MORAVIAN GEOGRAPHICAL REPORTS

VOLUME 11

NUMBER 1

2003

ISSN 1210 - 8812

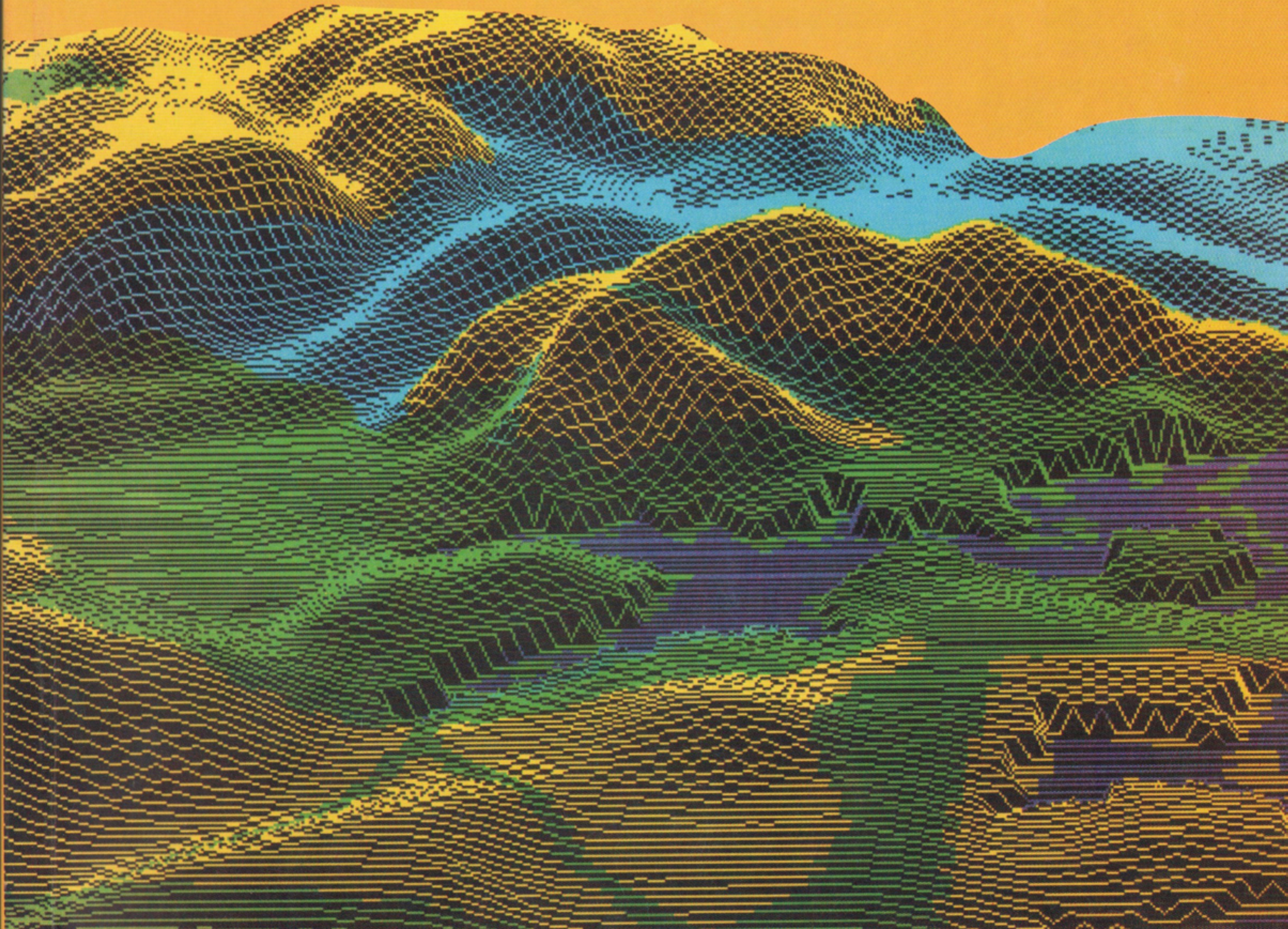

Photo 3: The originally bedrock debris flow gullies on the eastern side of the Hučivá Desná R. valley were regulated into stone-paved lined ditches. After 80 years their perfect adaptation through the mountain plants succesion can be seen.

Photo M. Hrádek

Photo 5: Channel of the Hučivá Desná R. is in its middle reach regulated by weits and dams.

Photo M. Hrádek

Illustrations to M.Hrádek's and J. Lacina's paper.

DESTRUCTIONAL LANDFORMS ARISED FROM EXTREME EVENTS IN THE DESNÁ RIVER VALLEY AND THEIR VEGETATION

Mojmír HRÁDEK, Jan LACINA

Abstract

The Desná River is a left-bank tributary of the Morava R. springing in the highest and most dissected parts of the Hrubý Jeseník Mountains in the Eastern Sudetes. In July 1997, this territory was affected by a flood which resulted from abundant rains lasting four days and which showed in an extreme geomorphic efficiency, leaving behind numerous erosional and depositional destructional landforms. Geomorphological and biogeographical research after the flood was focused on the inventory of these destructional landforms, on the monitoring of their further development and plant succession with regard to physico-geographical properties of the surrounding environment. The research also revealed some destructional landforms of older catastrophic events occurring in the 20th century, namely the disastrous debris flows of 1921 followed by a flood. The comparison of destructional landforms from the past floods made it possible to evaluate not only magnitude of the extreme events, but also to assess the frequency of geomorphic processes affected by human intervention into the natural environment of mountains. The research of biota and vegetation in particular demonstrated that floods and slope processes contribute to the colourful mosaic of biotopes, thus conditioning the increased biodiversity of the landscape altered by human activities.

