WALACHIAN COLONISATION ON MOUNTAIN RIDGE RECORDED IN ALLUVIA OF THE ŠKORŇANSKÝ STREAM (THE MORAVSKOSLEZSKÉ BESKYDY MTS., WESTERN CARPATHIANS, CZECH REPUBLIC)

MAŁGORZATA WISTUBA, AGATA SADY***

Małgorzata Wistuba, Agata Sady: Walachian colonisation on mountain ridge recorded in alluvia of the Škorňanský stream (The Moravskoslezské Beskydy Mts., Western Carpathians, Czech Republic). Geomorphologia Slovaca et Bohemica, 11, 2011, 1, 5 figs., 1 tab., 33 refs.

The aim of presented study is to: (1) investigate geomorphological effect of Walachian colonisation on fluvial relief of small mid-mountain valley, (2) to prove the relation between overbank deposition of studied stream and pastoral land-use of its catchment. The methods conducted were: (1) geomorphic mapping, (2) mapping of terraces lithology, (3) lithofacial analysis of alluvia, (4) plant macrofossil and (5) organic coal content analyses. In the mouth of the Škorňanský stream inset alluvial terrace exist. It is composed of fine, overbank deposits (mud to sand) with a tendency of upward grain-coarsening. Plant macrofossils extracted from alluvia are characterized by: (1) upward decrease of treeleaf findings and increase of conifer needles amount in studied profiles, (2) presence of seeds and fruits from species typical for meadows, pastures, segetal weed communities, (3) presence of charcoal and other burnt remains – locally over 50 % of findings. Achieved results allow to connect the deposition of overbank alluvia and creation of inset terrace with deforestation of the catchment of the Škorňanský stream (from the turn of the 17th century). Forest exploitation was conducted by Walachian, pastoral settlers, and in order to produce charcoal for iron-smelters.

Key words: inset terraces, anthropogenic alluvia, plant macrofossils, pasturing, Walachian colonisation, Moravskoslezské Beskydy Mts.

INTRODUCTION, AIM AND STUDY AREA

Škorňanský stream provides an example, how the past pastoral activity influenced the relief development in a small mid-mountain valley. Studies concerning evidences of indirect human impact on mid-mountain morphology are numerous: in the Sudetes (KLIMEK 2000 or LATOCHA 2005) and Carpathians (KLIMEK 1987 or KUKULAK 2004), in small (COULTHARD et al. 2002 or LATOCHA 2005) and big catchments (KUKULAK 2004 or WOSKOWICZ-ŚLĘZAK 2005). Yet there are no such analyses for the Moravskoslezské Beskydy Mts. area. The aim of presented study is to:

1. investigate geomorphological effect of Walachian colonisation on fluvial relief of a small mid-mountain valley of the Škorňanský stream,
2. to prove the relation between overbank deposition of a small stream and pastoral land-use of its catchment.

The Škorňanský stream (length: ~ 2.7 km, catchment area: ~ 1.4 km^2) drains the southern slope of the Grúň-Kozlena mountain ridge (842 – 886 m a. s. l.) in the Moravskoslezské Beskydy massif (Western Carpathians). The stream is a tributary of the Černá Ostravice River (the Odra River basin, **Fig. 1**). The river valley developed in flysh mudstones of the Silesian Unit (Palaeogen age), and follow the margin of the Magura Nappe (MENČÍK and TYRÁČEK 1985). The study site is located in the mouth of the Škorňanský stream (580 – 625 m n. p. m.; **Fig. 1**).

Highest parts of the Grúň-Kozlena mountain ridge were settled by people from pastoral, Walachian community. At the turn of the 17th century they arrived to the study area (KRYGOWSKI 1964). Foundation of pastoral settlements and pastures was carried out through forest clearing, probably associated with scorching (similarly as in the Bieszczady Mts., south-eastern Poland: WOLSKI 2007). Walachian origin of settlers is recorded in regional names. Name of the *Košárky* clearing, located close to studied site (**Fig. 1**), probably derive

* Department of Quaternary Palaeogeography and Palaeoecology, Faculty of Earth Sciences, University of Silesia in Katowice, ul. Będzińska 60, 41-200 Sosnowiec, Poland, e-mail: malgorzatawituba@gazeta.pl

** Department of Archeology, Silesian Museum in Katowice, ul. Korfantego 3, 40-005 Katowice, Poland, e-mail: a.sady@muzeumslaskie.pl

