GEOGRAPHIA POLONICA
2011, 84, Special Issue Part 1,
147–162

LOCAL EVIDENCE OF LANDFORM EVOLUTION VS. GLOBAL CHANGES – A CASE OF YOUNGER DRYAS STUDY IN THE UPPER NER VALLEY SYSTEM, CENTRAL POLAND

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Abstract: Domination of the fragmentary or full of sedimentation gaps records causes the necessity of asking about criteria for distinguishing between global factors and local changes in the landform evolution. This study has been conducted in the upper Ner Valley system at the Lublinek site, west of Łódź, central Poland. On the example of the Younger Dryas events in fluvial environment it has been shown that palaeogeographical evidence depends on the maturity of the landform and its position in a system. When dealing with a discontinuous record, only reconstructions of the tendency of evolution as well as its effects over a longer time period may describe the specifics of the environment in a given period, while a comparison of different parts of the system may enable the elimination of local factors.

Key words: palaeogeographical evidence, landform evolution, fluvial deposits, local factors, global changes, Younger Dryas, central Poland

INTRODUCTION

It is evident that environmental global changes are recognized best from continuous sections devoid of sedimentation gaps. For reconstruction of the termination of the last glacial period, such continuity is available from annually laminated ice covers from Greenland and the Antarctic and annually laminated lacustrine sediments from continental sequences. Within Europe, the longest series have been studied in lakes Holzmaar and Meerfelder Maar in the Eifel region in Germany, with varve chronologies established for the past 15,000 years, thus covering the Weichselian Lateglacial (Brauer et al., 2001; Litt et al., 2003) and being a stratotype of palaeoenvironmental changes during the termination of the last glacial period for the northwestern part of the continent. In Poland, the changes during the last 12,600 years are well known from Lake Gościąż (Ralska-Jasiewiczowa et al., 1998). The mentioned examples include, therefore, the crucial time of the Lateglacial – Holocene transition, together with the Younger Dryas cold spell of a millennial duration.

The dynamics of climatic changes at the beginning and the end of the Younger Dryas and the quantitative thermal characteristics have been intensively discussed in the literature. Based on the oxygen signal in the Greenland ice cores, a decline in the annual temperature of about 10°C could have taken up to 30 years (cf. Johnsen et al., 2001). Sedimentological and palynological data in the annually laminated sediments of the German lakes show the shifts at the beginning and the end of the Younger Dryas within no more than 20 years (Litt et al., 2003). The climate reconstructions indicate that winter temperatures decreased up to –20 or even –25°C and summer values lowered to 10–14°C for the area of northwestern and central Europe (Isarin et al., 1998). The sequence of climatic events during this period in central Poland may be inferred from the record of Lake Gościąż (Ralska-Jasiewiczowa et al., 1998). A subdivision into the early phase with a shift towards cooler and drier conditions, followed by the maximum cold and dryness, and the last part with a tendency to slight warming and more humid conditions is suggested. A chronology of the Younger Dryas has been determined at this locality to 12,650–11,500 cal years BP (~1,150 years).

A global character of the cooling as well as the specific features of the Younger Dryas environment justify questions about its palaeogeographical evidence. For the Łódź Region[1], detailed examination of the effects of such evidence, assumed to be of an Younger Dryas age and registered in landforms and sediments of three sedimentary environments – slope, fluvial and aeolian ones, has been carried out (Dzieduszyńska, 2011). The obtained results show the change in geological and morphological expression of each of the processes and, at the same time, their dissimilarity according to the location. The analyses gave not clear answer to the question about the nature (local or global) of the differences. It should be stressed out that the reconstructed data were the fragmentary records of events in the sedimentary systems of the region. Thus, it seems clear that in the terrestrial conditions the aim of achieving palaeogeographical conclusions from localities or sections, which register processes and their effects continuously, may be fulfilled exceptionally. In the Łódź Region, only the section Żabieniec, where interpretation of the results is in progress (Twardy et al., 2011), looks promising. Domination of the fragmentary, or full of sedimentation gaps records causes the necessity of asking about criteria for distinguishing between global factors and local palaeoenvironmental changes reflected in the landform evolution.

YOUNGER DRYAS IMPRINTS OF THE UPPER NER VALLEY SYSTEM AGAINST PALAEOGEOGRAPHICAL CONDITIONS OF THE INTERPLENIGLACIAL – HOLOCENE PERIOD

The key to the distinction between local and global roots of the processes has been looked for in the well-recognized small valleys, west of Łódź (Fig. 1). The area under study represents a gentle morainic plateau since the Wartanian stadial of the Odranian glaciation (stratigraphy after Lindner, 2005), into which the Ner Valley and the small valleys of its tributaries are incised (Fig. 2). In this paper, the response to global climatic changes at the end of the Pleistocene has been shown, with a special interest on the Younger Dryas cool episode in the upper Ner Valley system in two different topographic settings typified by different geological evolution. The fragmentary record of the landscape evolution, which is expressed by both surface and fossil landforms and series, has been recognized in two landscape units – the polygenic high level built up of various till facies, fluvioglacial sand and fluvioperiglacial sand, and the low level, corresponding with the Holocene valleys. The processes and their effects, recorded in two morphological situations, are exemplified at the following sites: Lublinek – sewage treatment plant (Turkowska, 1988, 1990) and Lublinek – railway station (Fig. 2).

The reconstruction of the relief evolution of the upper Ner River system was facilitated owing to excavations connected with the construction of a sewage treatment plant for the Łódź agglomeration. Building works carried out in the valley floor re-

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[1] The Łódź Region after Turkowska (2006) – the extraglacial zone of the Polish Lowland between the maximum Weichselian ice sheet extent and the maximum extent of the Wartanian ice sheet; the longitudinal boundaries are delimited on the basis of morphological criteria, i.e. the valleys of the Warta, Rawka and Pilica rivers.