Shrnutí

Destrukční tvary v údolí Desné vzniklé extrémními procesy a jejich vegetační poměry

Řeka Desná je levostranný přítok řeky Moravy pramenící v nejvyšších a nejčlenitějších partiích Hrubého Jeseníku, ve východních Sudetech. V červenci roku 1997 bylo toto území po vydatných, čtyři dny trvajících, dešťových srážkách postiženo povodní, která se projevila mimořádnou geomorfologickou účinností a zanechala po sobě četné erozní a sedimentační destrukční tvary. Geomorfologický a biogeografický výzkum po povodni se zaměřil na inventarizaci těchto destrukčních tvarů, monitoring jejich dalšího vývoje a opětovné osidlování vegetací s ohledem na fyzickogeografické vlastnosti okolního prostředí. Při výzkumu byly zjištěny i destrukční tvary starších extrémních událostí dvacátého století, zejména katastrofálních suťových proudů v roce 1921 doprovázených povodní. Srovnávání destrukčních tvarů minulých povodní umožnilo hodnotit nejen geomorfologickou účinnost a velikost extrémních událostí, ale posoudit i četnost geomorfologických procesů ovlivněných lidskými zásahy do přírodního prostředí hor. Výzkum bioty, zejména vegetace, prokázal, že veliké povodně i sesuvné procesy zmnožují mozaiku biotopů a tím podmiňují zvýšení biodiverzity antropogenně změněné krajiny.

Key words: *Hrubý Jeseník Mountains, floods and historical floods, debris flows, destructional erosional and depositional landforms, vegetation succession, territorial preconditions for flood development, Czech Republic*

1. Introduction

In 1999 – 2002, research was made under support of the Grant Agency AV CR within the framework of the Project No. IAA5086903 Floods, Landscape and People in the Morava River Basin to study impacts of the flood from June 1997 onto all components of the landscape and human society (Vaishar et al., 2002). Project outputs also included case studies focused on the Desná R. catchment (Hrádek et al., 2002) and on changes in river channels (Hrádek, 2002). In addition to remainders of the flood from 1997, the field research disclosed traces of older floods, too, of which some related to the origin of debris flows [muren]. The Desná R. basin therefore appeared to be a territory extraordinarily suited for the research of causes and consequences of natural disasters and for the search of indicators to compare their magnitude.

The theme of extreme events in the Eastern Sudetes has been up to now tackled by Polách and Gába (1998) who presented a list and description of recorded historical floods, Zvejška (1947) who documented the valley of the Hučivá Desná R. affected by disastrous debris flow, Sokol (1955), and Sokol and Vavřík (1971) who recorded the

MORAVIAN GEOGRAPHICAL REPORTS

Two numbers per year

PRICE

9 EUR
per copy plus the postage
18 EUR
per volume (two numbers per year)

PUBLISHER

Czech Academy of Sciences
Institute of Geonics, Branch Brno
Drobného 28, CZ-602 00 Brno
IČO: 68145535

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Brno, June, 2003

PRINT

Ing. Jan Kunčík, Úvoz 82, 602 00 Brno

ISSN 1210-8812

Articles

Reports

course and consequences of this irregular event in 1921, and Gába (1992) who described a similar phenomenon from the Keprnický potok Brook valley in 1991 and made references to some older events. Geomorphic effects of the flood from July 1997 in the Desná R. basin were described and evaluated by Gába and Gába Jr. (1997), Vít et al. (1998), Aichler and Pecina (1998), Hrádek (1999, 2000). Migoń et al. (2002) put the extreme events in the Hrubý Jeseník into the context of the whole Sudetes Mountains.

2. Study area

The Desná R. is situated in the area of the Eastern Sudetes, in the southern part of Hrubý Jeseník (Fig.1). A higher frequency of above-average precipitation and runoff – the so called steepland geomorphology characterized by steeper slopes and considerably dissected terrain with respect to river pattern density, alternation of the strips of resistant massive and less-resistant crystalline schists (gneisses, quartzites, mica schists, phyllites) with specific structural pre-requisites (general inclination of schistosity planes to the East) in combination with negative human interventions into the mountain ecosystem of local (insensitive tree logging) or global (exhalations) extent create natural preconditions for the development of floods and slope failures. The Desná R. valley (Tess in German) which was in the past affected by a number of natural disasters drains water from the highest mountain ridges of Keprník and Praděd and opens from the left into the Morava R. after 43.6 km. The upper reach of Desná R. is considered to be the stream of Divoká Desná which receives from the right in Kouty it main tributary – Hučivá Desná. The relative relief over 530 m makes the Divoká Desná R. valley the deepest valley of the Hrubý Jeseník. Together with the Hučivá Desná the two valleys represent the most dissected area in the Eastern Sudetes with relief amplitude ranging from 600 – 900 m per 1 km and values of average slope exceeding 15°.

Basement of geological structure of the both main sub-units – of the Keprnická hornatina Mts. and Pradědská hornatina Mts. forms old Variscan domes of Keprník and Desná built of massive gneisses and quartzites, with the strips of easily decomposable mica schists and phyllites with schistosity planes dipping to the South-East. The two old dome structures are separated by the Červenohorský Pass fault belt of NNE-SSW direction. On the structural basement of both old domes a younger neotectonic domal structure developed, broken by faults running both in the NNE-SSW up to NW-SE (so called Sudetes fault) and at some places also W-E directions (Hrádek, 1986). The Hučivá Desná valley follows the Červenohorský Pass fault direction, the valley of Divoká Desná is running along the Sudetes faults. Crossing of the both faults near Kouty nad Desnou manifest in occasional weak earthquakes (Procházková, 1996). The way of the crystalline schists position may support development of slide and shear planes and slope creep which can pass into debris flows under heavy rains (Fig. 2).

Eastern Sudetes mountain range with a high relief energy affects also the fluxes of air masses. The ridge of Praděd following the NW-SE Sudeten direction forms a pronounced barrier which affects the local development of weather on the both sides of the mountains (Photo 1). Rainfalls intensified by orographic effect of windward sides contributed – in addition to floods – in the past also to the development of debris flows in the valleys of Hučivá Desná and Keprnický potok Brook. Total rainfalls in the period from 5 – 8 July 1997 amounted to 443 mm (average annual total precipitation 1,474 mm) on the main ridge of Praděd and had generated high discharges (Q) in river channels. The Divoká Desná reached Q_{max} of 76 m³/s (Q_a = 1.09 m³/s) in Kouty nad Desnou. Being affected by high values of slope gradients and relative relief the long-term runoff coefficient amounts to high values: 0.72 in Hučivá Desná and 0.67 in Divoká Desná, respectively.

