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Accumulation Conditions and the Upper Limit of Neopleistocene Loesses in the Central Roztocze Region (SE Poland)

Warunki akumulacji i górna granica lessów neoplejstoceńskich na Roztoczu Środkowym (Polska SE)

Abstract. The disribution of younger loess in the Central Roztocze region has been analysed, taking into consideration particularly its vertical range. For the NW part of this region, distinguished by strong relief, differentiation of grain-size distribution and thickness of loess occurring in small patches (islands) has been determined. The obtained results account for local origin of loess material and a small distance of eolian silt transport. This warrants determination of the directions of predominanting loess-bearing winds, as well as the vertical range of loess accumulation. Taking into account data related to other regions, the hypsometric range of the loess vertical zone in Poland and differentiation of grain-size distribution of loess varieties occurring on different levels were determined. An analysis of comparison with periglacial loesses occurring in other areas of Central Europe and perimediterranean loesses in SE Europe was made.
Key words: granular varieties of loess, vertical loess range, eolian silt transport, Poland, Central Europe, SE Europe.

INTRODUCTION

Proper loesses occurring in Poland are associated largely with the belt of the South-Polish uplands, and to a lesser extent with the foothills of the Carpathians and Sudeten Mts. They are usually found at a hypsometric range of 200-350 m a.s.l. (H. Maruszczak 1985, 1991a). The lower limit of this range forms the northern limit of proper loess coinciding with the northern scarp of the South-Polish uplands. It should be stressed that it is the boundary of younger loesses, i. e. from the last glaciation (Vistulian), marked on geological maps. Older loesses are as a rule hidden under younger ones and their range is more limited.

The northern limit of proper loesses is most distinct there where it is connected with higher upland scarps. A classical example in this respect is the NW scarp of the Lublin Upland (H. Maruszczak 1961). Locally in his limit zone, loesses were also accumulated in adjacent areas of Middle Polish lowlands below 200 m a.s.l. In such cases sandy loesses and loess-like deposits of a relatively small thickness were usually formed, therefore, they do not show features characteristic for "loess relief". In the more closely presented case of the flat Łęczna environs, in the northern foreland of the Lublin Upland, most forms characteristic for loess relief are not found; on plains 170–180 m a.s.l. only low, accumulation near-edge ridges were frequently found (H. Maruszczak 1991b).

To demonstrate characteristics of proper upland loesses the area of Central Roztocze was chosen, which is at the upper limit of their distribution in the belt of the South-Polish uplands.

GEOLOGIC-MORPHOLOGICAL CHARACTERISTICS OF THE AREA STUDIED

Roztocze is an extreme south-eastern region of the belt of the South-Polish uplands. It is a distinctly distinguished orographic ridge extending at a distance of 180 km from the Kraśnik environs to Lvov. This ridge links the Lublin Upland with the Podolia Upland and delimits from NE the basin of the Carpathian foreland (H. Maruszczak and T. Wilgat 1956). The middle part of the Roztocze ridge, i.e. Central Roztocze (Tomaszów Roztocze), is the widest (Fig. 1). Its width is to 25–28 km, whereas in its NW parts (Goraj Roztocze) and SE (Rawa Roztocze) it reaches only 15 km. Central Roztocze rises 250–386 m a.s.l. and is distinguished by well preserved Neogene planation levels which rise to 350–360 m a.s.l. on considerable areas (Fig. 1). Loesses occur here in small, separate patches like in Rawa Roztocze (its largest part is in the Ukraina, beyond the scheme presented in the left bottom corner of Fig. 1). This distinguishes the chosen region from Goraj Roztocze rising lower, whose larger part has a continuous loess cover (H. Maruszczak 1961, J. Buraczyński 1993).

Discontinuous, insular loess occurrence in Central Roztocze facilitates studying the distribution regularity of this deposit. For this purpose the north-western part of this region, i. e. the environs of Szewnia and Guciów were chosen which are totally situated in the Wieprz river catchement (Fig. 1). The geological structure of the these environs is similar to that in the whole Central Roztocze. The bedrock is constituted by thick layers of upper Cretaceous rocks largely of the gaize and opoka type. They are exposed on the surface in many places because the Quaternary cover is discontinuous and of small thickness. Besides the upper Cretaceous rocks, in the zone of the SE scarp of Central Roztocze, rising over the Sandomierz