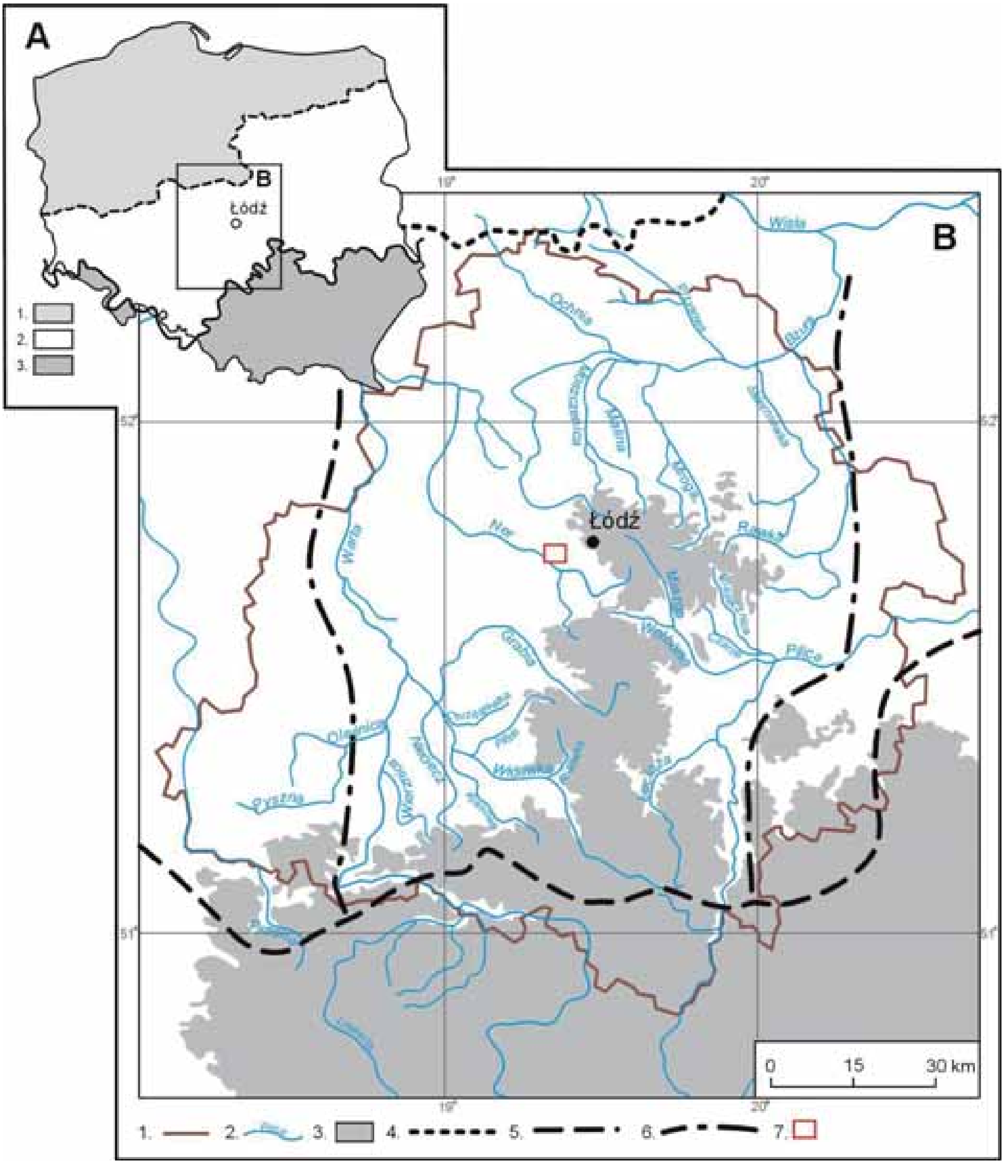

Figure 1. Location of the study area

A. Zones of glaciations: 1 – area covered by the Weichselian ice sheet, 2 – area between the Weichselian and Odranian ice sheets, 3 – area outside the Middle Polish Glaciations; B. Morphogenetic Łódź Region vs. Łódź voivodship: 1 – Łódź voivodship boundaries, 2 – river network, 3 – area elevated above 200 m a.s.l., 4 – maximum extent of the Weichselian ice sheet (after Roman, 2003), 5 – maximum possible extent of the Wartanian ice sheet (after Turkowska, 2006), 6 – eastern and western conventional boundaries of the Łódź Region, 7 – study area

sulted in lowering of the groundwater table by 6 m, providing an opportunity for the direct observation of the full section of valley deposits in trenches. The Younger Dryas events are in the present article set against the time background of about 20,000 years,