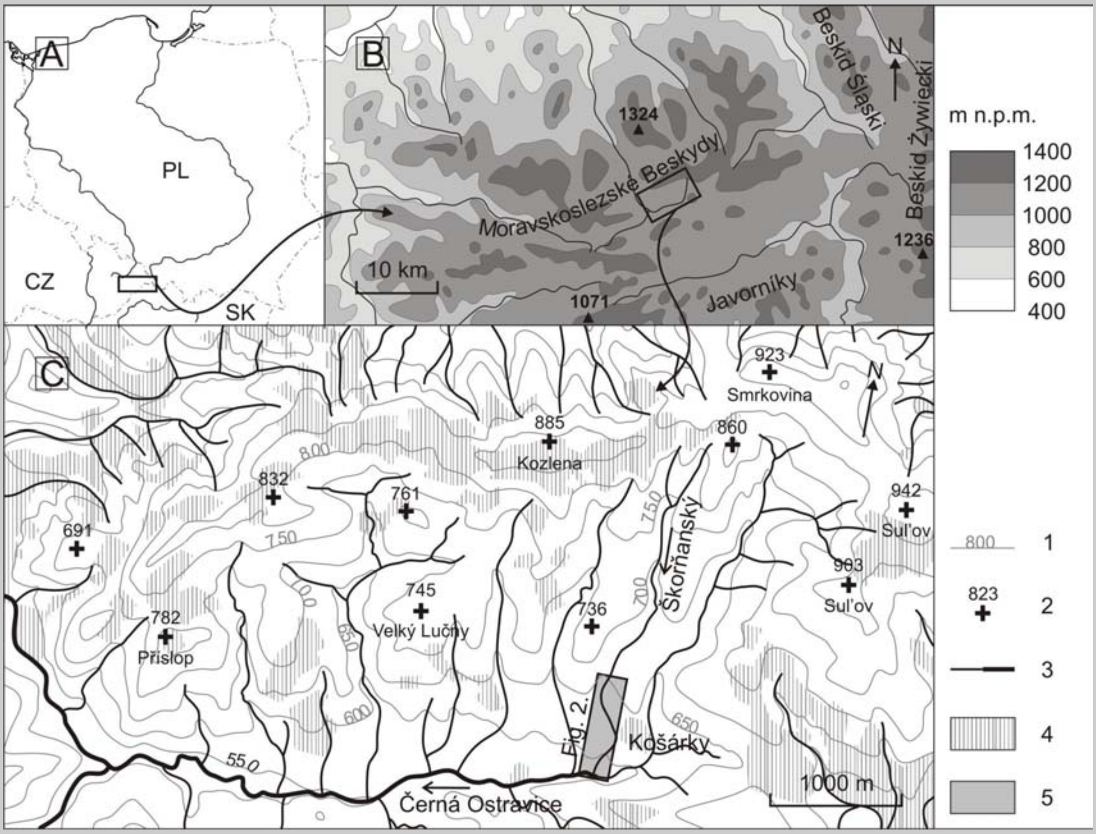

Fig. 1 A – Location of the Moravskoslezské Beskydy Massif; B – location of the Grúň-Kozlena mountain ridge in the Moravskoslezské Beskydy Mts.; C – location of the study site in the Grúň-Kozlena mountain ridge, in the mouth of the Škorňanský stream;

1 – contours (m a. s. l), 2 – mountain peaks (m a. s. l.), 3 – streams and ri-vers, 4 – meadows and pastures, 5 – study site

from the word *koszar*. Among the Wallahian ethnic group it was the name of a provisional pen, shifted each few days, where sheep and cattle were driven for nights (WOLSKI 2007). Herding in the Moravskoslezské Beskydy Mts. and other parts of the Western Carpathians was considerably reduced when highlanders lost half of their meadows in 1853 (due to legal regulations – ZIĘTARA 1986). Until now, only few pastures survived in the highest parts of the Grúň-Kozlena mountain ridge (**Fig. 1**).

Apart from pasturing, in the 18th and 19th century, in Staré Hamry (Old Smithy) – a village in the Černá Ostravice River valley – iron smelting and processing were conducted. The production was supported by clearance of local forests. Because of human influence deciduous forests growing on the Grúň-Kozlena ridge were replaced by spruce forests, mainly artificially planted.

METHODOLOGY

In the mouth of the Škorňanský stream geomorphic mapping was conducted (scale 1:1 500). Active and abandoned stream channels, boulder steps and dams of coarse woody debris, contemporary deposited and dissected alluvial bars, bank undercuts, peat hollows and slope/valley bottom morphological boundary were considered (**Fig. 2A**).

A map of the lithology of the Škorňanský stream terraces (**Fig. 2B**) was created with the use of data from 31 shallow digs (depth: ~40 cm) and outcrops (max 1.8 m) existing in bank undercuts. Two selected profiles, marked as Šp2 and Šp4 (**Fig. 4** and **Fig. 5**), were described according to Miall's lithofacial code modified by ZIELIŃSKI (1995; explanation of lithofacial abbreviations applied in the paper is placed under the **Fig. 5**). Samples for organic coal analysis (loss on ignition method, **Fig. 5**) were taken from the profiles (10 cm frequency).

Analysis of plant macrofossils – their species composition (**Fig. 5**) – was carried out using authors' method based on WASYLIKOWA (1973), BAKER (2000), TOBOLSKI (2000), LITYŃSKA-ZAJĄC and WASYLIKOWA (2005) works. Samples (~750 cm^3 each) were taken from sedimentary beds. They were washed on sieves (mesh: 1 mm). Col-

