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LATE GLACIAL DEPOSITS IN THE ROPA VALLEY FLOOR IN WYSOWA, BESKID NISKI MTS, CARPATHIANS

INTRODUCTION

In the upper mountain reaches of river valleys profiles with organic material based on which age of river deposits might be determined are found only exceptionally. In valleys of the Carpathian rivers the terraces occurring in valley bottoms are usually related to the Holocene or Late Glacial. On the other hand, terraces mantled with solifluction covers are related to cold stages of the Pleistocene, and especially to pleniglacial periods of the Last Glaciation (Starkel 1977, 1995). In the Dunajec valley and in the upper reach of the Jasiołka valley W. Zuchiewicz (1985, 1987) distinguishes singular terrace steps of the Late Glacial. Here, one of the more important criteria is overlapping of alluvial covers with solifluction ones, stated in the Carpathian valleys by M. Klimaszewski (1958, 1971) and L. Starkel (1977). According to L. Starkel (1977, 1995) each Pleistocene fluvial cover of a cold period in the Carpathians is characterised by transition from well rounded gravels of a channel facies, through worse rounded ones to gravels interlocking with loams that are intermixed with sharpedged debris. In the upper Ropa drainage basin, as well, the characteristics described above can be observed in a few exposures. For the Polish Carpathians and their foreland L. Starkel (1995) assumes pre-Alleröd dissection of the terrace of the Last Glaciation and inserting extra covers in the Late Glacial. In the region of Doły Jasielsko-Sanockie as well as in the Dunajec and San valleys there is evidence of the pre-Alleröd dissection of the valleys.

During geological mapping R. Kopciowski has discovered exposures of organic deposits in the Ropa valley. In a next stage of investigation a detailed mapping of Quaternary deposits in the surrounding area as well as the complementary studies and sampling for age determination by ^{14}C method have been performed.


A
KRAKÓW
Tarnów
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Wisła
Dunajec
Biała
Wisłok
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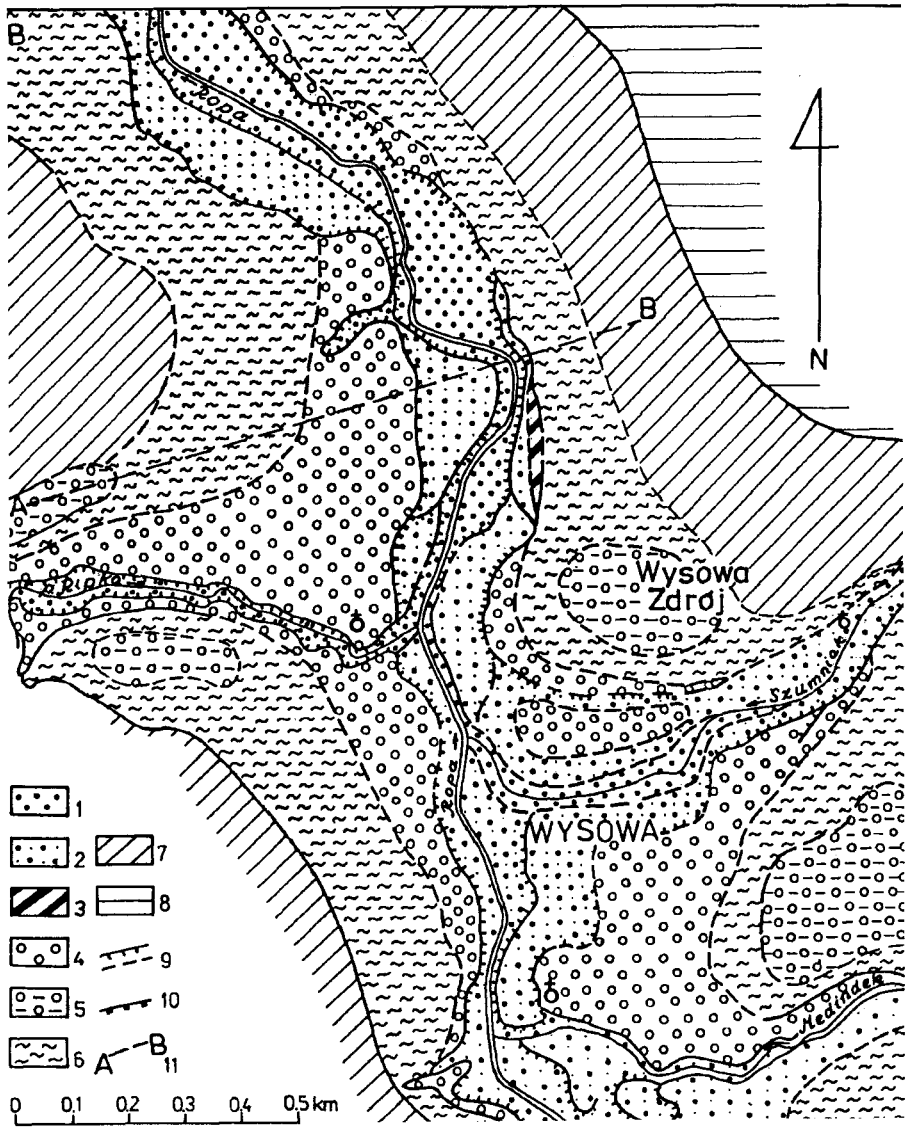
Gorlice
Nowy Sącz
KRAKÓW