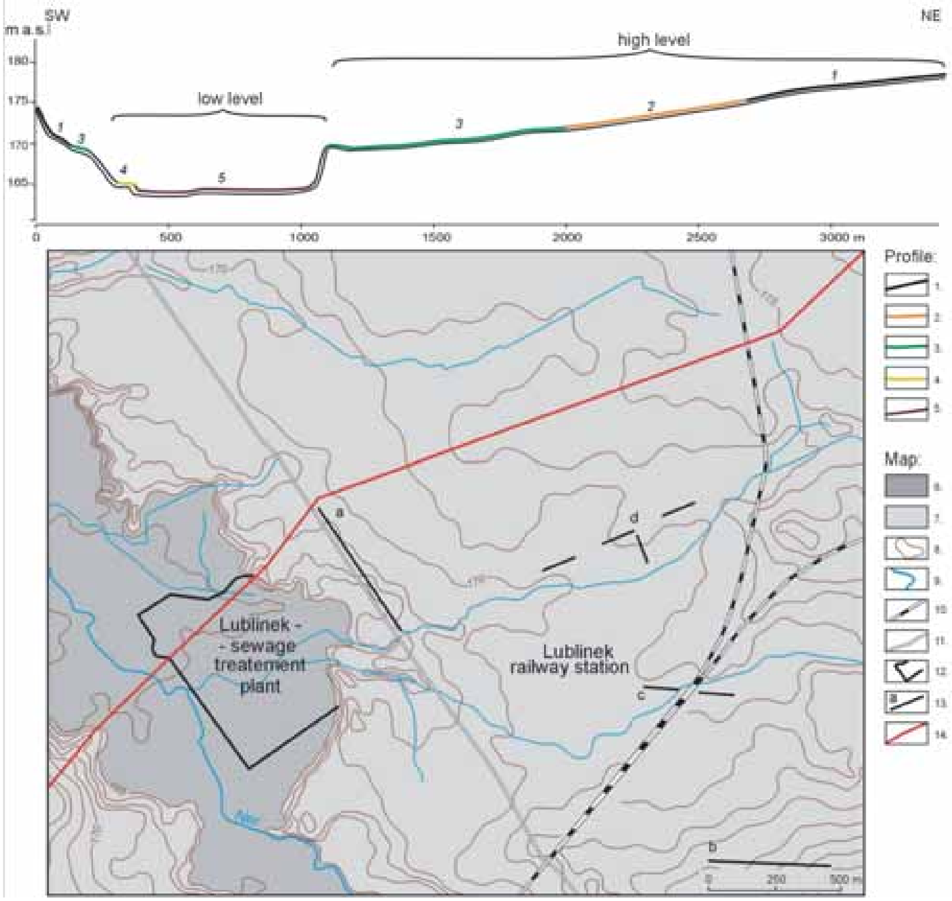

Figure 2. Situation sketch of the study area

Cross-section: 1 – denuded morainic plain, 2 – transitional zone, 3 – Pleniglacial terrace, 4 – Lateglacial terrace, 5 – valley floor. Map: 6 – low level, 7 – high level, 8 – hypsometry (isolines every 1.5 m), 9 – hydrological network; 10 – railway, 11 – Konstantynów – Pabianice road; 12 – sewage treatment plant (the area of trenches illustrating the low level), 13 – trenches examined in the high level, 14 – line of the cross-section

covering the Upper Pleniglacial and the Lateglacial. Pieces of geological evidence of the considered time period are in the valley system limited with two phases of climatically controlled erosion in Poland (Starkel et al., 2007). Dates quoted in the text, presented in conventional yr ^{14}C and calibrated ranges according to INTCAL09 (Reimer et al., 2009), are given in Table 1.

SITE LUBLINEK – SEWAGE TREATMENT PLANT

The natural valley floor of the upper Ner River at this locality lies 163–165 m a.s.l. and is 200 to 800 m wide (Figs. 2, 3). It is bounded by slopes of a varying angle (2–15°) and height (3–10 m). The valley widenings and the well-pronounced erosional slopes are in places linked to meander undercuts. The undercuts are accompanied by the low terrace, rising to 0.7–1.2 m above the flat valley floor. Sandy deposits of the low terrace appear at the surface built of overbank deposits and peat. The structure of deposits filling up the valley, being recognized in numerous complete sections, is complex and multicyclic. A few metres (3–5 m) below the

Table 1. Radiocarbon dates and calibrated age ranges of the dated material age determinations considered in this paper; in most cases the position of samples is marked in Figures

No	Material	^{14}C yr BP	cal BP (95.4% probability)	Laboratory code
1.	organic mud	8,180±220	9,550–8,544	Lod 276
2.	organic lens under the fan (Fig. 9)	8,240±160	9,535–8,728	Gd 1839
3.	wood (branch) (Fig. 4)	8,250±150	10,114–8,777	Lod 373
4.	palaeomeander base	8,350±160	9,692–8,798	Lod 342
5.	organic detritus	8,400±200	9,687–9,010	Gd 2410
6.	wood (oak trunk)	9,200±70	10,552–10,234	Gd 1764
7.	detritus (Fig. 7)	9,260±90	10,664–10,240	Gd 10099
8.	detritus (channel bar ?)	9,380±250	11,312–9,916	Lod 274
9.	detritus (Fig. 7)	9,470±40	11,065–10,581	Gd 7541
10.	fossilized lump	9,850±250	12,372–10,573	Lod 275
11.	wood (pine trunk) (Fig. 5)	9,870±190	12,027–10,743	Lod 238
12.	fossilized lump (Fig. 7)	10,220±170	12,525–11,317	Gd 9196
13.	fossilized lump (Fig. 8)	10,690±140	12,918–12,146	Gd 10027
14.	organic layer (Fig. 12)	11,320±160	13,573–12,754	Lod 444
15.	fossil soil	12,470±180	15,196–13,965	Lod 479
16.	fossilized lump	12,950±390	16,797–14,190	Lod 238
17.	organic mud in situ	13,800±200	17,500–16,490	Lod 370
18.	sandy mud (soil ?) (Fig. 11)	16,200±200	19,856–18,855	Lod 445
19.	organic mud (soil ?)	17,100±200	21,111–19,603	Lod 478
20.	fine detritus	21,720±220	26,873–25,260	Gd 1906

Figure 3. The boundary between the low level (valley floor linked with the meander undercut) and the “inner” member of the high level (Upper Pleniglacial terrace) of the Ner basin described in the paper

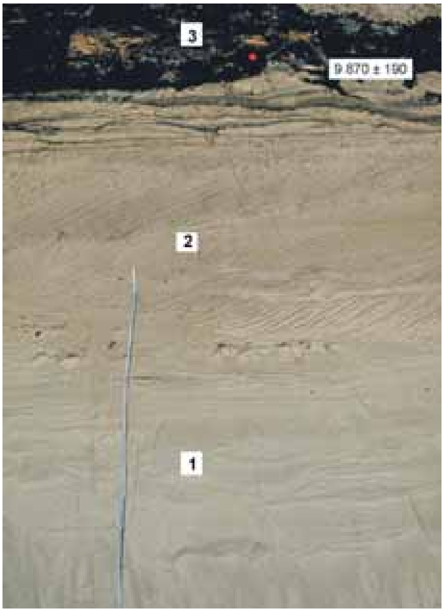

Figure 4. Structure of the valley floor deposits – example 1 (central part of the transverse profile)