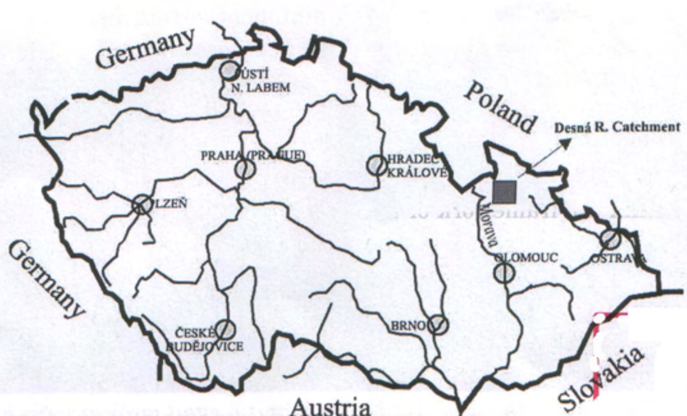

Fig. 1: Situation map

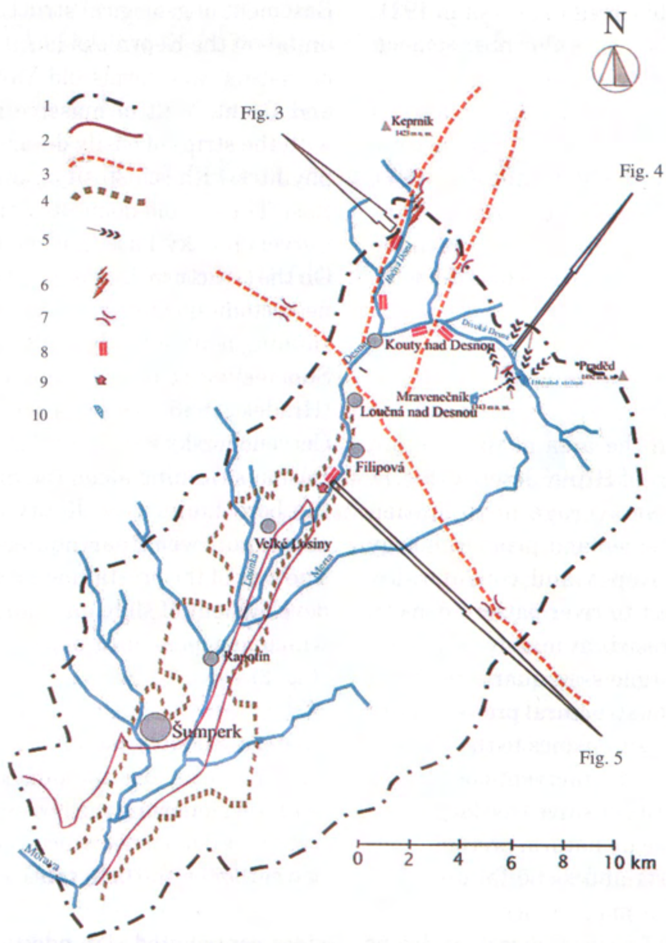

Fig. 2: Scheme of Desná R. catchment showing existing landscape types and geomorphological units with distribution of destructional landforms left by floods and debris flows: 1-watershed boundary; 2-landscape types boundaries; 3-significant faults; 4- Šumperk basin boundary; 5-crested ridges 6-tracks of debris flows; 7-passes; 8-chutes left by undistinquished historical floods and palaeofloods , 9-large covers of crevasse splays deposited during the flood in 1997 with extra-channels ; 10-site of flood wandering in valley of Divoká Desná R.

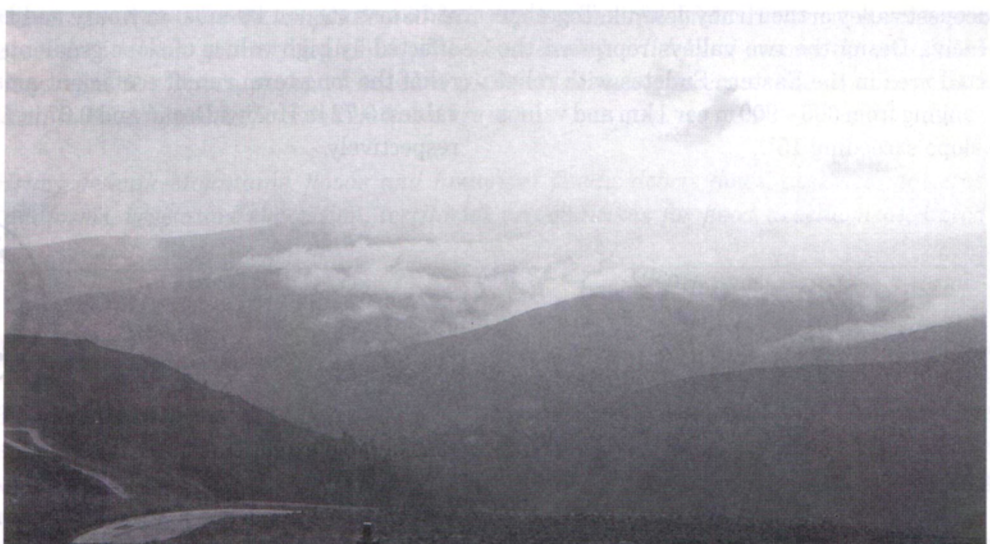

Photo 1: Low frontal clouds (stratus) with rain precipitation descending over the Červenohorské sedlo Pass and the main ridge of the Hrubý Jeseník Mts. from the north to the valleys on the southern side of the mountains. Photo M. Hrádek

The beginning of colonization of the upper part of the Desná R. valley by mainly German population most likely falls in the 15th century with its major part occurring in the in the 16 – 18th centuries. In the past, the valley subjected to several disastrous mountain floods which were sometimes triggered by debris flows. Awarness of the flood danger led to water stream regulation as early as towards the end of the 19th century. The ratio of channel/valley bottom widths was changed due to the construction of roads and railways. Railway to Kouty nad Desnou was finished in 1904 and the important motorway connection over the Červenohorské sedlo Pass to the town of Jeseník and farther on to Poland runs through the Desná R. valley too. After 1945, the German population was transferred and the landuse of the mountain landscape changed with the arrival of new settlers from the inland. Fields were gradually changing into forests and grazing land. Construction of re-pumping water reservoir of Dlouhé Stráně was finished in 1991. By construction of the dam in the valley of Divoká Desná slope gradient of it channel and runoff conditions changed.