B
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LOCATION

The study area is located in the western part of the Beskid Niski Mts where valley bottoms are found at 400–500 m a.s.l. while the ridges rise to 800–1,000 m a.s.l. A characteristic feature of that region is inversion of relief and a grill-like pattern of ridges (Starkel 1972). This part of the Beskid Niski Mts is built of the Magura nappe deposits, consisting of the Cretaceo-us-Paleocene Inoceramus beds and of the Paleocene Beloveza, Hieroglyphyic, Sub-Magura Beds and the Magura sandstones (Węcławik, Wójcik 1992, 1993). The ridges are built of the Magura sandstones while in the valley bottoms the Inoceramus and Beloveza Beds crop out (Węcławik, Wójcik 1993). The upper sections of slopes are steep and a marked concave scarp separates them from lower, gentler slope sections built of rocks that are less resistant to denudation. The slopes are covered with clay-loams, loams and loams with debris of various thicknesses.

TERRACES OF THE ROPA VALLEY NEAR WYSOWA

In the upper section of the Ropa valley near Wysowa there are some rocky accumulation plains being 20–30 m, 8–12 m high, as well as terraces of the valley bottom of the height of 4–4.5 m, 2–3.5 m and a flood plain terrace being up to 2 m high.

Fig. 1. Quaternary deposits in the Ropa valley near Wysowa. A — location of the study area, B — Quaternary deposits: 1 — gravels, sands and loams of the terraces 1–2 m high above river level (a.r.l.), 2 — gravels, sands and loams of terraces 2–4 m high a.r.l., 3 — clay, silt, peat and fluvial gravel of terraces 4–4.5 m high a.r.l. (North Polish Glaciation), 4 — gravels, sands and loams of terraces 8–11 m high a.r.l. (North Polish Glaciation), 5 — gravels, sands, and loams of river terraces 20–30 m high a.r.l. (Middle Polish Glaciation), 6 — loams, loams with fine rocky debris and solifluction-deluvial loams and clays with rocky boulders, 7 — loams and clays on exposures with rocky series with prevailing clay-shales, 8 — loams and loams with rocky debris on exposures with rocky series with prevailing sandstones, 9 — scarps of river terraces: a — well defined, b — weakly marked or worn off, 10 — high scarps of river terraces (more than 5 m) or erosional undercutting, 11 — geological transect

Ryc. 1. Utwory czwartorzędowe w dolinie Ropy w rejonie Wysowej. A — szkic położenia terenu badań, B — rozmieszczenie utworów czwartorzędowych. 1 — żwiry, piaski i gliny teras o wysokości 1–2 m n.p.rz., 2 — żwiry, piaski i gliny teras o wysokości 2–4 m n.p.rz., 3 — gliny, mułki, torfy i żwiry rzeczne teras o wysokości 4–4,5 m n.p.rz. (zlodowacenie północnopolskie), 4 —żwiry, piaski i gliny teras o wysokości 8–11 m n.p.rz. (zlodowacenie północnopolskie), 5 — żwiry, piaski i gliny teras rzecznych o wysokości 20–30 m n.p.rz. (zlodowacenie środkowopolskie), 6 — gliny, gliny z drobnym rumoszem skalnym oraz gliny i iły z głazami skalnymi soliflukcyjno-deluwialne, 7 — gliny i iły na wychodniach serii skalnej o przewadze iłołupków, 8 — gliny i gliny z rumoszem skalnym na wychodniach serii skalnych o przewadze piaskowców, 9 — krawędzie teras rzecznych: a — wyraźne, b — mało wyraźne lub zniszczone, 10 — wysokie krawędzie teras rzecznych (ponad 5 m) lub podcięcia erozyjne, 11 — linia przekroju geologicznego