1. Interpleniglacial member: medium-grained sands, vertical aggradation
2. Lateglacial member: vari-grained sands, poorly sorted, erosional pavement at the bottom, meandering river
3. Holocene member: organic overbank deposits, the pine trunk at the bottom

present valley floor, the sandy and silt-sandy rhythmically layered member, up to several metres thick, has been preserved (Figs. 4, 5). It was deposited during the Interpleniglacial period, as indicated by a radiocarbon date of 21,720 ± 220 BP for a layer with organic admixture at the top of the series (Table 1 v 20; Turkowska, 1988). The original maximum level of the deposition of this age is unknown at this locality (Fig. 6). As in other upper sections of the Łódź Region valleys, this member does not create a separate landform; during the Upper Pleniglacial it was partly eroded and overlain by braided river sediments. By analogy to the features recognized in other valleys of the region it may be assumed that the destruction of the topmost part of the series took place during the so-called Prosna phase, interpreted as a response to the climatic cooling and increasing humidity corresponding with the last ice sheet transgression (Rotnicki, 1987). The original thickness of braided river sediments at this locality is estimated at over 5 m. The effects of the Lateglacial erosion, which were at least somewhat greater than the aggradation of an Upper Pleniglacial braided river, may be estimated by the comparison of the location of the high terrace

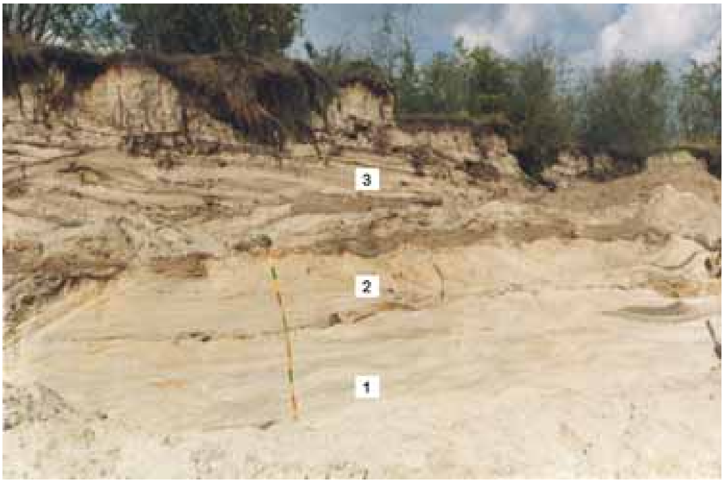

Figure 5. Structure of the valley floor deposits – example 2

1. Interpleniglacial member: fine-grained sands alternating with silts, locally with an organic admixture
2. Lateglacial member: vari-grained, poorly sorted channel sands with the lumps of overbank material
3. Holocene member: vari-grained channel, overbank sands and palaeomeander infillings, rich in an organic admixture

surface and the fossil metachronous erosional surface ascribed to a meandering channel pattern and lying 8 m below its surface. The formation of the valley in the outline similar to the present-day one lasted since about 14,000 BP to the beginning of the Holocene. This is proved by a radiocarbon date of 13,800 ± 200 BP as palynologically confirmed age for the base of the organic palaeochannel fill, 3.4 m below the valley floor (Table 1 v 17), and a date of 9,850 ± 250 BP for the youngest dated part of flood deposits

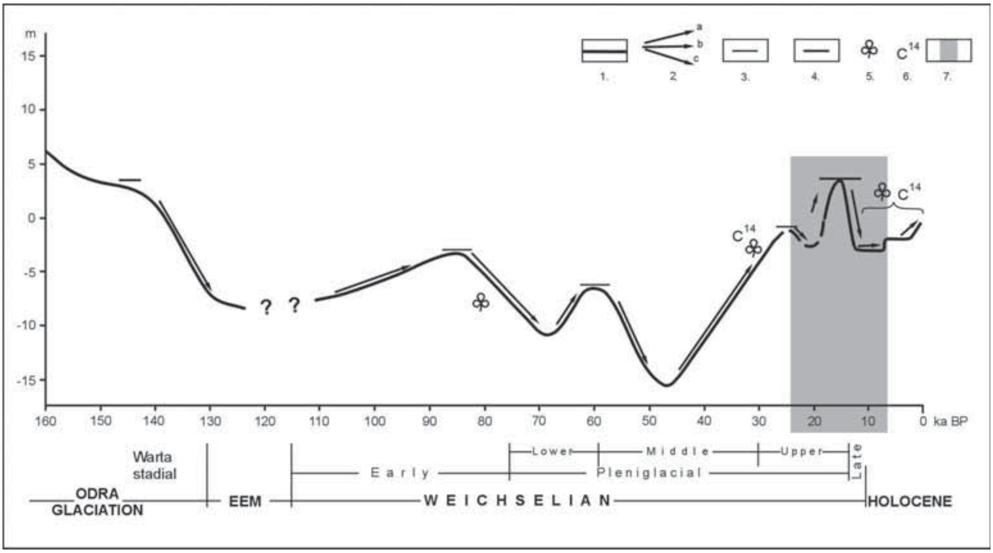

Figure 6. Evolution of the upper Ner Valley since the Wartanian up to the Holocene

1 – valley floor changes; 2 – tendencies: a – aggradation, b – equilibrium, c – erosion; 3 – fossil terraces; 4 – "main" terrace level (Pleniglacial); 5 – pollen analyses; 6 – radiocarbon dating; 7 – valley evolution shown in Fig. 4