The extreme flood of July 1997 posed among other a question whether the changes in the landuse of mountain landscape can have an influence on the magnitude and frequency of floods. Assessment and evaluation of the extent and kinds of ground surface damage by fluvial erosion and accumulation and vegetation cover changes is one of ways to search the relation between landuse and flood origin.

Present research was based on field investigations and geomorphological and biogeographical mapping which was combined with an analysis of aerial photographs and detailed topographical maps. Data on the historical floods from literature has been used too.

3. Changes in channels and valley floors of Desná River caused by extreme processes

The both main branches of the Desná River are of torrential character and flow through narrow mountain valleys in southern half of the Hrubý Jeseník. The valley of Hučivá Desná belongs to southern part of the Keprnická hornatina Mts., Divoká Desná runs down the western slopes of the Pradědská hornatina Mts. The confluence of the both branches is situated in the northern projection of the Šumperská kotlina Basin near Kouty where the Desná R. valley widens up and passes into the Sudetes Piedmont of Hrubý Jeseník.

In terms of relative relief and drainage network density and differences in geological structure, the two main valleys of the upper Desná river system have a typical river pattern and slope processes domains – often in dependence on human activities. This reflects in the morphology of valley floor and river channels which can affect the course of extreme floods.

The Desná R. basin was affected by several floods and other disasters in the 20th century, which left their traces in the river valleys. Easily identifiable are consequences of the flood in 1997, older events can be identified only with difficulties. The first irregular flood of the 20th century in the Hrubý Jeseník Mts. occurred in 6 – 11 July 1903 (and shortly before also in July 1897). Historical photographs from the flood show parts of the Desná R. floodplain covered with extensive deposits of coarse gravel.

Hučivá Desná R.

The Hučivá Desná R. flows through a generally simple mountain valley of NNE-SSW direction, whose slopes are little dissected by valleys of its tributaries. The only more important affluent from the right side is Poniklý potok Brook. The hitherto most comprehensive information about the valley of Hučivá Desná was presented by Zvejška (1947) who carried out geological documentation of the torrent channel and adjacent slopes affected by debris flows and described the more significant rock outcrops, their jointing and schistosity inclination. He also pointed out the specific geotechnical properties of mica schists – fine-grained slacking and slaking as well as the ground water seepages.

The both valley sides differ in their geological structure. While the western slope is built of mainly massive muscovite and muscovite-biotite gneisses, the eastern slope exhibits a typical alternation of paragneiss strips with low-resistant mica schists and micaschist gneisses. The interface between the two types of bedrocks is often to be found directly in the stream channel. In the upper part of the ridge on the right side of the valley there are block fields (felsenmeer) that developed in massive gneisses, particularly below the Klínová hora Mt. (1,157 m) and Spálený vrch Hill (1,312 m). Further down the hill the block fields become incontinuous with the lower parts being covered rather with isolated boulders or block streams. In the valley of Poniklý potok Brook the block fields descend down to the channel bank. The left side of the valley below the Červená hora Mt. (1,337 m) and Šindelná hora Mt. (1,123 m) was affected by disastrous debris flows in June 1921. Original features of the surface were to a considerable extent transformed by the event. According to Zvejška (1947) there are also slided parts of block fields on the slope, forming morphological steps. In their vicinity, there are wet spring areas from which water drains under the surface of block fields or via several erosion gullies.

Slopes affected by debris flows have the largest (up to 50°) gradient in their upper half, the lower half has lower inclination ranging between 15 – 30°, and the lowest slope section is once again steep and ending in rock walls and steps. One of specific characteristic properties of mica schists on the eastern valley-side slopes whose inclinations cut schistosity is slaking. Dipping against the slope inclination, the mica schists capture the running water which can percolate along the schistosity surfaces. The mica schists show accelerated fine-grained weathering and slake in the contact with water. Micas influence cleavage and fissility of the bedrock, development of slide/share planes and slope failures. Absorbing water, they increase their volume and decrease viscosity of the weathered bedrock.

Origin of debris flows which glided from western slopes of the Červená hora Mt. into the valley of Hučivá Desná during the rainstorm with a max. total precipitation of 196.5 mm (up to 33 $mm.h^{-1}$) on 1 June 1921 was an extreme event also from the viewpoint of European medium-high mountains. The debris flows in seven parallel tracks affected a slope section of approx. 1 km long. The phenomenon was first described as landslides with the rise of gullies. Flat debris flows tracks on the western slope of Červená hora Mt. were 800 – 900 m long and from 10 m up to the exceptional 180 m wide. Amplitude between the places of debris flows origin and their end amounted to 400 m. Stripped wide debris flows tracks made possible origin of partial gullies referred to as debris flow gullies (Brundsen, 1979). Morphology of the tracks depends on their gradient and on the structural condition of crystalline schists. According to Zvejška (1947), the debris flows tracks got deeper in the valley floor direction to reach as deep as to the mica schist basement at a depth of 1.5 m. In the upper part of the Červená hora Mt. western slope, the author described a scaly slacking on the stripped mica schists, which could have arised due to cleavage at bedrock dipping against the slope inclination, or due to the gravitational down-slope bending of schistosity into the direction of slope inclination. Through the action of creep and by schistosity bending the steep dipping of schistosity may change into a dip identical with inclination supporting the development of slide/share plane. Zvejška attributes an important role at the development of debris flows to subsurface flow of water from the ground water seepage areas on the less permeable mica schist basement.