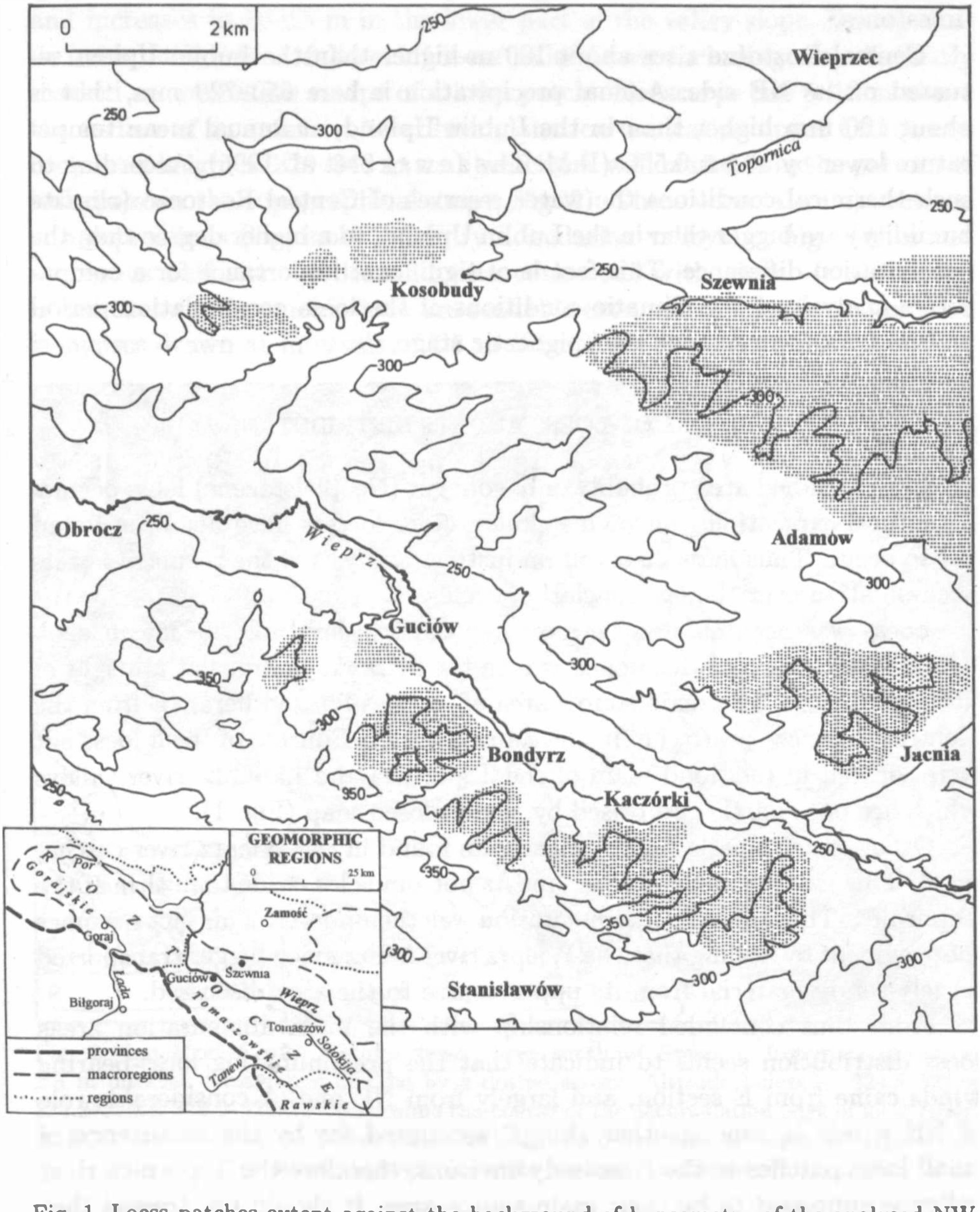

Fig. 1. Loess patches extent against the background of hypsometry of the analysed NW part of Central Roztocze in the environs of Szewnia and Guciów. Isohypses plotted at 50 m interval; loess extent marked by a dotted screen. In the left bottom corner a scheme of the regional division of the Polish part of Roztocze with marked location of Szewnia and Guciów

Basin, there occur also Miocene rocks up to 20 m thick; they are largely limestones.

Central Roztocze rises about 100 m higher than the Lublin Upland situated on its NE side. Annual precipitation is here 650–720 mm, that is about 100 mm higher than in the Lublin Upland, at annual mean temperature lower by about 0.5°C (B.M. Kaszewski et al. 1995). According to such thermical conditions the water reserves of Central Roztocze (climate humidity) are bigger then in the Lublin Upland, to a higher degree than the precipitation difference. This fact is of significant importance for a comparative analysis of the climatic conditions of the loess accumulation period and its transformation at the epigenetic stage.

THE AGE OF LOESS AND ITS DISTRIBUTION

In the studied area probably only younger (Neopleistocene) loess occurs. In natural expositions, on ravine slopes, older loesses have not been found yet to occur. Thus loess distribution justifies analysis of the regularity of its accumulation over the last glaciation cycle.

Loess was accumulated here on hypsometric level of 250–355 m a.s.l. The thickest patch of this deposits is in the Szewnia environs at a height of 250–340 m a.s.l. The main source area of silt was located here NE from the Central Roztocze scarp, i.e. in the Zamość Basin. Sources of fresh loess silt were located in the flood plain of the Topornica and Łabuńka river valleys which are only partly comprised by the enclosed map (Fig. 1).

Other, much smaller loess patches are found in the Wieprz river catchement. This valley is much deeper but its bottom is less wide than that of the Topornica. This area of silt alimentation was then poorer. This fact becomes more evident by adding that the Wieprz river being much bigger transported largely sandy material from its upper course to the area discussed.

From thus concluded relationship with the main alimentation areas loess distribution seems to indicate that the predominating loess-bearing winds came from E section, and largely from NE one. A considerable role of NE winds is, among other things, accounted for by the occurrence of small loess patches in the Kosobudy environs; therefore the Topornica river valley is supposed to be their main source area. It should be stressed that thus reconstructed directions of predominating winds in the discussed area were largely determined orographically, particularly by the system of bigger valleys dissecting Central Roztocze.