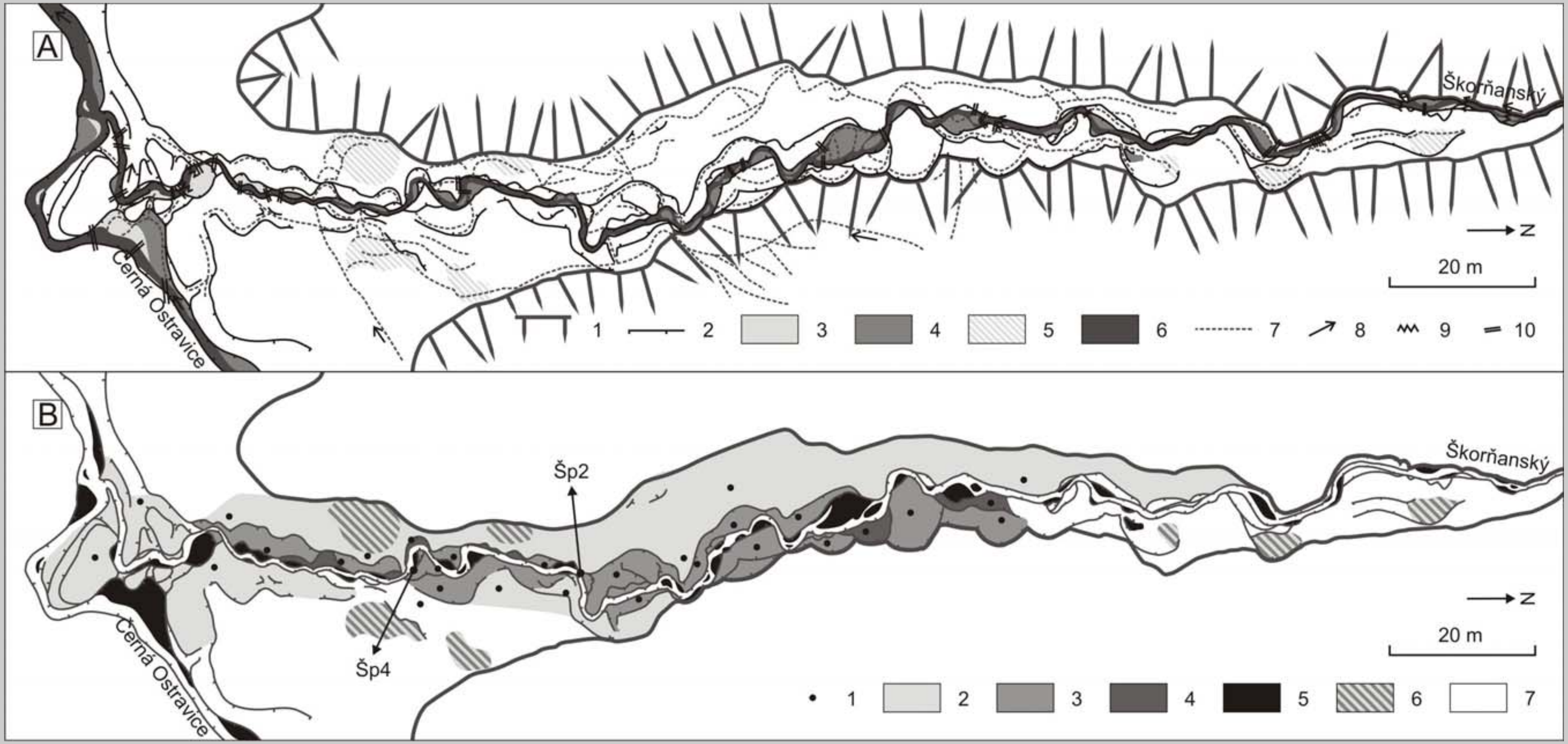

Fig. 2 A – Morphology of the mouth of the Škorňanský stream. B – Terrace levels in the mouth of the Škorňanský stream with the location of studied Šp2 and Šp4 profiles;

A: 1 – morphological boundary between slopes and valley bottom, 2 – active and abandoned bank undercuts, 3 – active channel bars, 4 – dissected channel bars, 5 – peat hollows, 6 – main channels of Škorňanský stream and Černá Ostravice, 7 – abandoned channels, 8 – slope/flow directions, 9 – boulder steps, 10 – dams of coarse woody debris; B: 1 – digs, 2 – uppermost, „loamy" terrace 3 – middle „muddy-sandy" terrace, 4 – lowermost „sandy-gravelly" terrace, 5 – bars in modern channels of the Škorňanský stream and the Černá Ostravice River, 6 – peat, 7 – unidentified deposits lected plant remains were checked for the presence of generative findings (seeds, fruits). Additionally, from each sample a subsample was collected (volume: 0.2 cm^3). In the subsamples the amount of selected vegetative macrofossils (tree leafs, conifer needles, wood, burnt remains, mosses, plant roots, undetermined) was determined.

Botanical identification of remains was made with the use of contemporary comparative plant material and works of KULPA (1988) and CAPPERS et al. (2006). Species composition of generative remains was used to determine (following instructions of ZARZYCKI et al. 2002) the plant communities, which probably existed in the Škorňanský catchment during deposition of studied alluvia (**Tab. 1**).

RESULTS

In the studied site, along the active, sinuous channel of the Škorňanský stream (**Fig. 2A**) there are many abandoned palaeochannels, accompanied by arched escarpments – former bank undercuts. Together they create a system of terraces (**Fig. 3**), with different height above water level (max ~2.2 m).

Three types of terrace deposits were identified. The highest surfaces are composed of unsorted diamictons with large admixture of angular gravels and boulders. Extensive middle terrace is composed of deposits with characteristic veritical sequence. (1) Poorly sorted sandy gravels and gravelly sands (truncated by erosive surface) are overlain by (2) fine-grained, sorted, coarsening upward deposits (muds, muddy sands, sands) with numerous layers of plant detritus. Narrow shelves of the lowest terrace are composed of poorly sorted sands and gravels with substantial admixture of coarser grains. On the map (**Fig. 2B**) there are also sandy gravels of contemporary channel bars distinguished.