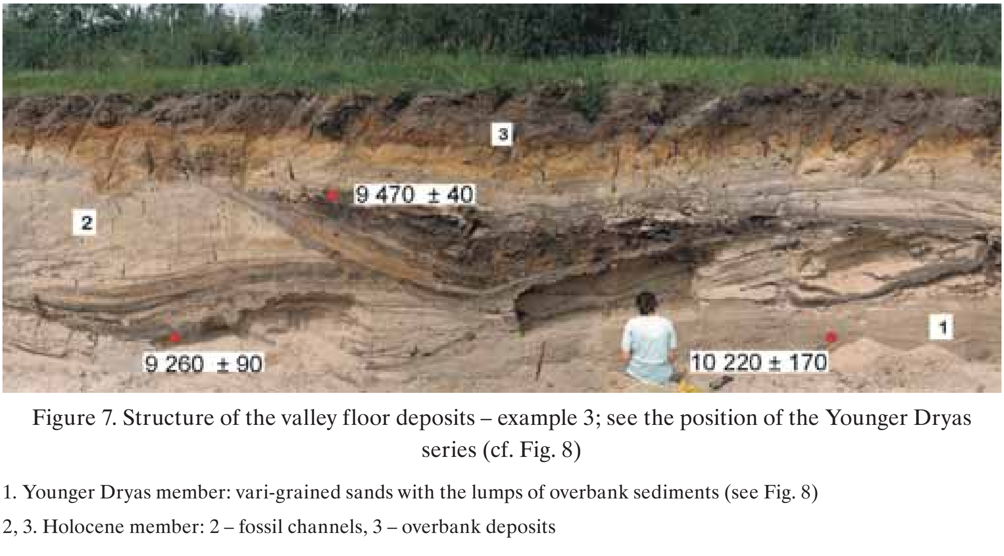

Figure 7. Structure of the valley floor deposits – example 3; see the position of the Younger Dryas series (cf. Fig. 8)

1. Younger Dryas member: vari-grained sands with the lumps of overbank sediments (see Fig. 8)

2, 3. Holocene member: 2 – fossil channels, 3 – overbank deposits

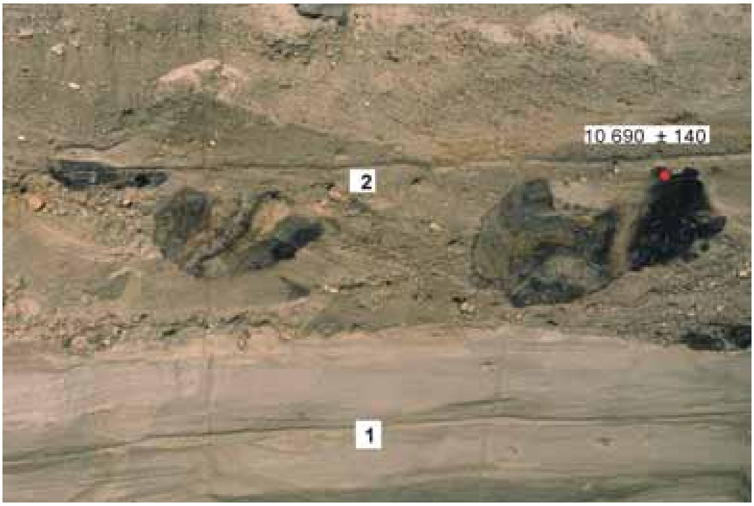

Figure 8. Contact between the Interpleniglacial and Younger Dryas series

1 – Interpleniglacial sand-silty series (cf. Figs. 4–1, 5–1); 2 – vari-grained, very poorly sorted sands with the lumps of overbank sediments (cf. Fig. 7–1)

(Table 1 v 10). The present valley fill consists of two distinct members, both of them representing products of a meandering river. The lower member was formed during the successive phases of large meanders and a period of their "disorganisation" and proves the valley transformation in the Lateglacial. The upper member represents the Holocene. Its deposits originated during the phase of small-size meandering channels, from ca. 9,000 BP up to the regulation of the river at the end of the 1930s. The balance of Holocene erosion has been estimated as negative. Considerable destruction of the Lateglacial sediments and burial of any remnants by the Holocene river seriously confine their palaeogeographical significance (Fig. 7).

Besides the palaeochannel fills, the Lateglacial series consists of channel facies and overbank deposits of the meandering river. The former is preserved *in situ*, though only partially, while the latter is usually redeposited and forms the fossilized lumps. In the extensive walls of the excavation, in only two cases the Lateglacial overbank deposits have been found *in situ*. In the central part of the valley, the sandy mud covering poorly sorted channel deposits has been preserved (Fig. 4). At the eastern valley slope, formed in sandy deposits of the side valley fan, disturbed deposits of the overbank series have been observed (Fig. 8). The post-sedimentary continuous deformations suggest the flow of saturated with water material facilitated by seasonal or perennial freezing of the ground. After the formation of these structures, the return towards braiding took place in a fragment of the valley floor. A lens of organic material from the top of the small shallow channel series is younger. Therefore, a date of 8,240 ± 160 BP (Table 1 v 2) points mainly to a Mesoholocene age of the overlying deposits of the fan.

Apart from the above mentioned examples, redeposited overbank deposits have been frequently observed in the form of lumps buried by vari-grained poorly sorted sediments above the erosional surface (Fig. 8). The lumps vary in age (Table 1 v 10 12, 13) and lithology, indicating different age and flood characteristics of the destructed floodplain fragments. The eroded remnants as well as structural and textural characteristics of deposits burying them point to the higher dynamics of the river in the valley sections containing the lumps. The sur-

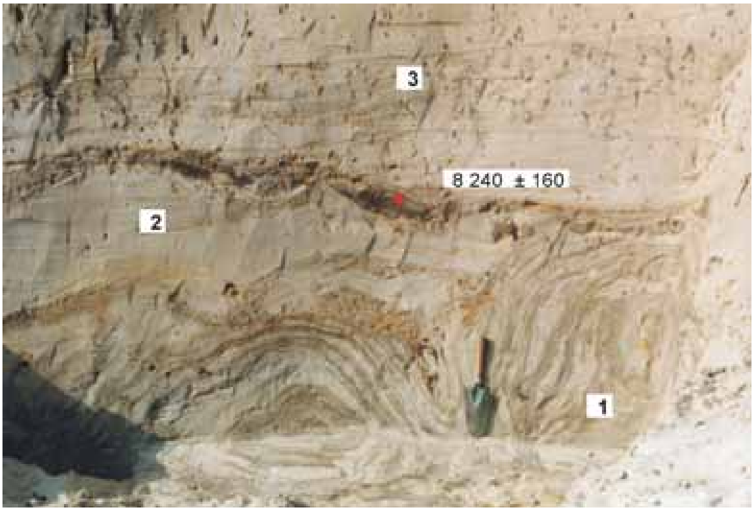

Figure 9. Structure of the deposits of the peripheral part of the Ner Valley

Lateglacial: 1 – sand-silty overbank deposits, post-sedimentary disturbed, 2 – channel deposits, vari-grained sands, at the top the lens of organic material formed in a small channel, probably in a Younger Dryas braided channel; Holocene: 3 – vari-grained sands of cross-stratification – the fan of the side valley, the structure destroyed due to present-day roots