The initiation of debris flowe put into motion large volumes of slope material with boulders and trunks. There are indications that masses moving down the western slopes of Červená hora Mt. contained 16 ha of ground surface with 50,000 m^3 of mica schist regolith and slope deposits together with the forest stand (Polách and Gába, 1998). The debris flows with boulders sized up to 4 m reached the valley floor of Hučivá Desná where they temporarily blocked the river channel forming a debris flow dammed lake. Failure of the debris dam gave rise to an extreme flood torrent whose cataclysmatic effects showed in the Desná River valley up to Šumperk. The village of Kouty nad Desnou was covered with a layer of debris which was at some places up to 1 m thick. According to Brundsen (1979), the event as that from 1921 can be identified as a multiple hillslope flow. After the disaster, extensive works were launched to stabilize and re-forest the hillslopes and to regulate water channels. The reforestation was made with the use of beneficial properties of green alder.

Apart from the development of debris flows and description of their tracks, attention has not been so far paid to changes which affected the valley floor of Hučivá Desná after the event. Zvejška does not mention them either and this is why the place at which the debris dammed lake arised is not precisely known. It can be assumed on the basis of field research that the valley damming with debris flows occurred at the point of today's highest situated protective dam built in 1925. The stone wall of the dam is seven meters high and today is completely filled with coarse gravel in which the torrent splits into several branches. A long-term filling of the dam is documented also by a stand of dwarfing green alder on its top. More up the stream, an accumulation of boulders overgrown with spruce forest raises above the dam filling. Its size can be expressed as about 50 m length and up to 5 m height above the level of stream channel. This accumulation is on both sides surrounded by boulder channels of the Hučivá Desná R. (Photo 2). On the right side there is an active channel, on the left side there is a chute through which water flows only during floods. The chute stripes the gneissic bedrock of the hillslope foot. Smaller relics of boulder stream can be found also in the valley above and below the dam. The boulder accumulation which divides the Hučivá Desná channel must originate from the event of 1921 which apparently had to wipe off features of any older valley floor modelling. It is assumed that the high dam was built before the frontal face of debris flow dam to trap the gradually loosening gravel of debris flow accumulation. A typical sign of the left valley slope above the high dam is a conspicuously dense drainage network of short slope tributaries. Thus the slope is furrowed with a network of parallel rills flown-through by tiny brooks and gills (Photo 3 – see cover p. 3). After 1921, the sides of original bedrock debris flow gullies were regulated with a stone wall which is still functionally stabilizing the adjacent slopes. Efficiency of slope processes on unprotected slope segments built of mica schists is ever high (Photo 4).

The high debris dam divides the valley of Hučivá Desná into upper and middle reaches (Fig. 3). The upper reach has a narrow (up to 4 m) rocky and coarse boulder channel whose gradient is up to 150‰. Farther below the dam, the stepped boulder channel widens up, becoming stony at the points of outcropping mica schists

Photo 2: Head of a boulder residue of debris flow from July 1921 in the Hučivá Desná R. valley above the upper high protective dam. In the background a stand of dwarfing green alder on the torrent banks, at the right side a boulder chute left by flood torrent. Photo M. Hrádek

and having a gradient decrease about to 70‰, on the lower reach beneath the confluence with the Poniklý potok Brook it is regulated with a slope gradient of 20 – 40‰. After 1921, a system of torrent training was built on the middle reach, formed of dams and weirs (Photo 5 – see cover p. 3).

The middle reach valley is at several points narrowed by a 2 – 5 m high colluvial terrace which originated by erosional cutting of the accumulation of coarse debris whose thickness is unknown. Outcrops in the terrace show a fine-grained matrix of sandy-loam material with stones and boulders which can also be found on the it surface. The origin of this colluvial terrace relates to the sliding of block streams down to the valley bottom in the Pleistocoene (Hrádek et al., 2002). Where the terrace is missing and the valley widens up, the active channel is accompanied by a channel of chute which is up to 3 m deep. Into this chute gullies from the hillslopes issue. The chute most likely originated during the catatrophic flood in 1921 and this is why it was dammed with a debris dam below the Klínová hora Mt. Some sections of the erosional chute were filled up due to road passage. In Kouty-Annín, a short section of the dry chute (ca. 1 m deep) has been preserved until today, with large boulders of gneiss on the bottom. The age of trees suggests that it could have arisen during the flood in 1921.

The flood of July 1997 did not markedly show in the valley of Hučivá Desná. A gravel alluvial fan got deposited on the confluence with the Poniklý potok Brook. In Annín, the valley floor surface exhibits an incontinuous cover of stony to boulder gravel (comp. Gába and Gába Jr., 1997).

One of reasons leading to the disaster of 1921 was doubtlessly also the stripping of slopes by inadequate deforestation and woodland clearence. A glasswork was founded in the valley of Hučivá Desná as early as in 1769; important hammer-mills, ironworks and sawmills were in Kouty and in the close surroundings. Today it seems that timber felling in the valley is selective so as not to give rise to larger denudated areas. Tree trunks bent down the slope direction suggest that there is a creep downslope movement occurring even at the present time.

Divoká Desná R.

The upper reach of Desná above the confluence with Hučivá Desná is named Divoká Desná. It springs on western slopes of the main southern ridge of the Hrubý Jeseník Mts. at an altitude of about 1,400 m. There are only a few records of extreme processes occurring in the valley of Divoká Desná; Czudek (1997) mentions a rock fall, Gába (1992) informs of the occurrence of debris flows.

The tight mountain valley of Sudeten direction forms together with the valleys of tributaries a heavily dissected topography. Southern slopes of the Praděd Mt. (1,491 m) are into depth incised by the Hladový potok Brook, Česnekový důl Brook and Divoký důl Brook, northern slopes of the Mravenečník Mt. (1,343 m), the Jezerná Brook and lower down the stream also the Borový potok Brook. Rocky crested ridges rise between the valleys of affluents (Photo 6).