The terrace, rising 20–30 m high a.r.l[1], is an erosional-accumulation terrace preserved at confluences of tributary stream valleys and the Ropa river near Wysowa. Deposits which are usually related to this accumulation level have also been stated downstream the study area, in Hańczowa region at the outlet of the Ropka to the Ropa river. In the r.h.s.[2] part of the Ropa valley, the deposits of this terrace level occur between the valleys of the Medindek and Szumniak streams (Fig. 1). Exposures of gravels show up on a local falttering, of the height of 530–550 m a.s.l., and in shallow incisions of cart roads. Towards the slopes, fluvial deposits are mantled with solifluction-deluvial loams with sandstone debris. To the level described above, corresponds a similar flattering (with a cover of loamed gravels) occurring near the outlet of the Szumniak stream, at the height c. 20–30 m above the Ropa river level, and fluvial deposits on both sides of the Ropka stream (Fig. 1). On the r.h.s. fluvial deposits are covered with loams and loams with fine rocky debris (Fig. 2).

The 20–30 m high terrace is preserved in a form of flat plains. These are fragments of alluvial fans. In other regions fluvial deposits are overlain with loamy, solifluction-deluvial covers. A position of this accumulation level relative to other terraces indicates that they are older than the Last Glaciation, and thus they have been connected with the Middle Polish Glaciation as it is the case of other Carpathian river valleys (Starkel 1965, 1972, Zuchiewicz 1985, 1987).

The 8–12 m high terrace forms the next, lower level and is mostly widespread along the Ropa valley and its tributaries (Fig. 1). The terraces reach maximum height within alluvial fans of the tributaries. Fluvial deposits occur on a rocky socle which is 3–5 m high. Thickness of the acumulational cover varies form 3 to 6–8 m. Solifluction-deluvial loams and loams with yellow and yellow-grey debris accrete the cover in a near-slope zone. Above the church in Wysowa, in an erosional undercutting of the Ropka stream dissecting a terrace of the Last Glaciation, one can observe overlapping of fluvial and solifluction deposits. In the exposure, from the top, there is a 0.7 m thick layer of loamed gravels, and below a 1 m thick layer of grey-yellow loam with singular, weathered gravels, and then below a layer of loam with weathered, not-rounded fine sandstone debris. The lower part of the profile is made up from a layer of "crowded gravels" with grey sandy-clay. This exposure provides evidence of solifluction creeping of frozen ground that took place during formation of this cover. Accumulation of fluvial deposits has been related to the Last Glaciation (North Polish Glaciation — Vistulian). The top face of the cover should be related most likely to the Younger Pleniglacial.

The next terrace, 4–4.5 m high a.r.l., has developed locally. Organic deposits, contributing to the terrace structure crop out in the r.h.s undercutting of the Ropa river downstream of the Ropka outlet (Fig. 1, 2) to the north of a concrete

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[1] Above river level.
[2] Right hand side.

