Fig. 3.3). These minerals are characteristic for Tertiary sandy sediments. They are much less in Quaternary glacial sediments. The mean content of these minerals in the Korshov loess is 6.8%. Their vertical differentiation in the profiles is small.

Content of garnets (Table 9, Fig. 3.4). They are a characteristic component of Quaternary sediments; in Tertiary sediments they occur rarely in larger amounts. The mean content of garnets in the Korshov loess is 14.3%. The differences between the distinguished layer complexes are relatively small; garnets are the least in two lower complexes. Neighbouring samples may differ considerably in this respect, which can be associated with changed conditions of sedimentation and redeposition. A relatively high content of garnets may account for a multiple exposition of neighbouring Quaternary sediments to wind action.

Table 9. Garnets content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	14.9	3.4	10.3 — 19.7
GJ1	4	19.8	7.5	13.3 — 31.5
LSg	9	14.8	2.9	10.6 — 18.5
GJ2	8	11.4	3.3	6.6 — 19.3
GJ3a	5	11.9	5.4	4.4 — 19.3
Total	39	14.3	4.8	4.4 — 31.5

Table 10. Epidotes content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	12.9	3.1	6.4 — 19.6
GJ1	4	9.5	3.4	3.9 — 13.3
LSg	9	12.3	3.1	8.1 — 18.7
GJ2	8	13.3	5.7	2.2 — 20.3
GJ3a	5	9.0	2.6	5.0 — 11.8
Total	39	12.0	4.1	2.2 — 20.3

Content of epidotes (Table 10, Fig. 3.5). Epidotes together with zoisites are characteristic largely for glacial sediments and products of their redeposition in various sedimentation environments. Their mean content in the loesses studied is 12%. Differences between layer complexes and neighbouring samples are considerable. It is difficult to explain them at the present stage of studies. This was probably associated with differentiation of source materials of loess silt.

Table 11. Amphiboles, pyroxenes and biotite content (percentage by quantity) from among transparent heavy minerals in the Korshov loess profile. Fraction 0.06–0.02 mm

Layer symbol	n	$\bar{x}$	S	R
LM	13	22.9	4.8	12.4 — 29.6
GJ1	4	9.7	3.1	4.9 — 10.6
LSg	9	17.9	4.8	11.6 — 25.9
GJ2	8	7.4	3.1	3.6 — 13.9
GJ3a	5	7.0	1.6	5.2 — 9.7
Total	39	15.6	7.9	3.6 — 29.6

Content of amphiboles, pyroxenes and biotite (Table 11, Fig. 3.6). This group of components is characteristic for sediments of direct glacial accumulation; they are sporadically observed in Tertiary substratum sediments. At their mean content of 15.6% the differentiation is very big. The most of these minerals are found in younger loess (LM) and upper older loess (LSg). Thus it can be supposed that the source material of the two layer complexes was similar, which was largely constituted by sediments of glacial accumulation. Observations of the surface grains of these minerals in the analysed loesses do not indicate that they underwent epigenetic weathering processes.

RESULTS AND DISCUSSION

1. The distinguished layer complexes and neighbouring samples in the profile studied have often been found to differ considerably in the content of the particular heavy minerals. This can be associated largely with changing sources of loess silt. In dependence on the age and genesis of the source sediment it may be characterized by an individual composition of heavy minerals assemblage. These differences may also result from the dynamics of loess silt transport and sedimentation, as well as reflect the consequences of postsedimentation redeposition and degradation. Differentiated content of transparent minerals in some layers can be also associated with pedogenetic processes at the stage of epigenesis. The latter processes must have also changed the content of opaque minerals and ferruginous and carbonate concretions. They are thus conclusions similar to those which were drawn from studies of loess profiles in the neighbouring regions (R. Racinowski 1969, 1976, H. Maruszczak and M. Wilgat 1978, J. Buraczyński et al. 1978, 1986, A. Bogucki and R. Racinowski 1994).

2. On the basis of the assemblage composition of heavy minerals, irrespective of its considerable differentiation, two basic layer units can be distinguished in Korshov loesses (Table 12). The first comprises younger loesses (LM) and upper older ones (LSg). These layers are characterized by the following sequence of main transparent heavy minerals: zircon + rutile > amphiboles + garnets + epidotes. The most resistant components constitute 40% of grains. This seems to indicate that the source of blown silt material were largely glacial and glaciofluvial sediments as well as products of their redeposition. For that reason layers of proper loess and soil horizons of interstadial rank occurring among them are similar. This indicates that when soils of this rank were developing hypergenetic processes could only to a small extent affect destructively transparent heavy minerals.