The Divoká Desná arrives from the area of the so called Desná dome whose major structural units are among

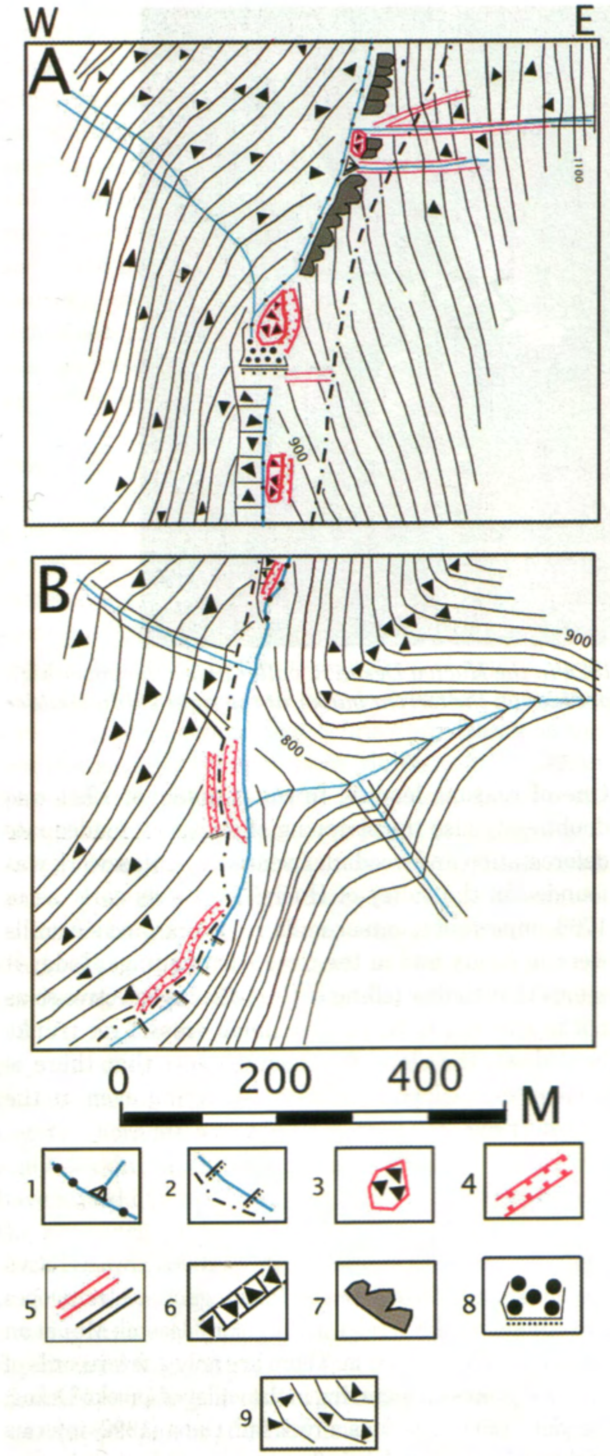

Fig. 3: The map of residual destructional landforms left by disastrous debris flows and flood in July 1921 founded in July 2002 in the valley of Hučivá Desna R.: A-Upper reach of the valley; B-Middle reach: 1-boulder channel with dejection cone at mouth of the regulated debris flow gully; 2-system of weirs in the river channel accompanied by road; 3-boulder residue of debris flow; 4-chute generated by flood torrent; 5-bedrock debris flow gullies [violet] and other gullies; 6-colluvial terrace; 7-rock scarps and walls; 8-gravel fill of the high protective dam; 9-boulders loosely scattered on the valley sides (Original: Hrádek, 2002).

other massive migmatitized biotitic gneisses and less resistant, finer disintegrating biotitic paragneisses.

Unlike the Hučivá Desná, the Divoká Desná flows against the schistosity of metamorphed bedrocks, whose surfaces dip towards the South-East. This is why the both valley sides have similar features. Narrow rocky crests on the both of valley sides show intensive mechanical weathering of gneiss and it falling into debris copiously supplying valley floors. Rills on the slopes and arrangement of vegetation in belts on hillslopes severely striped by logging bring another evidence to the present intensity of the mass wasting. Foothill talus and debris cones prove the processes of intensive mechanical weathering and debris transfer into the valley. A tiny debris flow track of about 30 m was documented below the lower reservoir (Photo 7). The toe of its sandy-loam accumulation with stons dwells on the valley floor. It came into existence most likely in July 1997 and later the debris flow track was modelled by rill erosion (Hrádek et al., 2002). Traces of older debris flow tracks were also found in the upper reach of the valley on slopes below Velká Jezerná Hill. Bases of some valley sides cover block fields originating during the Pleistocoene periglacial conditions.

The valley of Divoká Desná was severely changed by the construction of the Dlouhé Stráně re-pumping reservoir. Building site of the lower reservoir on middle reach of the stream, quarry on the upper reach and the upper reservoir situated on the top of the Dlouhé Stráně Hill at an altitude of 1,350 m were connected by roads, both reservoirs by tunnels. Adjacent slopes and valley floor in the vicinity of the reservoirs and roads were artificially modified. The channel with uncohesive banks is mainly narrow up to 4 – 5 m, incised 1 – 3 m into coarse gravel to boulder deposits. The lower reservoir splits the valley into the upper and lower reaches. Channel slope on the upper reach reaches up to 170‰, decreasing to 40‰ lower in the valley before the reservoir and falling below 10‰ in front of the confluence with the Hučivá Desná R.

An exceptional place in the valley can be found in the reach below the lower reservoir where the river enters migmatitized gneisses in a river bend. Here the valley floor width is about 50 m. Slope gradient of the shallow channel of Desná increases and the channel pattern shows features of wandering. At the beginning of the river bend, two narrow distributaries with large boulders separate from the main channel and enclose a space of mutual communication between them. Water roll along the main step/pool channel, and between the both type of described channels there is a coarse gravel to boulder bar which is divided into smaller isles by the narrow channel branches (Fig. 4).