Figure 10. Structure of the inner member of the high level

Vari-grained, poorly sorted sands of the Upper Pleniglacial braided river. Excavation connected with the construction of a sewage treatment plant (Fig. 2–13a)

vival of the lumps may provide evidence of a floodplain freezing, which facilitated their (thermal ?) erosion and fossilization as a whole by the fast accumulation. The discharge must have been therefore intense and rapid, with an increase in sediment load, and quickly vanishing. These situations, where a poorly developed pavement between the

Upper Pleniglacial and Lateglacial series is replaced by the vari-grained, exceptionally poorly sorted sediments with the buried lumps, prove a considerably higher flow dynamics than in the other, older parts of the Lateglacial valley. A date of 9,850 ± 250 BP (Table 1 v 10) from the youngest dated lump gives an evidence of the destruction of the floodplain later than the overbank accumulation, thus it was the earliest at the end of the Younger Dryas. Also, other fragments of the exceptionally heterometric Lateglacial series containing the lumps of overbank deposits come from the Younger Dryas. These evidence intensification in the flow dynamics as compared to the previous Lateglacial stratigraphical units; though, as with the thick series of vari-grained sands assumed to be the Lateglacial point bars of large palaeomeanders, they are poorly preserved. Worth mentioning are an erosional top of the Lateglacial series as well as a blanket of the Holocene deposits of different facies and age, since the Boreal period up to modern anthropogenic overbank loams, covering the valley floor (Fig. 7).

SITE LUBLINEK – RAILWAY STATION

The high level near the Lublinek railway station site at 168–180 m a.s.l. is characterized by a gentle relief. The only diversity are small valleys with discontinuous floors, varying in width and situated several dozen centimetres below the plain level (Fig. 2–13a,b,c,d). They are marked in the landscape rather by the change of vegetation (the meadow between farmlands and wetlands) than in hypsometry. The geological structure of the level was available in the trenches up to a depth of 5–7 m. Transversely to the Ner Valley axis, one may distinguish its three members (Fig. 2 – cross-section). The “inner” member, corresponding to the Upper Pleniglacial terrace of the Ner Valley, reveals an exceptional homogeneity (Fig. 10). As with the upper segments of the valleys from the Łódź region, aggradation by the sands of a braided river overlay the erosional

Figure 11. A fragment of the excavation connected with the construction of a sewage treatment plant, with fossil valleys (Fig. 2–13b)

1 – vari-grained, mainly wash deposits of the infilling of the marginal part of the Ner Valley; 2 – silts and silts with sands with an organic admixture of the valleys dissecting the high level of the Ner basin; 3 – Younger Dryas vari-grained sands with gravels covering mineral-organic deposits

surface of the Prosna phase. Braided-river series, which corresponds with the last glaciation, evidence a multi-phase accumulation in the valley, also strongly influencing the present-day environment (the higher terrace surface is poorly susceptible to blowing out and often reforested area). As mentioned earlier, in the western side of the Ner Valley near Łódź, a few (4–5) metres thick vari-grained sands deposited by a braided river filled up the valley incision.

The "outer" member of the high level comprises the morainic plain, which is situated a few metres higher than the sandy terrace level. It is also a monotonous, slightly undulating surface consisting of gentle elevations and valley depressions. In the analysed area, the surface is dominated by till, which is replaced by fluvioglacial sands farther eastwards. The lack of sediments younger than those of the Wartanian stadial indicates the post-glacial periglacial denudation, whose products were transported through the surrounding valleys, presented below. As observed in the trenches, the surface till is of the ablation origin, is only 1.0–1.5 m thick, and underlain by very diversified, glacially disturbed sediments, which allowed to the reinterpretation of the Wartanian glacial events west of Łódź (Turkowska, 1993).

The "transitional" member is situated at the junction of the main valley and the plain built up of glacial deposits. Its structure was analysed in the trenches, about 35 m long and up to 6 m deep (Fig. 2–13b). It registers a high dynamics of post-glacial processes, which has not been recorded at the surface. This member's base comprises till lobes alternating with water sediments, deposited both in stagnant water and along routes of the local flow. Till as well as water deposits are frequently post-sedimentary disturbed. Flow traces and crack structures in the shape of a network system suggest the periglacial origin of the deformations. Unfortunately, neither age determination nor palaeoenvironmental studies in order to establish the chronostratigraphic position of the series have been done. These investigations concerned the time of the Pleistocene – Holocene transition, evidenced by fossil concave forms, 2–3 m deep, filled with silts, rhythmically layered silty-sandy sediments and fine-grained sands with ripple marks

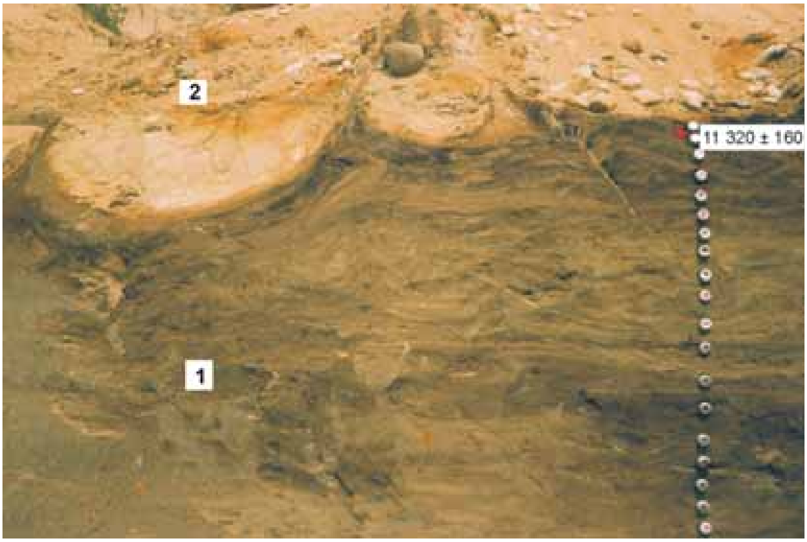

Figure 12. Contact between mineral-organic infillings of dry valleys (1) and Younger Dryas vari-grained series (2) in the excavation (Fig. 2–13b). Small wash-out structures with edges outlined with load disturbances. Series 1 – samples for pollen analysis (Table 2), the top – radiocarbon analyses