A big role of a large area of silt alimentation in the Topornica river valley is testified not only by loess distribution but also by its thickness. In the

Szewnia environs this thickness is the biggest: it is 5–10 m in interfluve area and increases to 10–15 m in the lower part of the valley slope. Due to that we encounter here a full set of loess relief forms including also distinctly marked accumulation scarps of a loess patch. The scarps rise 5–10 m above the surface of an extensive interfluve planation truncating upper Cretaceous rocks at a height of 320–340 m a.s.l. which are well readable in the pattern of isohypses on the topographical map (Fig. 2). There occur also: a) enclosed cup depressions ("wymoki"), b) dry denudation valleys, c) big ravines and numerous suffosion kettles and pits connected with them. It should be noted that the "wymoki" here are readable even on topographic maps with isohypses drawn at intervals of 2.5 m (Fig. 2).

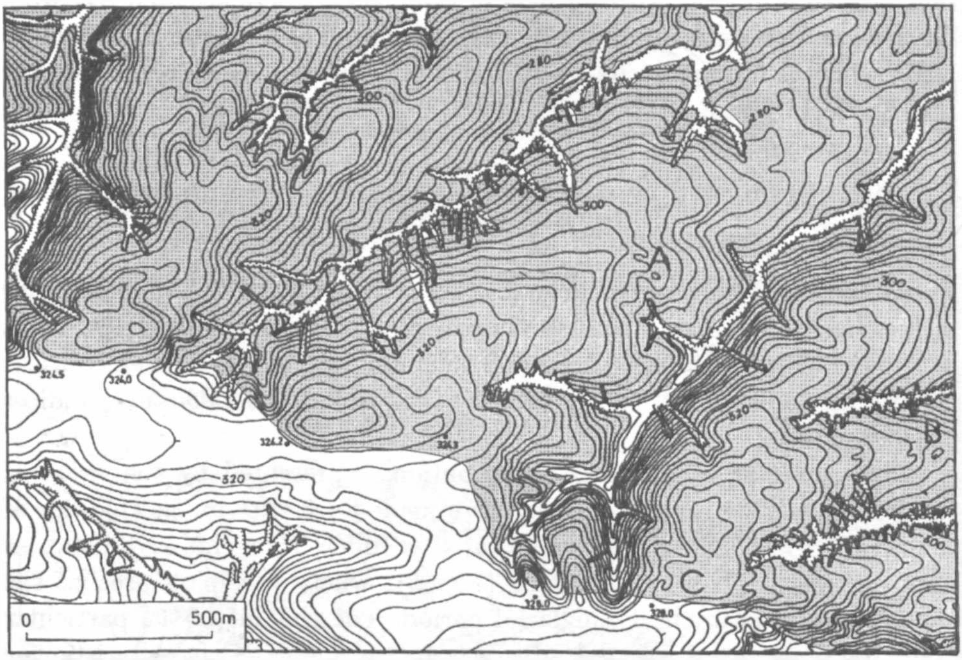

Fig. 2. Land relief with a thick loess cover south of Szewnia. Isohypses drawn at 2.5 m interval; loess range marked by a dotted screen. Altitude points — 324.5–324.0; 324.2–324.3; 328.0–328.0 — determine the course of the accumulation edge of loess cover. A, B, C letters denote the places where enclosed cup depressions of "wymoki" type occur, distinctly readable on the topographical map

In the patches associated with the Wieprz river valley loess thickness is considerably smaller. Therefore, they have not got more pronounceably marked accumulation scarps (see Fig. 3 and 4). The cup depressions of "wymoki" type are smaller and shallower; their occurrence is not reflected by isohypses on topographic maps. However, in the Wieprz river valley ridges of loess accumulation occur in places, which are asociated with terrace edges of relative heights exceeding 10 m. In the upper Wieprz river valley, however, such terraces occur fragmentarely. The best example of a small form of a near-edge ridge can be found at Guciów; it is a small secondary loess patch at a height of about 260 and 280–285 m a.s.l. (Fig. 3).

The lower limit of loess occurrence is at a hight 250–260 m a.s.l. in bigger valleys. Near this limit loess thickness is up to 15 m at Szewnia and 10–12 m at Guciów. In the Szewnia environs the loess cover reaches 320–340 m a.s.l.; near this boundary its thickness is 5–10 m. The extreme location of the upper loess limit is at Guciów with its highest point 356 m a.s.l. The loess thickness at a height of 335–356 m is here about 3 m and exceptionally increases to 5 m (Fig. 4). In a part of Central Roztocze situated SW from Guciów, an extensive interfluve planation is found at a height of 350–360 m a.s.l., which is fragmentarily covered with a thin loess layer only at Guciów and Kaczórki (see Fig. 1).

GRANULOMETRIC COMPOSITION AND SOME PHYSICO-CHEMICAL PROPERTIES OF LOESS

At the lower limit of its range loess is usually sandy with interbeddings of fine sands in the area studied. The median of grain size (Md) oscillates considerably from about 0.035 to 0.050 mm in such places, whereas at the upper range limit loamy loesses with Md 0.020–0.035 mm indices predominate.