The other unit comprises horizons of interglacial soils together with accompanying layers such as: Horokhov (GJ1), Korshov (GJ2) and Luck

Table 12. Average composition of transparent heavy minerals in particular loess layers in the Korshov profile (percentage by quantity). Fraction 0.06–0.02 mm. Explanations of strata symbols in Fig. 1

Layer symbol	Amphibole	Apatite	Biotite	Disthene	Epidote	Glauconite	Garnet	Monazite	Pyroxene	Rutile	Staurolite	Sillimanite	Tourmaline	Zircon	Others
LM	15.3	2.0	4.1	3.6	12.9	1.0	14.9	1.2	3.5	14.5	1.8	0.5	2.7	22.0	+
GJ1	6.3	1.2	1.2	6.2	9.5	0.2	19.8	0.5	2.2	21.3	3.4	0.3	2.2	25.5	0.2
LSg	11.2	1.4	2.3	4.3	12.3	0.4	14.8	0.9	4.4	19.6	2.1	0.5	1.8	23.8	0.2
GJ2	4.1	0.7	1.3	4.5	13.3	0.3	11.4	0.7	2.0	28.0	2.0	0.7	2.2	28.6	0.2
GJ3a	4.1	1.5	0.8	6.9	9.0	1.7	11.9	0.5	2.1	28.5	1.6	0.2	1.9	29.2	0.1

(GJ3a). In samples from these three layer complexes, the content of components most resistant to destruction increases distinctly (up to 54%) among transparent minerals. They are characterized by the following sequence of leading minerals: zircon + rutile > garnets + epidotes. The mean content of the least resistant (amphiboles, pyroxenes, biotite) is only 8%, i.e. 2.5 times lower than in the first unit (20%). It would be difficult to explain the differences between the two discussed units only by the changed character of loess silt sources. Particularly little probable seems to be the fact that the change of the source material may concern only these layers of the upper older loess which were changed by interglacial pedogenesis (soil GJ1 is developed on substratum LSg).

3. Despite differentiated composition of heavy minerals assemblage in layer complexes and in neighbouring samples a distinct tendency of the content of the least resistant components to decrease down the profile can be observed. This may be connected largely with hypergenetic processes accompanying the development of interglacial pedogenesis. Thus, this conclusion is convergent with that presented by H. Maruszczak and J. Morawski (1976) on the basis of analysis of differentiated composition of heavy minerals assemblage in basic lithostratigraphic units of Polish loesses. As no corrosion signs were found on grains of the least resistant minerals, it can be implied that above all they undergo disintegration.

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STRESZCZENIE

W profilu w Korszowie (18 km na SW od Łucka) wyróżniono pięć kompleksów warstw lessów i gleb kopalnych według schematu stosowanego dla Ukrainy NW (ryc. 1). Dla ułatwienia porównania z innymi opracowaniami oznaczono te kompleksy indeksami literowymi stosowanymi dla lessów polskich: LM — less młodszy (vistulian) razem ze współwystępującymi poziomami gleb interstadialnych; GJ1 — horochowska gleba interglacjalna (eemian); LSg — less starszy górny (wartanian) razem z poziomami gleb interstadialnych; GJ2 — korszowska gleba interglacjalna (lublinian = saal.I/saal.II) łącznie z warstwami współwystępującymi od dołu; GJ3a — łucka gleba interglacjalna (zbójnian = Dömnitz) z warstwami współwystępującymi.

Skład minerałów ciężkich określono dla frakcji 0,06–0,02 mm. Wyniki opracowano statystycznie za pomocą testu t-Studenta (tab. 1–11 i ryc. 2–3). Stwierdzono znaczne zróżnicowanie składu mineralnego próbek sąsiadujących ze sobą w profilu. Wiązało się to zapewne przede wszystkim ze zmianami charakteru materiału źródłowego, ewentualnie kierunków nawiewania pyłu lessowego. Pomimo tego wyróżnione kompleksy warstw wykazują pewne cechy indywidualne.

Wyróżniono dwa zasadnicze zespoły warstw, różniące się spektrami minerałów ciężkich (tab. 12). W pierwszym zespole, obejmującym LM i LSg, wiodącymi minerałami przezroczystymi są: cyrkon + rutyl > amfibole + granaty + epidoty. Najbardziej odporne (cyrkon i rutyl) stanowią w tym zespole 40%, a najmniej odporne (amfibole, pirokseny i biotyt) 20% ilości ziarn minerałów przezroczystych. Zespół drugi obejmuje kompleksy warstw GJ1, GJ2 i GJ3a, w których minerałów najodporniejszych jest jeszcze więcej (54%), a nieodpornych zdecydowanie mniej (8%). Minerały wiodące w tym drugim zespole to: cyrkon + rutyl > granaty + epidoty. Nie stwierdzono istotnych różnic między poziomami genetycznymi wymienionych gleb interglacjalnych.

Skład minerałów ciężkich wskazuje, że materiał źródłowy tworzywa lessów z Korszowa pochodził głównie z miejscowych utworów glacjalnych oraz produktów ich redepozycji (zasobnych w granaty, epidoty, amfibole, pirokseny i biotyt) oraz lokalnych skał trzeciorzędowych i górnokredowych (zasobnych głównie w cyrkon i rutyl). Świadczy to o autochtonizmie (w skali regionalnej czy wręcz nawet lokalnej) lessu z Korszowa, stwierdzanym także dla innych analizowanych profili lessów z terenu Ukrainy NW i Polski SE. Natomiast znaczne wzbogacenie udziału składników najbardziej odpornych, a duże zubożenie zawartości najmniej odpornych w glebach interglacjalnych wskazuje na istotną rolę wietrzeniowych procesów hipergenicznych, związanych z rozwojem intensywnej pedogenezy.

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