During the normal water stage there is a weak communication between the main channel and the channel of lower situated distributary (Photo 8). This way of wandering resembles braiding; however, boulders as large as these can be moved only during

Photo 4: The unprotected sides of newly constructed forest road at the foot of eastern slope of Hučivá Desná valley built of mica schist scree cause natural hazards of rapid water erosion and gravity-controlled mass movement. Photo M. Hrádek

heavy floods. A concrete block of 3 m in size was found on one of the isles, which originates from period of the reservoir construction in the years 1970 – 1991. Z. Gába claims that it is for certain that the block was deposited in the boulder bar during the flood in 1997. The above mentioned extra-channels developed during the previous floods as chutes shortening the track of flowing water in the river bend. The extra-channels were activated during the flood in 1997 but a precise extent of changes cannot be specified without knowing the situation before the flood. A fresh incision of the lowest situated chute reveal the valley floor construction to a depth of 2 m. There are big and well rounded boulders of gneiss and the spaces between them are filled with fine sand.

Remainders after the flood in 1997 on the upper reach of Divoká Desná can also be considered low stony and coarse gravel levees skirting the channel. Some sections of the valley floor beneath the dam lake are covered with a coarse gravel deposition. Flooding of the valley floor in the section below the reservoir is remarkable. At the beginning of the flood reservoir reduced discharge in Divoká Desná by 6 – 21 m^3/s; draining of water from reservoir was limited, only at the end of the flood the volume of water discharge was rather increased (cca 15 m^3/s) (Gába and Gába Jr., 1997). This indicates that the flood origin was strongly influenced also by tributaries of the Desná R. from below the reservoir.

Photo 6: The dissected relief of the Divoká Desná R. valley at site of the dam of Dlouhé Stráně re-pumping reservoir. Deforested rocky crested ridges of Malá Jezerná (left) and Tupý vrch Hill (middle) release great amounts of debris which falls from the hillslopes into the valley. Photo M. Hrádek

Photo 7: Track of small debris flow originated probably in July 1997 was lately exposed to rill erosion. Photo M. Hrádek

The widened valley section above the mouth of Hučivá Desná exhibits several generations of overbank channels in a close vicinity of the active channel. Apart from a narrow trench from the flood of 1997 (Hrádek et al., 2002), there is also an older (up to 20 m long, 8 m wide and about 1 m deep) extra-channel overgrown with older trees, which remained preserved downstream from the bridge over Desná in Kouty at a distance of about 5 m from the active channel, and which most likely developed during the flood in 1921 or 1903.

Desná R.

The floodplain of Desná R. is markedly developed from the confluence with the Hučivá Desná R. in Kouty nad Desnou where the valley starts to widen up. At the beginning, its width is up to 100 m and in Loučná nad Desnou it reaches about 400 m. Thickness of fine-grained overbank deposits amounts at the beginning to 1 m (often with gravel layers), near Filipová up to 1.5 m. Under them, there is a coarsely boulder gravel.

Geomorphological effects of the flood in 1997 manifested themselves more below the confluence with the Hučivá Desná R. Main feature of the flood was lateral widening of the channel and development of chutes and crevasse channels. Active channel of the Desná R. in section of the valley between Kouty n. D. and Loučná n. D. was locally widened up to ten times to 90 m and thick gravel

Photo 8: Flood wandering of the Divoká Desná R. channel. Left-active channel, right-(shaded) bank of erosional flood extra-channel / chute. The lower situated flood channel communicates unilaterally through arm (in front) with the active channel. Beech forest preserved on the bar of central isle (middle) brings evidence to a higher age of the boulder accumulation. Photo M. Hrádek

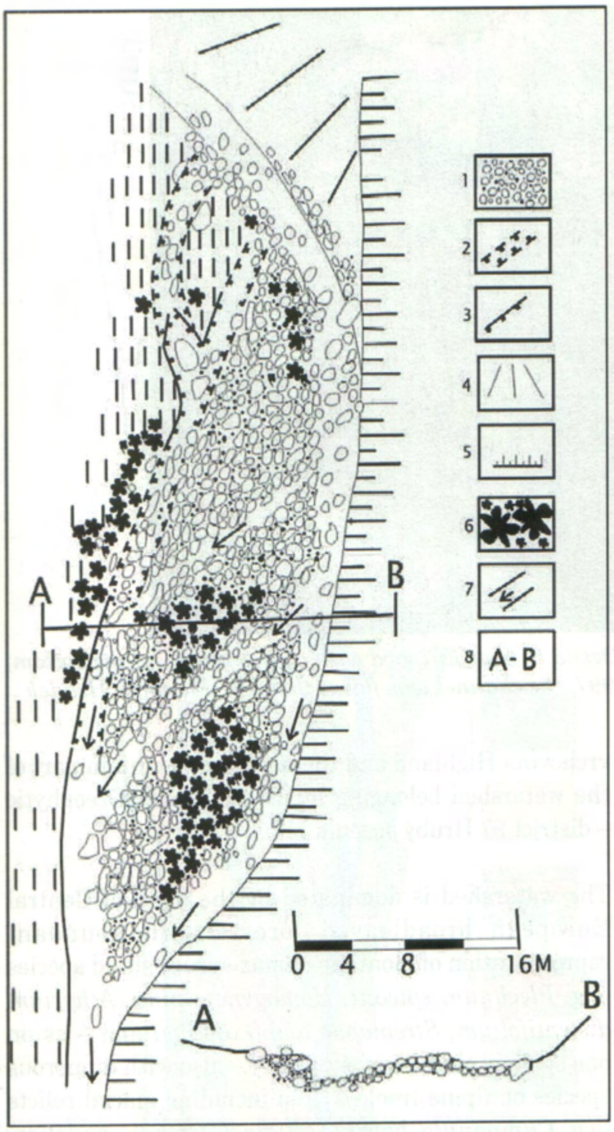

Fig. 4: Mountain flood wandering of Divoká Desná R. channels in the reach below the dam of reservoir: 1-coarse gravel and boulder bars of isles; 2-erosional extra-channels / chutes; 3-edges of fresh cuttings; 4-slopes with inclination of up to 10°; 5-slopes with inclination above 10°; 6-crowns of trees and shrubs; 7-water flow direction in river channels and distributaries; 8- line of cross-profile (Original: Hrádek, 2002).

extra-channel accumulatione were deposited here (Gába and Gába Jr., 1997; Hrádek, 2002a). More details on the geomorphological and biogeographical impacts of the flood were documented in the broadened valley section downstream from the bridge near the railway station at Loučná-Filipová where the flood residua can be seen as late as today. Changes occurred both in the vicinity of the active channel and in the more remote parts of the floodplain (Fig. 5).