The character of grain-size distribution is presented by the enclosed results of analyses (Table 1). They were made for 3 sites in the environs of the prehistoric castle in Guciów, situated at different heights and distances from the Wieprz river valley axis (Fig. 3), where the main area of silt alimentation was in the Pleniglacial period. The content of the particular grain fractions in all selected sites was in the intervals characteristic for Polish loesses (H. Maruszczak 1985). The differences beween the sites are distinct and relatively significant from the view-point of analysis of the conditions of loess silt accumulation.

In site 5 situated 275 m a.s.l., distant only 0.6 km from the valley axis, the average Md was 0.033 for 21 analyzed samples; Mz indices were in the interval 4.2–6.0 ø, and σ_1 from 1.7 to 2.9 (in this case two nonrepresentative upper samples taken from the present soil horizons were omitted). In site 17A at a height of 333 m a.s.l., distant 1.1 km from the valley axis, the average Md index was 0.029 mm; Mz indices ranged from 5.4 to 6.2 ø, and σ_1 from 2.0 to 3.1. In site 6, at a hight of 353.5 m a.s.l., distant 1.4 km

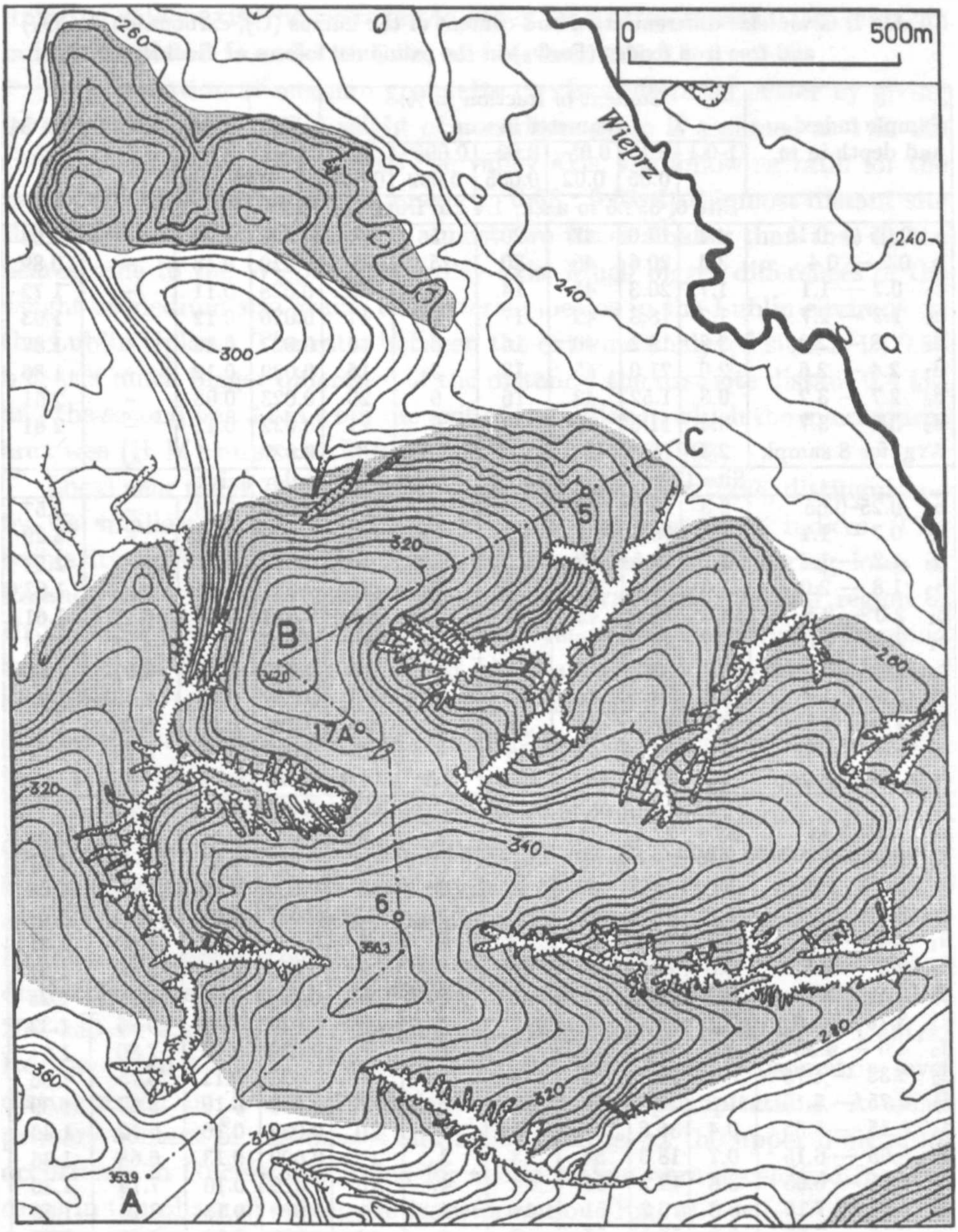

Fig. 3. Relief of the Guciów environs with small loess patches of differentiated thickness. Isohypses were drawn at 5 m interval; loess extent marked by dotted screen. A-B-C line crossing the region of an early mediaval castle, denotes geological cross-section presented in Fig. 4; on this line the sites are marked (5, 6, 17A), at which samples for laboratory analyses were taken