In the deposits of middle terrace two lithofacial profiles were studied (**Fig. 4** and **Fig. 5**). The Šp4 profile represent typical, above described, alluvial sequence. In the Šp2 profile the tendency of upward grain-coarsening is less clear. In the deposits of both profiles massive structure dominate (lithofacies Fm, SFm, GSm, Sm). Trough cross-bedding (lithofacies SGt, SFt) and traces of horizontal lamination (lithofacies Fh) are of secondary importance. Both profiles have similar variability of organic matter content (**Fig. 5**). Apart from the surficial layer – soil (0 cm: 13.92 and 15.95 % loss on ignition), two other levels of organic coal concentration were found, on the depth of 20 – 30 (6.21 and 6.84 %) and 50 – 60 cm (7.57 and 20.68 %). Both occur in massive muds (lithofacies SFm).

Palaeobotanical analysis (**Fig. 5**) revealed, that most of collected plant material is highly fragmented and impossible to determine. In both profiles, among determined macrofossils, similar changes of species composition occur (the tendency is more distinct in Šp4). In fine-grained alluvia (muds-sands) the number of tree-leaf remains (probably a beech – *Fagus sylvatica*) decrease upward while the amount of conifer needles findings (a fir – *Abies alba* and a spruce – *Picea abies*) increase. In both profiles charcoals and other burnt remains occur: in Šp4 – in three uppermost layers (even >50 % of 0.1 cm^3 subsample); in Šp 2 in 3 lowermost layers (1 – 3 %). In subsample 4 from the Šp2 profile undetermined remains domi-

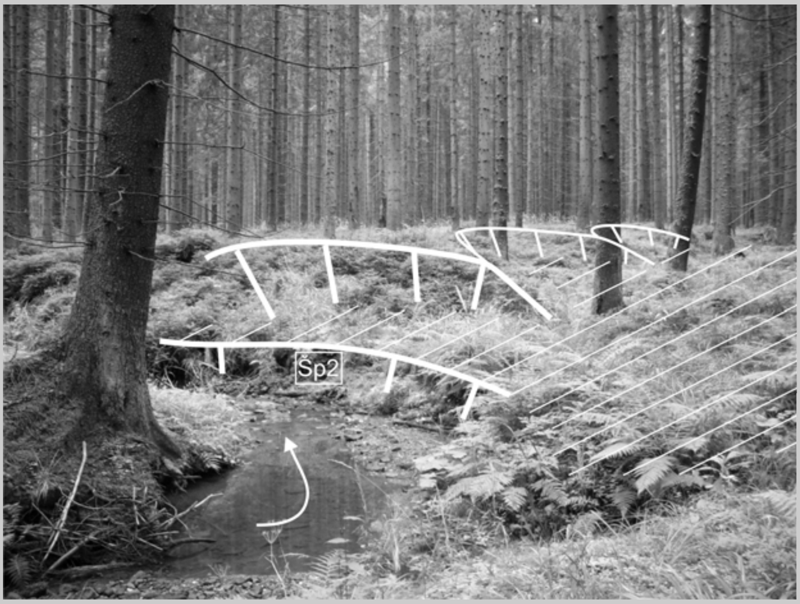

Fig. 3 Channel, abandoned, sinuous undercuts and terraces of the Škorňanský stream with the location of the studied Šp2 profile. Fine-grained (mud-sand) Walachian terrace shaded

Fig. 4 Studied Šp2 and Šp4 profiles of the middle terrace of Škorňanský stream. Detailed lithofacial profiles, with sedimentary beds distinguished, are presented on **Fig. 5**

nate (52 %). These are mostly fragments of grasses and sedges.

INTERPRETATION AND DISCUSSION OF RESULTS

Lithology features of the deposits from the Škorňanský middle terrace prove that they are overbank sediments. They are fine-grained, have massive structure and show traces of planar lamiantion (**Fig. 5**). Vertical deposition of the alluvia, during floods, and on the alluvial plain explain similarities between two profiles located 25 m one from each other. The similarities are: sedimentary beds sequence, vertical variability of organic matter content, vertical variability of tree-leafs and conifer needles amounts. It may be an evidence of similar age of deposits studied in both profiles.

Variability of loss on ignition curve (**Fig. 5**) depends on grain size. The reasons of increased organic coal content in muds can be: sedimentary environment (low-energy) and conditions of fossilisation (better in fine material than in sands).

The tendency of upward grain-coarsening in the whole overbank alluvia sequence indicates their connection with human impact. The tendency was observed in many rivers and streams (KLIMEK 2000, KUKULAK 2004 or SZMAŃDA 2009), and was explained as an effect of catchment deforestation. Anthropogenic character of studied deposits was confirmed by results of palaeobotanic analysis.

Because of the specificity of the study site and sampled alluvia (containing material delivered from the whole catchment), extracted plant remains are mixed. They derive from different plant communities and habitats. Examined macrofossils were mainly redeposited forest litter. It appears that upward decrease in the number of tree-leaf remains and increase of conifer needles amount in profile Šp4 (**Fig. 5**) demonstrate the gradual restructuring of forests in the catchment of the Škorňanský stream. Deciduous forests, typical for lower montane vegetation belt in the Western Carpathians, were replaced by coniferous communities.