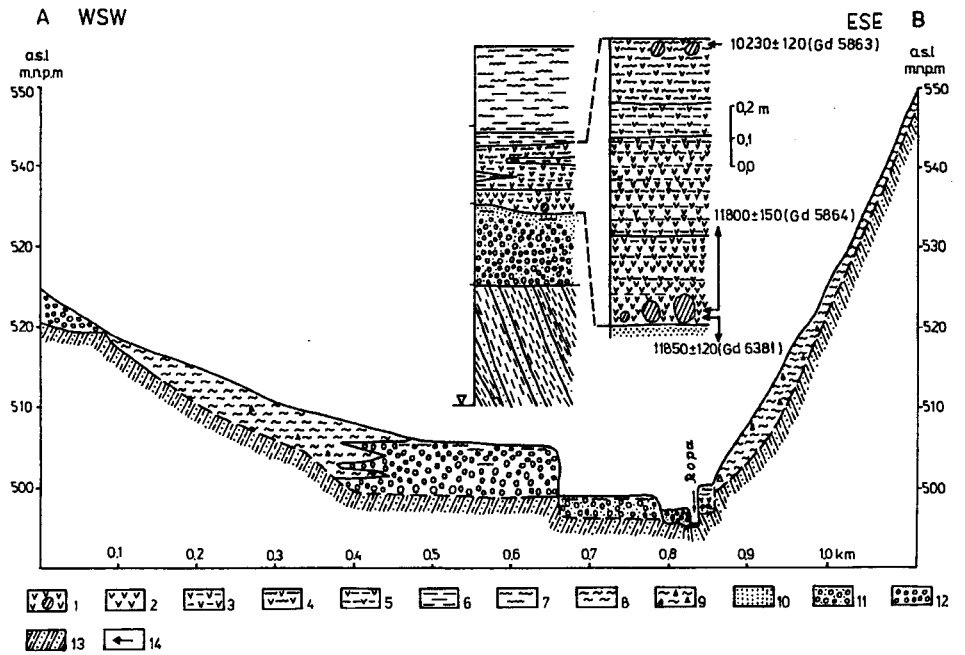

Fig. 2. Geological profile of the Quaternary deposits near Wysowa. 1 — peat with wood, 2 — peat, 3 — peat interlaminated with silt and clay, 4 — clay with organic remnants, 5 — silt with organic remnants, 6 — clay, 7 — silts, 8 — loams, 9 — loam with rocky debris, 10 — sands, 11 — gravels and sands, 12 — gravels, 13 — shales and sandstones (exposures of flysch substratum of the Quaternary) 14 — sampling sites for ^{14}C datings

Ryc. 2. Przekrój geologiczny przez utwory czwartorzędowe w rejonie Wysowej. 1 — torfy z drewnem, 2 — torfy, 3 — torfy warstwowane (laminowane) mułkami lub iłami, 4 — iły ze szczątkami organicznymi, 5 — mułki ze szczątkami organicznymi, 6 — iły, 7 — mułki, 8 — gliny, 9 — gliny z rumoszem skalnym, 10 — piaski, 11 — żwiry i piaski, 12 — żwiry, 13 — łupki i piaskowce (wychodnie fliszowego podłoża czwartorzędu), 14 — miejsca pobrania próbek do oznaczeń radiometrycznych metodą ^{14}C

bridge to Wysowa-Zdrój. This terrace level is preserved in a few sites along the valley. At the height of the river channel and up to 1.5 m above there are exposures of the Beloveza Beds consisting of claystones with thin inserts of sandstones and sometimes with singular inserts of clayey red shales. The socle is overlain with gravels with admixture of sand and loam (0.9 m thick) and at the top face a 0.1 m thick layer of loamy sands (Fig. 2). On the described deposits the 0.7–0.8 m thick series of sediments containing significant admixture of organic remnants has been deposited. At the bottom of this series there is the 18–20 cm thick series of black peat with fragments of wood and tree trunks reaching up to 151 mm in diameter (Fig. 2). The peat is interlaminated with the 1–5 mm thick grey silt. Two samples for radiometric dating were taken from the base of the peat layer. A fragment of wood is dated at 11,850 ± 150 BP

(Gd 6,381) while the peat sampled above the trunks at 11,800 ± 120 BP (Gd 5,864). The peat changes into the 0.1 m thick layer of grey silt with laminae of black peat. Above there is the 0.4 m thick layer of grey clayey silt with black interlamination ceasing upward. This layer is overlain with the 0.3–0.4 m thick black peaty silt with grey silt (Fig. 2) which gradually changes in brownish clay with fragments of wood dated at 10,250 ± 120 BP (Gd 5,863).

The lower part of the profile provides evidence of continual organic accumulation interrupted by silt deposition during floods. In the middle part of the profile mineral sedimentation starts to predominate. That evidences a higher frequency of flooding or a rise in a water level. It might be also connected with an increased frequency of floods in a younger period. The obtained ^{14}C datings place these deposits in the Alleröd or Younger Dryas. A primary paleobotanical analysis of the samples from the top and bottom of the profile, made by Kazimierz Szczepanek, indicates a "cold" spectrum represented mainly by pollen of pine (dwarf pine, probably), willow, alder and birch.