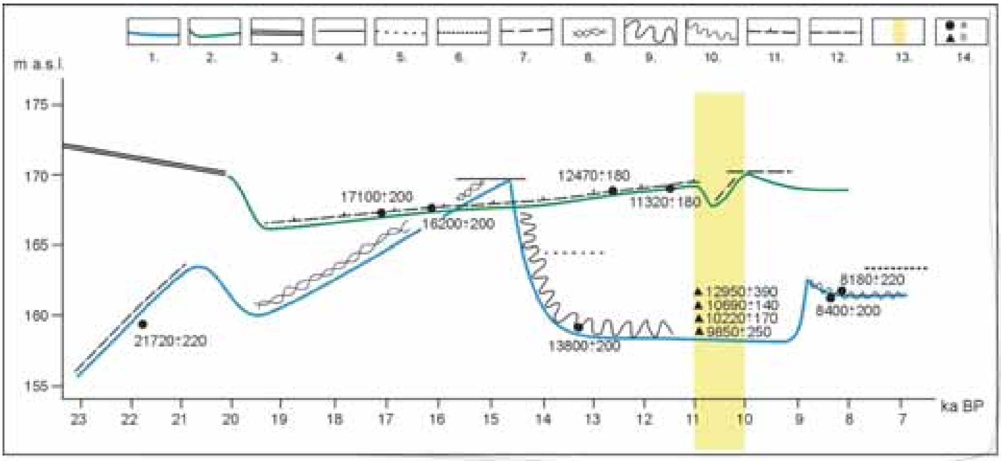

Figure 13. Tendencies of development in the Ner Valley system during 23–7 ka BP
1 – main valley, 2 – tributaries; 3 – denuded morainic plain; 4 – Pleniglacial terrace level; 5 – Lateglacial low level; 6 – Ner Valley floor; 7 – Younger Dryas accumulation horizon; 8 – braided channel pattern; 9 – large meandering pattern; 10 – small meandering pattern; 11 – overbank deposits; 12 – wash deposits; 13 – extent of Younger Dryas time; 14 – radiocarbon dating of: a – *in situ* material, b – lumps

Figure 14. Trenches through the Lateglacial-Holocene fossil valleys (Fig. 2–13c). Southern view of the Younger Dryas sands

(Fig. 11). The features of their infilling point to both closed forms and denudational valleys and forms with a periodic flow. The mineral deposits are separated by three horizons of hydromorphic soil, dated by ^{14}C (Table 1 v 15,18,19); one of them is shown in Fig. 11. Also, the radiocarbon age for the most of organic material situated at the top of the structureless depression infilling, directly below the erosional furrows dissecting them (Fig.

12), has been determined. The age determinations (Fig. 13, Table 1) set the processes at the main stadial of the last glaciation. The formation of small valleys in the morainic plain was probably due to connection of some selected accumulative-deformational (thermokarst ?) concave forms, especially common in the Ner Valley and at plateau boundary. This process took place during the Interpleniglacial – Upper Pleniglacial time, but evidently somewhat later than the erosion of the basal series in the main valley. Those small valleys were filled synchronously with the aggradation of the braided river. Breaks in the accumulation, expressed as the hydromorphic soil horizons, are exceptional remains of the Upper Pleniglacial (16,200 ± 200 and 17,100 ± 200 – Table 1 v 18,19) warmings in the Łódź Region and those of the Lateglacial (12,470 ± 180 – Table 1 v 15). The palynological analyses have shown very low frequency and a high degree of grain corrosion. The NAP pollen domination is indicative for poor open communities (Table 2). ^{14}C analyses of most of organic samples have allowed to establish the sequence of events corresponding with an interphase warming of the Weichselian main stadial (Table 1). A radiocarbon date of 11,320 ± 160 BP (Fig. 12) points to formation of the topmost sandy series, visible in the excavation and building the nearest surface, at the end Lateglacial decline. This sandy series rests on the erosional surface, which in places forms furrows underlain by pavement. The boundary is additionally disturbed with load structures of amplitude up to 0.5–0.7 m. The vari-grained sandy series, sometimes with a gravel admixture, is 2.5 m thick. These poorly sorted, mostly cross-stratified deposits expand over the small valleys visible in the walls in a transverse profile and occupy a large part of the analysed plain surface. They were also observed in the water-mains excavations along the Łódź – Pabianice railway track and about 400–700 m to the north, at the road leading to the treatment plant (Fig. 14). Structurally, they are very similar to the deposits building the high terrace surface of the Ner Valley, which are a full cycle older and inserted along the transversal small valleys. “Routes” of the Younger Dryas sand are dissected in axes of the present-day small valleys, which correspond to the Ner Valley through the fans deposited on the previously formed valley floor. One of the fans was presented above, at the site Lublinek – sewage treatment plant. It probably contributed to the preservation of the organic lens (8,250 ± 150 BP) formed in the abandoned belt of a braided river together with a sequence of overbank and channel deposits of the Younger Dryas.

The above review has shown that the structure of the high level is surprisingly complex in comparison with its monotonous surface. The imprint of the Younger Dryas is extensive and significant in the present environment, especially within the Wartanian morainic plain, which became firstly washed out and afterwards covered with vari-grained sands obliterating the morphology and resulting in its resemblance to the “inner” member of the level.