Among the generative findings (seeds and fruits) occur some species, that (according to ZARZYCKI et al. 2002) grow in: open, non-forest (**Tab. 1,** e.g. wind-falls, grasslands) and anthropogenic (**Tab. 1,** e.g. logging areas, meadows, pastures, segetal weeds) plant communities.

Achieved results show, that anthropogenic alluvia of the Škorňanský stream preserved evidences of colonisation of the Gruň-Kozlena ridge by Walachian, pastoral communities. Large amounts of charcoal and other burnt remains (even >50 % of 0.1 cm^3 subsamples) are

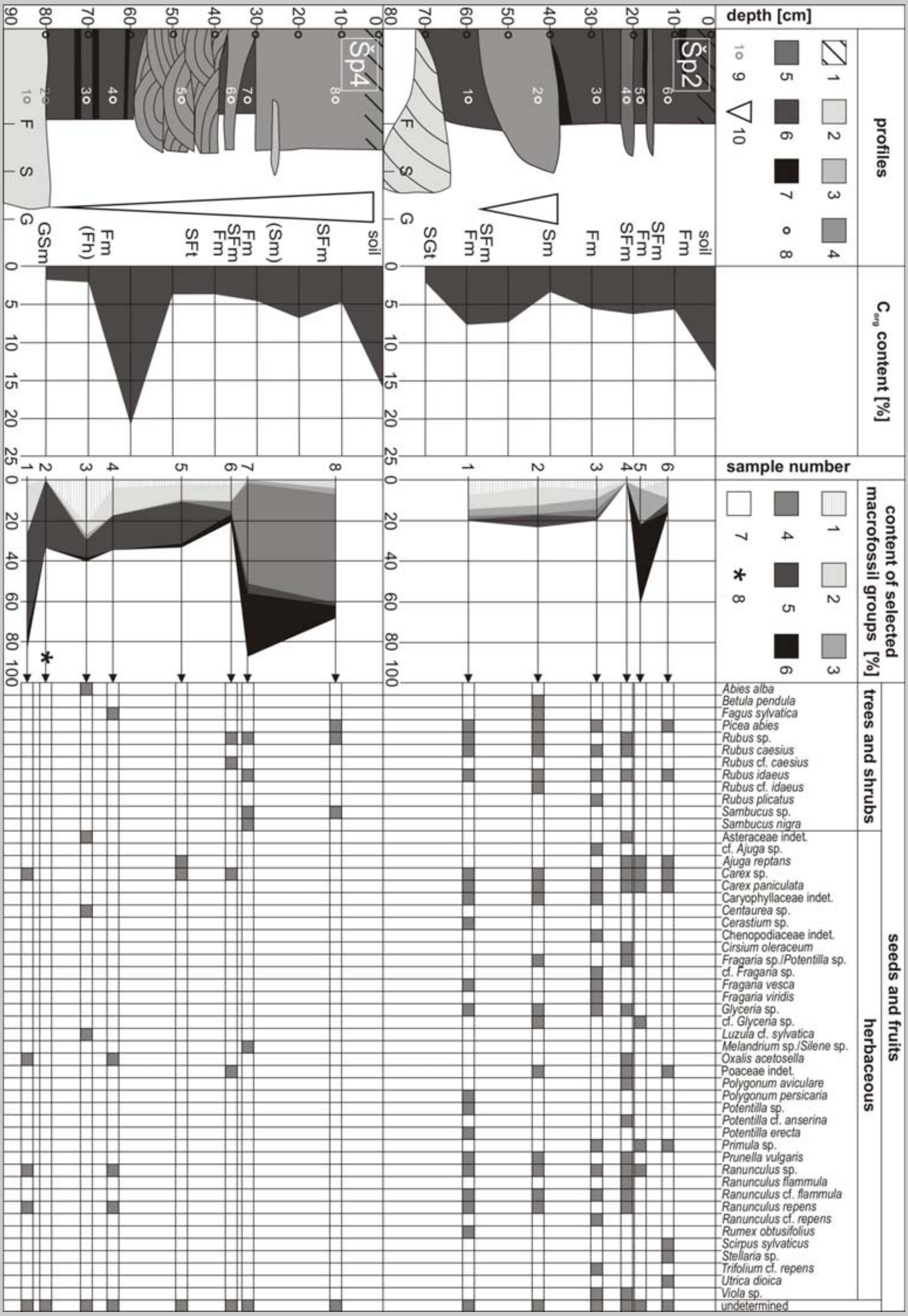

Fig. 5 Šp2 and Šp4 lithofacial profiles of deposits of the middle terrace with sampling points marked, the results of organic coal content analysis; the results of palaeobotanic analysis

profiles: 1 – soil, 2 – lithofacies GS and SG, 3 – lithofacies S, 4 – lithofacies SF, 5 – lithofacies FS, 6 – lithofacies F, 7 – layers of plant detritus, 8 – samples for organic coal content analysis, 9 – samples for palaeobotanic analysis, 10 – upward grain-coarsening, F – fine-grained deposits (clay, mud), SF – muddy/clayey sand, S – sand, SG – gravelly sand, GS – sandy gravel, G – gravel, boulders, h – horizontal lamination, m – massive structure, t – trough cross-bedding; macrofossils: 1 – tree-leafs, probably *Fagus sylvatica*, 2 – needles of *Abies alba* and *Picea abies* in total, 3 – wood, 4 – charcoal and other burnt remains, 5 – mosses, 6 – roots, 7 – undetermined, 8 – subsample less than 0.1 cm^3