Table 1. Grain-size differentiation and content of the humus (C), carbonate ($CaCO_3$) and free iron oxides (Fe_2O_3) in the examined loesses at Guciów

Sample index and depth in m	Content of fraction in %; diameter in mm: 1-0.1	0.1–0.05	0.05–0.02	0.02–0.005	0.005–0.002	< 0.002	Md mm	C org %	$CaCO_3$ %	Fe_2O_3 %
Site 6; 353.5 m a.s.l.; 1.4 km from the valley axis										
a 0.05 — 0.15	4.4	17.6	47	20	5	6	0.029	1.20	–	1.04
b 0.2 — 0.4	3.4	20.6	45	20	5	6	0.029	0.18	–	0.89
c_2 0.7 — 1.1	1.7	20.3	45	14	3	16	0.028	0.11	–	1.72
c_3 1.2 — 1.7	1.7	18.3	42	17	4	17	0.026	0.12	–	1.93
d_1 1.8 — 2.2	3.8	19.2	40	16	6	15	0.027	0.16	–	1.82
d_1 2.4 — 2.6	2.0	21.0	45	13	3	16	0.029	0.12	–	1.86
d_2 2.7 — 3.2	0.8	1.52	42	16	6	20	0.023	0.08	–	2.61
d_2 3.2 — 3.7	0.4	11.6	42	19	6	21	0.022	0.11	–	2.61
Avg. for 8 sampl.	2.3	18.0	43.5	16.9	4.8	18.1	0.027			
Site 17A; 333 m a.s.l.; 1.1 km from the valley axis										
b_1 0.25–0.65	2.3	23.7	42	19	2	11	0.029	0.26	–	1.57
b_2 0.7 — 1.1	1.5	20.5	37	13	3	25	0.025	0.22	–	3.29
b_3 1.2 — 1.7	1.5	23.5	42	15	2	16	0.029	0.17	–	2.57
b_3 1.8 — 2.0	1.6	24.4	45	14	2	13	0.031	0.14	–	1.93
c_1 2.0 — 2.5	1.4	28.6	45	11	3	11	0.034	0.14	6.28	1.61
c_1 2.5 — 3.0	1.2	23.8	46	15	4	10	0.030	0.12	8.38	1.68
c_1 3.0 — 3.5	1.7	28.3	43	12	4	11	0.035	0.13	9.01	1.54
c_1 3.5 — 4.0	1.8	23.2	44	15	3	13	0.030	0.18	8.59	1.75
c_2 4.0 — 4.5	0.9	17.1	47	16	3	16	0.026	0.15	6.28	1.89
c_2 4.5 — 4.85	0.8	14.2	47	19	4	15	0.025	0.18	6.70	2.07
Avg. for10 sampl.	1.5	22.7	43.9	15.1	2.8	14.0	0.029			
Site 5; 275 m a.s.l.; 0.6 km from the valley axis										
a_2 0.35–0.45	25.6	27.4	33	8	2	4	0.054	0.45	–	0.61
b_1 0.6 — 0.7	3.6	29.4	41	8	0	18	0.034	0.12	–	1.97
c_1 1.2 — 1.3	5.0	31.0	47	7	2	8	0.039	0.08	–	1.04
c_1 2.1 — 2.25	5.0	31.0	42	7	2	13	0.037	0.09	–	1.57
d_1 2.4 — 2.9	4.4	29.6	46	12	0	8	0.037	0.07	5.69	1.21
d_1 2.9 — 3.4	2.0	28.0	49	10	2	9	0.035	0.07	5.69	1.21
d_1 4.4 — 3.75	2.1	28.9	51	9	1	8	0.036	0.08	5.59	1.25
d_2 3.75 — 4.0	2.1	24.9	50	12	3	8	0.033	0.11	6.96	1.32
d_2 4.0 — 4.35	1.8	20.2	51	17	3	7	0.030	0.14	7.80	1.61
d_2 4.35 — 4.75	0.8	21.2	53	14	2	9	0.031	0.11	6.75	1.36
d_2 4.75 — 5.15	1.6	20.4	55	11	3	9	0.031	0.10	5.69	1.39
d_3 5.15 — 5.65	0.4	36.6	42	9	2	10	0.038	0.16	6.12	1.39
d_3 5.65 — 6.15	0.7	18.3	54	13	3	11	0.029	0.13	6.68	1.36
d_3 6.15 — 6.65	0.8	19.2	52	14	4	10	0.029	0.13	7.74	1.36
d_3 6.65 — 7.15	0.8	19.2	51	14	4	11	0.029	0.13	8.16	1.50
d_3 7.15 — 7.65	0.9	18.1	53	12	4	12	0.029	0.13	7.74	1.43
d_3 7.65 — 8.15	1.1	19.9	49	14	5	11	0.029	0.14	7.98	1.32
d_3 8.15 — 8.65	0.8	16.2	51	15	5	12	0.027	0.12	7.98	1.36
d_3 8.65 — 9.15	1.0	18.0	50	14	4	13	0.028	0.16	7.77	1.39
d_3 9.15 — 9.65	0.9	17.1	49	15	4	14	0.027	0.15	7.35	1.46
d_3 9.65 — 10.15	0.9	17.1	49	15	4	14	0.027	0.19	7.66	1.43
Avg.for 21 sampl.	3.0	23.4	48.5	11.9	2.8	10.5	0.033			

from the valley axis, the average Md index for 8 samples was 0.027 mm; Mz indices oscillated from 5.4 to 6.0ø, and σ_1 from 2.6–3.2.