The described above, whole series with organic deposits is covered with silts and loams being grey, grey-yellow and sometimes reddish in colour. At the base these are brown silts while upward — grey ones. These deposits can be classified as clay alluvial loam, overbank facies deposits. ^{14}C dates point to a relatively early dissection of the cover of the 8–12 m terrace of the Last Glaciation. Dissection occurred c. 12,000 years BP at least, i.e. before the Alleröd the river channel cut down almost to the present-day level. The dissection had to be significant as the organic accumulation in the paleochannel was not interrupted during the Alleröd and Younger Dryas, and only during larger floods fine sediments of flood facies were deposited. The dissecting was connected with wasting of permafrost, ceasing of solifluction on the slopes and succession of vegetation and thus with reduction of material supply to the channel.

The beginning of the organic accumulation, according to ^{14}C date, is associated with a lower age limit of the Alleröd. On the other hand, the upper date corresponds to dates from the turn of the Younger Dryas and pre-Boreal period, i.e. to the limit Pleistocene–Holocene. This type of accumulation was preceded by the Younger Dryas accumulation of silts, known from some valley bottoms of the Carpathian rivers (Ralska-Jasiewiczowa and Starkel 1975). Records from the Ropa valley indicate a relatively small accumulation in valley bottoms. A similar phenomenon of valley bottom incision was stated in the Jasiołka valley in the area of Doły Jasielsko-Sanockie (Wójcik 1987). Deposition of clays and clayey silts stopped organic accumulation likely at the beginning of the Holocene.

The present-day Ropa channel and its tributaries are accompanied by the youngest Holocene, 2–4 m high river terraces and by the flood plain up to 2 m high.

FINAL REMARKS

Based on the presented material conclusions about development of the upper sections of the river valleys and about accumulation in the last cold stage and in the Late Glacial in the Carpathians can be drown.

In the cold period of the Last Glaciation accumulation of alluvia took place. In the near-slope zone the solifluction-deluvial covers were overlapping with fluvial deposits due to inflow of solifluction covers onto flat valley bottoms and then due to aggradation in the valley bottoms and covering them with younger and younger alluvial covers. That has been stated in the study area in the erosional incision of the Ripka stream and confirms findings of M. Klimaszewski (1958, 1971), J. Dziewański and L. Starkel (1962) and L. Starkel (1960a, 1972, 1977, 1995) about relation of river accumulation to cold periods.

The stated deposits of the Late Glacial, laying much below the terrace of the North Polish Glaciation, point to deepening as well as to dissection of alluvial covers and flysch deposits before Alleröd. First, it is associated with climatic changes although the influence of neotectonic movements registered in the Carpathians (Rączkowski et al. 1985, Wójcik 1988, Zuchiewicz 1987) on such significant erosion cannot be excluded.

At the end of Pleniglacial, in the older part of the Late Glacial there was a tendency to deepening of the uppermost, spring reaches of the valley bottoms due to dissection of alluvia and flysch substratum. In the Carpathians the pre-Alleröd erosion is evidenced by peat sites in Dubiecko (Mamakowa 1962), in Tarnawa on the San river (Ralska-Jasiewiczowa 1972), in Grel on the Czarny Dunajec river (Klimaszewski 1961, Koperowa 1962) and in the area of Doły Jasielsko-Sanockie (Koperowa 1970, Wójcik 1987).

The obtained results indicate synchronous or only slightly delayed dissection when compared with the Carpathian foreland that is assumed for 12–13 ka BP (Starkel 1995). Thus, it is hard to accept the Late Glacial erosion progressing from the mountain margin towards the Carpathian interior as suggested by L. Starkel (1960b). The Younger Dryas is marked with aggradation and represented by silt series (Fig. 2) as it was stated in Tarnawa on the upper San river (Ralska-Jasiewiczowa, Starkel 1975). The beginning of the Holocene was also a period of aggradation in the upper reach of the Ropa valley as evidenced by accumulation of silts on the organic deposits (Fig. 2). The Holocene is characterised by an insert of alluvial cover in the form cut at the beginning of the Late Glacial.