plant species distinguished in the alluvia	plant communities
Betula pendula, *Abies alba*, *Luzula* cf. *sylvatica*, *Oxalis acetosella*, *Picea abies*, *Potentilla erecta*	fir, spruce and pine forests
Carex paniculata, *Cirsium oleraceum*, *Oxalis acetosella*, *Rubus caesius*, *Scirpus sylvaticus*	swamp forests and thickets with black alder
Rubus caesius, *Rubus plicatus*, *Utrica dioica*	riverine poplar-willow forests
Betula pandula, *Fagus sylvatica*	poor subatlantic oak forests
Ajuga reptans, *Oxalis acetosella,*	deciduous forests and thickets
Fragaria vesca, *Rubus idaeus*, *Sambucus nigra*	logging areas and wind-falls communities
Rubus caesius, *Rumex obtusifolius*, *Sambucus nigra*, *Utrica dioica*	ruderal, perennial plant communities
Polygonum aviculare, Polygonum persicaria, Ranunculus repens, Rumex obtusifolius	segetal and ruderal weeds communities
Potentilla cf. *anserina, Prunella vulgaris, Trifolium* cf. *repens*	meadows and pastures
Potentilla erecta	poor grasslands on non-calcareous soils
Fragaria viridis	stenothermic grasslands
Ranunculus flammula	peat bogs, mires

Tab. 1 Plant communities, which potentially existed in the catchment of the Škorňanský stream, in the period of the deposition of studied alluvia – determined on the base of seed and fruit findings

probably connected with forest scorching, when pastures were created. Deforestation, intensive herding in forests and meadows resulted in creation of unique plant communities – which is recorded in seed and fruit findings (**Tab. 1**).

Herding and need for timber, for iron smelting caused forest clearing in two directions: upslope, from the bottom of the Černá Ostravice River valley and down slope from the top of the Gruň-Kozlena mountain ridge. Reforestation proceeded by secondary succession and artificial spruce planting. Change from natural, deciduous to artificial, coniferous forests is recorded in the variability of vegetative macrofossils composition (increase of needles and decrease of tree-leafs).

Geomorphic evolution of the mouth of the Škorňanský stream proceeded in several stages.

(1) In the periglacial climate, during the last glaciation loamy colluvial covers were deposited (contemporary uppermost terrace level).

(2) In the Holocene surface of the covers was dissected by the Škorňanský stream. Fine material was carried away, sands and gravels were redeposited as channel alluvia. Now they underlay anthropogenic alluvia (bottom lithofacies SGt, GSm). Redeposition occured also in mouths of other streams – as was proved by PÁNEK et al. (2007). Organic layers in gravelly alluvia of nearby (distance of 3.6 km) stream were dated (^{14}C) to 7650±110 and 6210±130 BP (PÁNEK et al. 2007).

(3) Deforestation, which began in valley heads of the Škorňanský stream in the 16^{th} – 17^{th} century, caused erosion of the slope covers. The pastoral type of land-use indicates that it proceeded through: surface wash (in areas where grass was trampled down by cattle) and erosion of dirt roads and paths. The slope material was delivered to channels in the upper part of catchment and partially deposited in the mouth of the Škorňanský stream. Overbank character of the studied alluvia indicate that it proceeded mainly during floods – in connection with spring thaws and extreme summer rainfalls. Alluvia deposition fell on the period of Little Ice Age (BRÁZDIL 1992), but it was probably the human impact, that played the main role. Human impact caused the change in the style of deposition of small Škorňanský stream: from sands and gravels (channel type) to mud's and sands (over bank type). Alluvia filled older dissection – creating the (nowadays middle) terrace level.

(4) In the mid of the 19^{th} century herding in the Moravskoslezské Beskydy Mts. was limited by legal regulations. The reforestation caused changes in hydrological regime of the Škorňanský stream. Anthropogenic alluvia were eroded. The dissection is now partially filled with sandy-gravels of the lowest terrace and contemporary channel bars. These deposits originate in reworking of material delivered from bank undercuts: muds, sands, gravels and loams from higher terraces.

Above described course of events led to the creation of inset terraces in the mouth of the Škorňanský stream. Alike rules/conclusions concerning human impact on morphology of small mid-mountain valleys were presented by: COULTHARD et al. (2002) for British uplands, KLIMEK and MALIK (2005) for the Hrubý Jeseník Mts. and LATOCHA (2005) for the Śnieżnik Massif. The creation of inset terraces, as a result of human impact on the Ruda River and its catchment, was described by KLIMEK (1999) in Southern Poland.

Discussed study site is an example of indirect human impact on relief and stream dynamics in mid-mountains, in the area nowadays weakly developed, forested and popularly treated as „natural" or „primeval". It is also an example of environmental change recorded by fluvial system of small mid-mountain valley – despite, that sites like this are sometimes treated as „mute" for palaeogeographic studies. Presented reconstruction is based on the inner structure and relative age (height) of the Škorňanský stream terraces. Established scheme requires confirmation by radiocarbon dating.