Differentiation of medium grain size can be illustrated better by giving its weight/volume. If the weight of a medium grain is assumed as 1 in the site situated lowest and nearest the valley axis, the following ratio for the three analyzed localities is obtained: 1 : 0.68 : 0.55. It the most distant site the weight of a medium grain is almost two times smaller than that at the nearest one to the Wieprz river valley axis. Much bigger differences of the weight of medium size grains characterize loesses in the Lublin environs on the Lublin Upland. The ratio between the extreme analyzed sites is 1 : 0.36 but at a much bigger difference of the distance: the first site distant 0.4 km and the second one 3 km from the axis of the valley in which the main source area was (H. Maruszczak and R. Racinowski 1968).

Loess near the upper limit of its range in Central Roztocze, distinguished by its smallest grains, is characterized by the biggest σ_1 indices. This regularity is found also in other upland regions with occurring loess in Poland, e.g. in the environs of Kraśnik in Goraj Roztocze and region of Hrubieszów (L. Dolecki 1995) or Przemyśl in the Carpathians foreland and foothills (M. Łanczont 1994). A weak sorting of loesses occurring on interfluve levels, rising high over the bottoms of bigger river valleys, is connected with a high content of colloidal fractions which is two times bigger then at low situated sites.

The loess at Guciów is characterized by a relatively small content of $CaCO_3$ in the interval of 5–9% (Table 1). Much richer in carbonates is a younger loess in the Hrubieszów environs 60 km ENE from Guciów; $CaCO_3$ content in the layers of Upper Plenivistulan increases here to 10–15%. The Hrubieszów loesses, however, were accumulated under climatic conditions distinctly characterized by continental features, and at smaller heights, i.e. 200–230 m a.s.l. A small content of carbonates in the loess of Central Roztocze can thus be associated with the climate on hypsometric level distinguished by lower temperatures and higher precipitations. A small primary content of carbonates and loess thickness at the upper limit of its occurrence in Guciów accounted for the fact they were decalcified in most cases in the phase of epigenetic transformation (Fig. 4).

The Guciów loess is also characterized by a small content of humus and Fe_2O_3 (Table 1). This is largely interpreted by the absence of layers with signs of intensive pedogenesis development. This can be associated with intensive relief (big surface declines), thus with a big intensification of morphogenetic processes accompanying silt deposition in Pleniglacial.