Table 2. Absolute values of sporomorphs, Lublinek railway station site, fossil valley I (Fig. 12)

Sample no	Pinus	Betula	Juniperus	Alnus	Picea	Carpinus	Cyperaceae	Gramineae	Artemisia	Liguliflorae	Armeria	Ericaceae	Chenopodiaceae	Cruciferae	Gentianaceae	Botrychium	Polypodiaceae	Sphagnum	Corroded	Others
1	8.5	17	–	–	–	–	68	19	–	3	–	–	1	–	–	4	2	–	39	8
4	14.5	24	–	–	–	1	135	41	2	2	1	–	–	–	–	83	–	2	312	7
8	12.5	26	2	1	0.5	–	46	27	2	–	–	1	1	1	–	–	1	1	204	1
11	5.5	2	–	–	–	–	3	–	1	–	–	–	–	–	–	–	–	–	30	–

Analysis by Z. Balwierz

COMPARISON OF THE YOUNGER DRYAS PALAEOGEOGRAPHICAL EVIDENCE IN THE UPPER NER VALLEY AND THE SIDE SMALL VALLEYS OF THE SYSTEM AGAINST THE INTERPLENIGLACIAL–HOLOCENE EVOLUTION

In the light of this study, the Younger Dryas climatic changes are reflected differently in the present-day Ner Valley and the side small valley dissecting the high level of the described fragment of the Ner River basin.

Generally, processes operating in the Ner Valley during the Pleistocene – Holocene transition did not rework the outline of the landform fashioned during earlier Lateglacial periods by a large meandering river of a tendency to downcutting and removing the Upper Pleniglacial material. This outline was partly remodelled in the Holocene due to local undercuts, transverse processes (fans of the side valleys, slope processes, overbank aggradation, etc.). The Younger Dryas processes resulted probably in the straight belts and the tendency to braiding, but surely in the floodplain destruction. Registration of the Younger Dryas cooling is supported by deformations of the overbank deposits, while climatic humidity is reflected in the properties of the vari-grained series with lumps of overbank deposits pointing to an increased activity, mainly rapidity and variability of fluvial action. Radiocarbon dates set the fluvial response the earliest from the second part of the Younger Dryas, which is coherent with climate reconstruction in the section of Lake Gościąż. The record from the upper Ner Valley corresponds with a wet phase in Poland, dated at 12,000–11,000 cal BP and identified by Starkel (2002, 2011). Though the Younger Dryas rapid climatic deterioration did not cause the fundamental relief transformation, it left the fossil evidence in the buried valley infilling, possible to recognize exclusively when available in extensive excavations.

There is no doubt that in the initial valleys, the palaeogeographical evidence reflecting the Younger Dryas climate features is easier to detect and concerns both relief transformation and surface geology. Unlike the low valley level, morphogenetic processes refashioned the surface of the high level. It became washed out and afterwards covered with the thick sand series which levelled it. Moreover, disturbances at the boundary of both series, probably of load density origin which does not exclude the presence of the frozen ground, have been considered as the palaeogeographical evidence; possible development of permafrost in favourable local conditions was recognized for the Łódź Region (Dzieduszyńska, in press). Such conditions were highly probable within the morphologically and lithologically diversified surface of the peripheral zone of the high Ner Valley level. The surface wash was facilitated as an effect of the poor vegetation (Table 2) and the surficial cover of fluvioglacial or fluvioperiglacial sands as an available sediment source.

The comparison of palaeogeographical evidence during the Interpleniglacial – Lateglacial in two morphological positions has shown that the genetic indications of the same and synchronous processes vary according to the location in a system and often occur alternatively. These reflect a reverse balance, thus the aggradation in the main valley coincides with the erosion in the side valleys, and vice versa – the erosion in the main valley with the accumulation in the plain. Evidently, taking into account various scales of events as well as collecting data from various locations in a system, causes confusion and may lead to serious failures in the interpretation[2]. During relief evolution, the diversity of original pieces of evidence is multiplied by a similar diversity of their preservation conditions, which also depend on the location in a denudation-accumulation system and are, thus, local factors. A condition of their elimination from consideration has to be fulfilled in order to describe global influence, which is identified as phases of increased morphological activity (Starkel, 2011).

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[2] A different stratigraphy of the Weichselian slope deposits, depending on their morphological position, has already been discussed by Turkowska and Wieczorkowska (1986)

CONCLUSIONS

- The Younger Dryas climatic instability, documented on the basis of analyses of the continuous ice core records and the sequences of annually laminated lake sediments, are in the studied area confirmed by fragmentary evidence of various processes, frequently of opposite trends in the evolution of landforms; for example increased erosion in the smallest landforms of the first order is accompanied by increased aggradation at their outlets to the valleys of the second order or the other lower sections of a system.
- The studies of the fluvial environment from the Ner system presented above have shown that palaeogeographical evidence of the Younger Dryas depends on the maturity of the valley form steaming from its position in a system, thus from an individual stage of evolution controlling the balance of erosion and denudation of different sign (positive or negative) in landforms of various orders.
- Dealing with a discontinuous palaeogeographical record, only reconstructions of the tendency of evolution as well as its effects over a longer time span may provide the specifics of the environment in a given period, while a comparison of different parts of the system may enable the elimination of local factors.
- Only a synchronous (sub-synchronous) increase in dynamics of the processes in both the valley axis and its peripheries may be regarded as the joint response to global environmental changes in the upper Ner Valley system during the Younger Dryas; it follows the concept presented by Starkel (2002, 2011) on a global phase of increased fluvial activity in the Younger Dryas.

More pieces of evidence exist showing that the sequence of events with a final catastrophic climatic deterioration as an integral part was similar for other glacial terminations (Broecker et al., 2010). Therefore, the relatively comprehensive recognition of the Younger Dryas nature and its influence on the geoecosystems functioning provides a basis for taking it as a model for the reconstruction of its previous equivalents.

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Paper first received: May 2011
In final form: August 2011