Palaeobotanical analyses of human impact on environment usually are based on pollens (RALSKA-JASIEWICZOWA 1969 or HARMATA 1995) or wood and charcoal studies (results from Carpathians ex.: KUKULAK 2002 and 2004). As an extreme case of plant macrofossil, whole tree logs from alluvia can be studied (GURNELL et al. 2000), among them, black oaks (LINDNER 1977). Using fruits and seeds extracted from alluvia for palaeobotanical analyses is more rare. Transport and deposition of these kind of plant remains in fluvial systems of Carpathian streams was studied by PELC (1983), CABAJ (1993) or CABAJ and PELC (1991 and 1996). In the Eastern Sudetes the antropogenic character of alluvia in the small, arable valley head, was confirmed by the presence of seeds of segetal weeds (KLIMEK and MALIK 2005, KLIMEK and LATOCHA 2007).

In the study area there are no palaeobotanical studies based on remains of vegetative parts of trees and herbaceous plants extracted from alluvia. Data achieved for the Škorňanský stream are hard to compare and verify, because of the lack of analogous studies from the region. Despite this, it seems, that results described in the paper prove that plant macrofossils from alluvia, generative and vegetative remains, are valuable source of palaeoecological data, especially in small catchments. The created method should be tested and improved in order to prepare it for wider usage.

CONCLUSIONS

1. Anthropogenic deforestation and forest exploitation of the Gruň-Kozlena mountain ridge (from the 16th-17th century) caused: (1) increase of surface wash on exposed slopes, (2) redeposition of periglacial, loamy slope covers, (3) increase of sediment delivery into stream channels, (4) deposition of anthropogenic alluvia in the mouth of the Škorňanský stream – filling of the older channel dissection, (4) change in the mountain stream style of deposition – from sands-gravels (channel type) to muds-sands (overbank type).
2. Limitation of pasturing (1850s) and reforestation caused: (1) dissection of anthropogenic alluvia – creation of the middle terrace, (2) continuous reworking of muds, sands, gravels and loams (from older terraces), (3) their redeposition – creation of the youngest terrace.
3. Human interference into vegetation cover of the Škorňanský stream catchment resulted in the creation of inset terrace system in the stream mouth.
4. Established scheme requires confirmation by radiocarbon dating. The created method of plant macrofossils analysis should be tested and improved in order to prepare it for wider useage.

REFERENCES

BAKER, R. G. (2000). Holocene environments reconstructed from plant macrofossils in stream deposits from southeastern Nebraska, USA. *The Holocene*, 10, 3, 357 – 365.

BRÁZDIL, R. (1992). Climatic conditions of the Little Ice Age in Bohemia. In Mikami T., ed. *Proceedings of the International Symposium on the Little Ice Age*. Department of Geography, Tokyo Metropolitan Univeristy, Tokyo, 214 – 220.

CABAJ, W. (1993). *Wpływ sedymentacji na formowanie i strukturę tafocenozy karpologicznej w środowisku rzecznym*. Prace Monograficzne WSP, 158, Kraków.

CABAJ, W., PELC, S. (1991). Nasiona i owoce z osadów współczesnego jeziorka osuwiskowego w dolinie Wetliny (rezerwat Sine Wiry). *Ochrona Przyrody*, 49, 31 – 52.

CABAJ, W., PELC, S. (1996). Studia nad etapami tworzenia się tafocenozy karpologicznej na przykładzie potoku w Lubniu (Beskid Wyspowy). In Kostrzewski, A., ed. *Geneza, litologia i stratygrafia utworów czwartorzędowych*. Wyd. UAM, Poznań, 59 – 67.

CAPPERS, R. T. J., BEKKER, R. M., JANS, J. E. A. (2006). *Digitale Zadenatlas van Nederland. Digital Seed Atlas of the Netherlands.*

Series: Groningen Archeological Studies. Groningen University Library, Groningen.

COULTHARD, T. J., MACKLIN, M. G., KIRKBY, M. J. (2002). A cellular model of holocene upland river basin and alluvial fan evolution. *Earth Surface Processes and Landforms*, 27, 3, 269 288.

GURNELL, A. M., PETTS, G. E., HANNAH, D. M., SMITH, B. P. G., EDWARDS, P. J., KOLLMANN, J., WARD, J. V., TOCKNER, K. (2000). Wood storage within the active zone of large European gravel-bed river. *Geomorphology*, 34, 1 – 2, 55 – 72.

HARMATA, K. (1995). Traces of human impact reflected in pollen diagram from Tarnowiec mire near Jasło (Jasło-Sanok Depression), SE Poland. *Vegetation History and Archaeobotany*, 4, 4, 235 – 243.

KLIMEK, K. (1987). Man's impact on fluvial processes in the Polish Western Carpathians. *Geografiska Annaler*, 69A, 1, 221 – 226.

KLIMEK, K. (1999). A 1000 Year Alluvial Sequence as an Indicator of Catchment/ Floodplain Interaction: The Ruda Valley, Sub-Carpathian, Poland. In Brown, A. G., Quine, T. A., eds. *Fluvial Processes and Environmental Change*. John Wiley & Sons Ltd, 329 – 343.

KLIMEK, K. (2000). The Sudetic tributaries of Upper Odra transformation during the Holocene period. *Studia Geomorphologica Carpatho-Balcanica*, 34, 27 – 45.