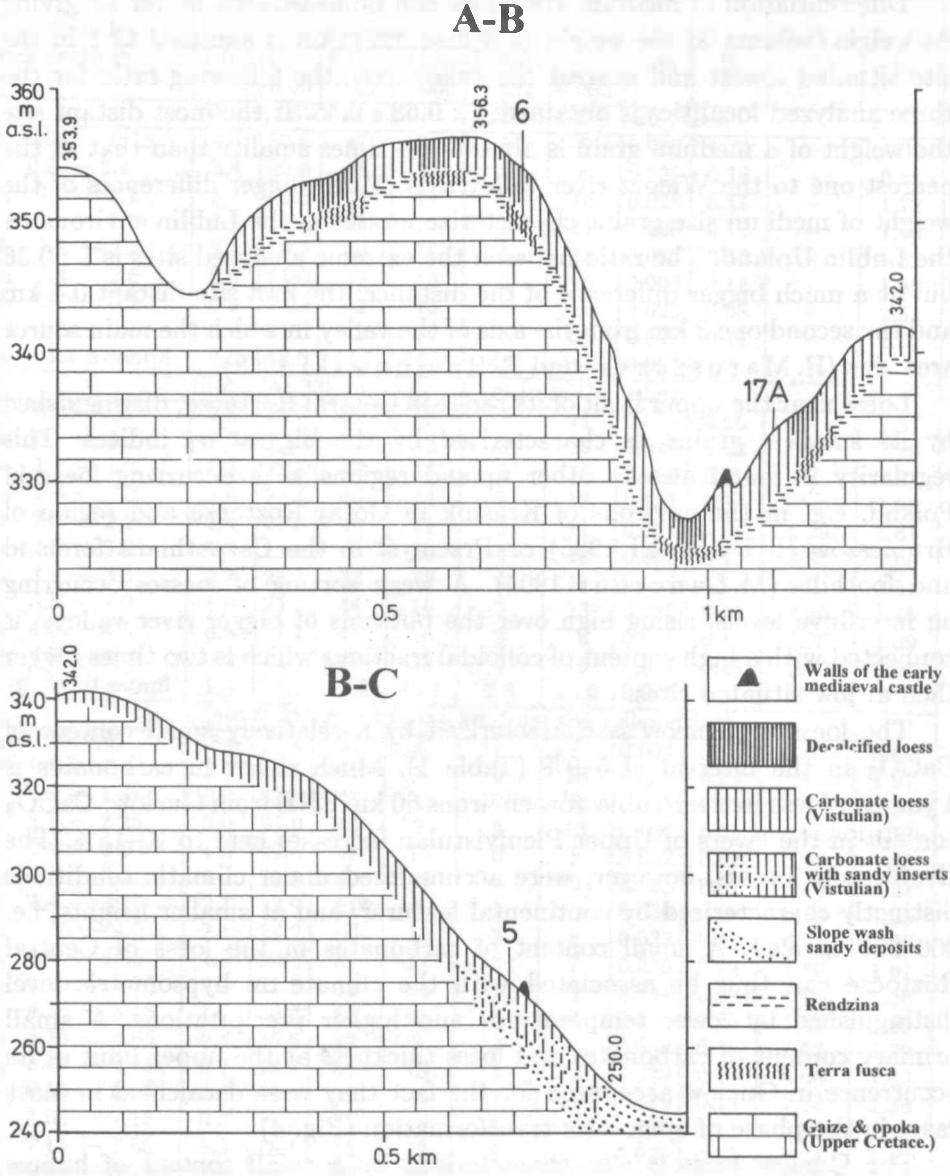

Fig. 4. Geological cross-section of the Wieprz river slope coverd with loess in the environs of an early mediaval castle at Gućiów. The cross-section lines A-B and B-C are marked on the hypsometric map (Fig. 3); numeration and situation of sites 5, 6 and 17A, at which samples for laboratory analyses were taken

DISCUSSION AND CONCLUDING REMARKS

1. An analysis made for the Central Roztocze region has confirmed the earlier presented opinions about a small distance of loess silt transport in Poland (A. Malicki 1950, H. Maruszczak 1967). Most of the material of loess covers was here transported at a distance of several kilometres similarly as in the neighbouring regions of the Lublin Upland (H. Maruszczak and R. Racinowski 1976, H. Maruszczak 1991 b). Therefore, the Roztocze loess can be defined as an autochthonous deposit, or even local on topographical scale. Thus, the opinion of J. Buraczyński (1993, p.54) that "[...] in Roztocze sandy loesses mark a transitional zone between loesses and sands[...] The source area of silts was the bottom of the upper Wieprz river basin situated in the north, and of sands — the Sandomierz Basin from the west" — is not justified. The distances between alimentation areas, according to the author mentioned, are several tens of kilometres. In the area presented in this paper, the distance of sandy loesses from loamy ones is only 1–2 km within one patch.

2. Proper loess in Central Roztocze is associated with the middle and upper part of the hypsometric distribution range of these deposits in the belt of South-Polish uplands. Taking into consideration also other regions of this belt, it can be assumed that the lower and upper distribution limit of proper loess in Poland is marked by 170 and 360 m isohypses. In the lower part of this hypsometric range in the belt of South-Polish uplands, the northern limit of proper loess runs at a height of about 200 m a.s.l. Lower, i.e. 200–170 m a.s.l., on the neighbouring plains of the belt of Middle Polish lowlands, proper loess occurs only sporadically among sandy loesses and loess-like deposits. At the upper limit of the "loess range", i.e. 340–360 m a.s.l., proper loess generally appears as loamy variety. Above 360 m there occur loamy, carbonate-free loess-like deposits of a small thickness; in the Kraków-Częstochowa Upland such deposits are sometimes also distinguished at height of 450–490 m a.s.l. (R. Dulias 1994). The hypsometric limits of the "loess range" is very similar in other regions of Central Europe. So, e.g., in Saxony younger Pleistocene proper loesses over 3 m deep occur 190–400 m a.s.l.; higher up to about 500 m only thin loamy loess covers are found (K.P. Unger and D. Rau 1961, G. Haase et al. 1970). In SW foreland of the Harz Mts., young-Pleistocene loesses over 3 m thick occur 190–320 m a.s.l. (W. Ricken 1983). The vertical range from 180–200 to 360–400 m a.s.l. must have been representative for young-Pleistocene periglacial loesses accumulated in Central Europe. Beyond the extent of permafrost, in SE Europe accumulation proceeded in condition appropriate

for loesses of perimediterranean type (sensu H. Maruszczak 1990 — fide Maruszczak 1995). It proceeded here largely below 200 m a.s.l.; in the coast-zone of the Black Sea, the range of loess in Pleniglacial extended to the sea level, in that time, situated to 100 m below the present one (P.F. Gozhik and F.A. Novoselskiy 1989, A.A. Velichko et al. 1994).