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STRESZCZENIE

A. WÓJCIK

PÓŹNOGLACJALNE OSADY DNA DOLINY ROPY W WYSOWEJ (BESKID NISKI, KARPATY)

W górnym odcinku doliny Ropy w rejonie Wysowej stwierdzone zostały różnowiekowe osady rzeczne tworzące stopnie terasowe o wysokości 20–30 m, 8–12 m oraz terasy w dnie doliny o wysokości 4–4,5 m i 2–3,5 m oraz terasa przykorytowa o wysokości do 2 m. Najwyższa z nich o wysokości 20–30 m n.p.rz. z wysokim cokołem (ryc. 1, 2) wskazuje, że jest ona starsza od ostatniego zlodowacenia (zlodowacenie środkowopolskie).

Niższa terasa o wysokości 8–12 m n.p.rz. ma najszersze rozprzestrzenienie wzdłuż doliny Ropy i jej dopływów (ryc. 1). Osady rzeczne występują na cokole skalnym o wysokości 3–5 m. Miąższość pokrywy akumulacyjnej wynosi od 3 do 6–8 m. W strefie przyzboczowej nadbudowana jest przez soliflukcyjno-deluwialne gliny. Akumulację osadów rzecznych powiązano z okresem ostatniego zlodowacenia (vistulian — północnopolskie), a jej strop z młodszym pleniglacjałem.

Młodszą w dnie doliny Ropy jest terasa o wysokości 4–4,5 m n.p.rz. Osady rzeczne złożone ze żwirów z domieszką piasku i gliny, o miąższości 0,9 m, leżą na cokole skalnym o wysokości 1,5 m. W stropie leży 0,1 m piasków (ryc. 2), a wyżej 0,8 m seria z domieszką szczątków organicznych. Z 18–20 cm warstwy torfu, z pniami drzew w spągu, pobrano dwie próbki do oznaczeń radiometrycznych (ryc. 2). Dla fragmentu drewna otrzymano datę 11 850 ± 150 BP, a z próbki torfu pobranej powyżej pni otrzymano wiek — 11 800 ± 120 BP. Wyżej 0,1 m warstwa mułków z laminami torfu przechodzi w 0,4 m warstwę mułków. Przykrywa je mułek torfiasty barwy czarnej z iłem popielatym o miąższości do 0,4 m, przechodzący stopniowo w iły brunatne z fragmentami drewna w stropie, datowanymi na 10 250 ± 120 BP. Wyniki oznaczeń radiometrycznych ^{14}C (ryc. 2) lokują akumulację osadów zawierających szczątki organiczne w późnym glacjale ostatniego zlodowacenia (alleröd — młodszy dryas). Z wstępnych oznaczeń paleobotanicznych wykonanych dla tego profilu przez K. Szczepanka ze spągu i stropu otrzymano „zimny" charakter zespołów roślinnych reprezentowanych głównie przez pyłki sosny (prawdopodobnie kosodrzewiny) oraz wierzby, olchy i brzozy.

Wyżej opisana seria z osadami organicznymi przykryta jest mułkami i glinami barwy popielatej i popielato-żółtej czasami rdzawej. W spągu są to mułki barwy brunatnej, a wyżej barwy popielatej. Utwory te można określić jako mada ilasta.

Otrzymane wyniki wskazują na bardzo wczesne rozcinanie terasy z okresu ostaniego zlodowacenia także w źródłowych odcinkach dolin. Rozcięcie terasy 8–12 m nastąpiło przed około 12 tys. lat BP, a więc już w okresie bölingu lub starszego dryasu i wcięcie koryta rzecznego prawie do współczesnego poziomu. Ma to związek z zanikaniem wieloletniej zmarzliny i soluflukcji na stokach, wkroczeniem zwartej roślinności, a przez to zmniejszeniem dostawy materiału do koryta. Początek akumulacji organicznej jest związany z dolną granicą wiekową alleröedu. Natomiast górna data dowiązuje do dat z granicy plejstocen–holocen. Seria mułkowa reprezentuje młodszy dryas znany z innych stanowisk (Ralska-Jasiewiczowa, Starkel 1975). W czasie późnego glacjału miała miejsce wyraźna tendencja w pogłębianiu den dolin poprzez rozcięcie aluwiów i podłoża fliszowego. Zatem trudno mówić o erozji późnoglacjalnej postępującej od brzegu gór, jak sugerował to L. Starkel (1960b).

Najmłodsze holoceńskie terasy rzeczne reprezentowane są przez stopnie o wysokości 2–4 m oraz terasę zalewową o wysokości do 2 m.