KLIMEK, K., LATOCHA, A. (2007). Response of small mid mountain rivers to human impact with particular reference to the last 200 years; Eastern Sudetes, Central Europe. *Geomorphology*, 92, 3 – 4, 147 – 165.

KLIMEK, K., MALIK, I. (2005). Geomorfologiczne skutki wylesień w górach średnich: wiele problemów w małej zlewni, Jesioniki. In Kocel, K., ed. *Human Impact on Mid-Mountain Ecosystems*, 1, University of Silesia, Sosnowiec, 31 – 36.

KRYGOWSKI, W. (1964). *Beskidy. Śląski, Żywiecki, Mały i Średni (część zachodnia)*. Sport i Turystyka, Warszawa.

KUKULAK, J. (2002). Sedimentary record of early wood burning in alluvia of mountain streams in the Bieszczady range, Polish Carpathians. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 164, 1 – 4, 167 – 175.

KUKULAK, J. (2004). *Zapis skutków osadnictwa i gospodarki rolnej w osadach rzeki górskiej na przykładzie aluwiów dorzecza górnego Sanu w Bieszczadach Wysokich*. Wyd. Naukowe Akademii Pedagogicznej, Kraków.

KULPA, W. (1988). *Nasionoznawstwo chwastów*. Państwowe Wyd. Rolnicze i Leśne, Warszawa.

LATOCHA, A. (2005). Geomorphic evolution of mid-mountain drainage basins under changing human impacts, Eastern Sudetes, SW Poland. *Studia Geomorphologica Carpatho-Balcanica*, 39, 71 – 93.

LINDNER, L. (1977). Wiek terasów zalewowych rzek świętokrzyskich w świetle datowania „oziomu czarnych dębów" metodą ^{14}C. *Kwartalnik Geologiczny*, 21, 2, 325 – 333.

LITYŃSKA-ZAJĄC, M., WASYLIKOWA, K. (2005). *Przewodnik do badań archeobotanicznych*. Series: Vademecum Geobotanicum. Sorus, Poznań.

MENČÍK, E., TYRÁČEK, J., (1985). *Geologická mapa Moravskoslezských Beskyd a Podbeskydské pahorkatiny* 1:100 000. ÚÚG, Praha.

PÁNEK, T., ŠILHÁN, K., HRADECKÝ, J. (2007). Náplavový kužel v údolí Černé Ostravice. In Hradecký, J., Pánek, T., eds. *Geomorfologický sborník 6 (Stav geomorfologických výzkumů v roce 2007, Malenovice, Czech Republic, 2 – 4 April 2007)*. Ostravská univerzita v Ostravě, Přírodovědecká fakulta a Česká asociace geomorfologů, Ostrava, 70 – 71.

PELC, S. (1983). *Owoce i nasiona we współczesnych osadach Dunajca w rejonie Pienin i przełomu beskidzkiego*. Prace Monograficzne WSP, 59, Kraków.

RALSKA-JASIEWICZOWA, M. (1969). Ślady kultury człowieka w diagramach pyłkowych z Bieszczadów Zachodnich. *Acta Archeologica Carpathica*, 11, 1, 105 – 109.

SZMAŃDA, J. B. (2009). Koncepcja modelu uwarunkowań depozycji aluwiów pozakorytowych. In Kostrzewski, A., Szpikowski, J., eds. *Funkcjonowanie geoekosystemów zlewni rzecznych 5. Rozwój dolin rzecznych w warunkach zmian klimatu i zróżnicowanej antropopresji (Kołobrzeg, Poland, 26 – 28 October 2009)*. UAM, Poznań-Storkowo, 34 – 35.

TOBOLSKI, K. (2000). *Przewodnik do oznaczania torfów i osadów jeziornych*. Series: Vademecum Geobotanicum. Wyd. Naukowe PWN, Warszawa.

WASYLIKOWA, K. (1973). Badanie kopalnych szczątków roślin wyższych. In Rühle, E., ed. *Metodyka badań osadów czwartorzędowych*. Wyd. Geologiczne, Warszawa, 161 – 210.

WOLSKI, J. (2007). *Przekształcenia krajobrazu wiejskiego Bieszczadów Wysokich w ciągu ostatnich 150 lat*. IGiPZ PAN, Warszawa.

WOSKOWICZ-ŚLĘZAK, B. (2005). Wpływ antropopresji na układ koryta dolnej Soły na przedpolu gór średnich. In Kocel, K., ed. *Human Impact on Mid-Mountain Ecosystems*, 1, University of Silesia, Sosnowiec, 143 – 148.

ZARZYCKI, K., TRZCIŃSKA-TACIK, H., RÓŻAŃSKI, W., SZELĄG, Z., WOŁEK, J., KORZENIAK, U. (2002). *Ecological indicator values of vascular plants of Poland. Ekologiczne liczny wskaźnikowe roślin naczyniowych Polski*. Series: Biodiversity of Poland. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

ZIELIŃSKI, T. (1995). Kod litofacjalny i litogenetyczny – konstrukcja i zastosowanie. In Mycielska-Dowgiałło, E., Rutkowski, J., eds. *Badania osadów czwartorzędowych. Wybrane metody i interpretacja wyników*. WGISR UW, Warszawa, 220 – 235.

ZIĘTARA, T. (1986). *Krajobraz ziemi żywieckiej*. Wyd. Szkolne i Pedagogiczne, Warszawa.