3. Eolian transportation of fresh loess silt from the alimentation areas, associated with more extensive bottoms of river valleys, in Central Roztocze ranged vertically to 120 m. In the lower parts of this range, to a height of 40 m, sandy loess-like deposits and a sandy variety of proper loess were accumulated. In the upper ones, however, at a height of 100–120 m, a loamy variety of proper loess was largely formed. In the sandy variety of loess, i.e. about 40 m above the valley bottom of the Wieprz at that time, the amount of grains >0.1 mm is 2.5 times bigger than colloidal fraction <0.002 mm. In the loamy loess variety, i.e. 100–120 m above the valley bottom, grains of these two extreme fractions are found in equal amounts. However, in the loamy variety the content of colloidal fraction is two times higher than in the sandy variety. It is not likely that a considerably higher content of colloidal fraction in loesses at a high interfluve level could be associated with distant, eolian suspension transport taking place at considerable heights. In the sandy loess variety the content of colloidal fraction is about 10%; after separating it would constitute a 1 m thick "layer" in 10 m thick loess cover. In the loamy loess variety, however, the content of this fraction is two times higher, i.e., after separating it would constitute an 0.75 m thick layer in 3.75 m thick loess cover. Comparison of these two indices (1.0 nad 0.75 m) seems to account for the fact that even the finest loess grain originated largely from local transport. It should be stressed that a larger part of colloidal fraction in Polish loesses occurs in polymineral microaggregates (K. Dwucet 1993). Loess microaggregates (microglobular aggregates — globules) differ from macroaggregates by a considerable resistance to compression and compaction (A.K. Larionov and N.N. Komissarova 1986). They very probably occurred as early as in the protogenetic stage in source deposits of loess. In periglacial environment clay particles undergo disintegration, the products of which participate cementation and aggregation processes (V.N. Konischchev and V.V. Rogov 1993).

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STRESZCZENIE

Less młodszy (=neoplejstoceński) na Roztoczu Środkowym występuje tylko w małych płatach; ich rozmieszczenie w NW części tego regionu przedstawia ryc. 1. Ta część Roztocza wyróżnia się dużymi deniwelacjami, którym odpowiada znaczne zróżnicowanie miąższości lessu. Miąższości ponad 10-15 m stwierdzono tylko w terenach wzniesionych 250-300 m n.p.m. W takich terenach występuje cały zespół form "rzeźby lessowej" włącznie z bardzo charakterystycznymi, akumulacyjnymi krawędziami lessowymi na poziomie wierzchowinowym (ryc. 2). W terenach powyżej 300-350 m n.p.m. miąższość lessu zmniejsza się dość szybko poniżej 5-3 m; oprócz wąwozów nie ma tutaj wyraźnie czytelnych, innych form rzeźby lessowej (ryc. 3).

W obrębie niewielkich płatów lessowych zaznacza się tutaj duże zróżnicowanie uziarnienia. W dolnych partiach, w sąsiedztwie znaczniejszych dolin rzecznych i obniżeń, występują lessy piaszczyste. Natomiast na poziomach wierzchowinowych wzniesionych powyżej 330-340 m lessy są gliniaste (tab. 1). W okolicy Guciowa w dolinie Wieprza w dolnej części zbocza na wysokości 275 m (w odległości 0,6 km od osi doliny) przeciętna wielkość ziarna wynosi 0,033 mm, a na wysokości 353,5 m (w odległości 1,4 km od osi doliny) średnie ziarno ma wymiary 0,027 mm (ryc. 4). Waga (kubatura) ziarna w tym drugim punkcie jest więc prawie dwukrotnie mniejsza niż w pierwszym.

Dużym nachyleniom zboczy w obszarach międzydolinnych odpowiada znaczne natężenie denudacji. Dlatego też starsze utwory plejstoceńskie są przeważnie zdegradowane. W omawianej części Roztocza less młodszy akumulowany był na górnokredowych skałach podłoża lub ich zwietrzelinach (ryc. 4).

Podkreślone cechy rozmieszczenia i zróżnicowania uziarnienia lessu wskazują, że jest to utwór lokalny nie tylko w skali regionalnej, ale wręcz także i topograficznej. Daje to podstawę do określania kierunku wiatrów "lessotwórczych", a w szczególności do analizy pionowego zasięgu akumulacji lessu. Wiatry przeważające w neoplejstocenie na omawianym obszarze były głównie z sektora NE, co było zapewne w znacznym stopniu predysponowane strukturą orograficzną obszaru (ryc. 1). Bardziej istotne są wnioski dotyczące pionowego zasięgu akumulacji lessu. Rozwijała się ona w piętrze wznoszącym do 120 m ponad dna dolin, gdzie znajdowały się główne źródła pyłu lessowego. Do wysokości około 40 m akumulowane były lessy i lessopodobne utwory piaszczyste, a na wysokości 100-120 m powstawały głównie gliniaste odmiany lessu.

Uwzględniając wyniki analizy rozmieszczenia lessu przy północnej granicy jego rozmieszczenia w Polsce podkreślono, że w naszym kraju less neoplejstoceński akumulowany

był w piętrze hipsometrycznym 170–360 m; powyżej 350–450 m n.p.m. występują już tylko bezwęglanowe, gliniaste utwory o małej miąższości. Podobnie określane jest hipsometryczne piętro akumulacji lessu neoplejstoceńskiego w strefie niemieckiego średniogórza (G. Haase et al. 1970, W. Ricken 1983). Takie rozmieszczenie pionowe charakterystyczne jest więc dla lessu peryglacjalnego w Europie Środkowej. Wyraźnie inne były prawidłowości rozmieszczenia lessu perymedyterańskiego (sensu H. Maruszczak 1990 — fide H. Maruszczak 1995). W Europie SE w pleniglacjale był on akumulowany głównie poniżej 200 m n.p.m.; w strefie wybrzeża czarnomorskiego dolna granica jego zasięgu sięgała do ówczesnego poziomu morza, położonego do 100 m niżej niż obecnie.