In addition to the narrow chute from the last flood there are also some older chutes from 0.5 to 12 m width and up to 2 m deep, overgrown with broad leaves (old about 50 years) in a 50 m wide forest belt along the river banks behind the first meander of Desná (Photo 9).

Palaeochannels originating from an older floods (1897, 1903, 1921 ?) are preserved to a limited extent, and indicate communication with active channel. The fact that they were flown through by overbank flow in 1997 is documented by accumulations of boulders and thin fine-grained silt layer.

The course of the flood in 1997 was strongly affected by the conductive effect of high embankments of the motorway and railway body. An overbank flooding arm penetrates from the Desná R. into an artificially made terrain depression between the railway and motorway and when returning back, it formed a system of anastomosing extra-channels in Teysseyre (1991) sense incised through shallow alluvial loams up into the gravel of the valley floor. The flood channels are characterized by a number of remarkable details:

- The up to 20 m wide channel does not have a flat bottom but is rather divided by steps into lower and higher levels (Fig. 6). Some lower levels of the channel bottoms could have developed out of various reasons – e.g. by deepening (up to 1 m) through headward erosion during the return of water into the active channel of Desná, the higher part of the channel (deep about 1 m) got joined with another and deeper crevasse channel which separated lower downstream (Photo 10 – see cover p. 2). The lower level of channel may be accompanied by a low gravel levee passing into a well-preserved isle of the original floodplain together with its grass cover (Hrádek, 2002a).
- The joining of the chute with crevasse channel occurred in hanging position. The deeper, newly separeted crevasse channel is up to 2 m deep and 4 – 10 m wide, paved with coarse gravel. It is however gradually narrowing, becoming shallower and passing into a flat, fan-like crevasse splay cover. Its surface was subject to braiding of flood arms.
- The anastomosing of extra-channels did not occur at the same time. Channels through which water was returning to the Desná R. developed during the flood decrease, channels that went on in given

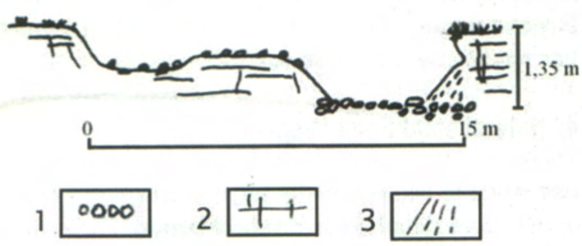

Fig. 6: Cross-profile through the flood extra-channel of Desna R. from July 1997: 1-coarse gravel; 2-fine-grained overbank deposits of Desna R.; 3-material of collapsed channel wall (Original: Hrádek, 2002).

Photo 9: One of well preserved palaeoflood channels of the Desná R. near Filipová with coarse gravel on the bottom, overgrown with the deciduous forest. During the flood in 1997, the channel was flown through. Photo M. Hrádek

direction are apparently older and open in hanging position into a relatively even older crevasse channel originating from the stage of flood increase. The analysis of chutes in the basin-section of Desná valley provided a possibility to differentiate the flood stages and to have a certain insight of its physiology (Hrádek, 2002a).

After the flood in 1997 channel of Desná got filled with coarse gravels and the river returned back to the stage of braiding (Teysseyre, 1991; Migoń et al., 2002) pronounced by a number of gravel bars (Photo 11 – see cover p. 2). In cut bank of Desná channel cavitations were found in overbank deposits.

While the deep and forested valleys of Hučivá Desná and Divoká Desná have always been used mainly for timber felling, the milder slopes in the Šumperk basin have served for agricultural purposes as fields and pastures. After German polulation transfer landuse changed. Upper parts of the slopes are today overgrown with forest and shrub vegetation, lower parts are used as pastures. The broad floodplain was used for agriculture before the flood, too. Nevertheless, influence of the landscape structure change on the flood magnitudes and frequeces has not been so far found out.

4. Natural condition of vegetation

According to the regionally phytogeographical division of the Czech Republic (Institute of Botany, Czechoslovak Academy of Sciences 1987), the Desná River watershed reaches into two phytogeographical regions with the lower southern half belonging in the Bohemian-Moravian Mesophytic – phytogeographical district 73b Hanušovická vrchovina Highland and the northern mountain part of the watershed belonging in the Bohemian Oreophytic – district 97 Hrubý Jeseník Mts.

The watershed is dominated by the biota of Central European broadleaved forests with abundant representation of montane climax spruce stand species (e.g. *Blechnum spicant*, *Homogyne alpina*, *Athyrium distentifolium*, *Streptopus amplexifolius*) and – as on one of a few places in the country – also with numerous species of alpine treeless area including glacial relicts (e.g. *Campanula barbata*, *Viola lutea ssp. sudetica*, *Mutellina purpurea*, *Juncus trifidus*, *Salix herbacea*). Mountain pine (*Pinus mugo*) is not autochthonous here and its existing stands originate from man-made plantations.

As a windward valley, the valley of Divoká Desná represents an important part of the anemoorographic system (Jeník, 1961), which fully shows in the extraordinarily colourful flora in the Velká kotlina Basin (immediately behind the Desná R. watershed in the Moravice River spring kar).

The map of potential natural vegetation of the Czech Republic (Neuhäuslová and Moravec, 1997) differentiates the Desná basin into the following vegetation units (arranged in the order from broad river alluvium up to peak altitudes): *Querco-Ulmetum*, *Pruno-Fraxinetum*, *Melampyro nemorosi-Carpinetum*, *Dentario enneaphylli-Fagetum*, *Luzulo-Fagetum*, *Calamagrostio villosae-Fagetum*, *Calamagrostio villosae-Piceetum*, *Mastigobryo-Picetum*, *Athyrio alpestris-Piceetum*, and the alpine vegetation (*Juncetea trifidi*, *Mulgedio-Aconitetea*, *Salicetea herbaceae* and other).

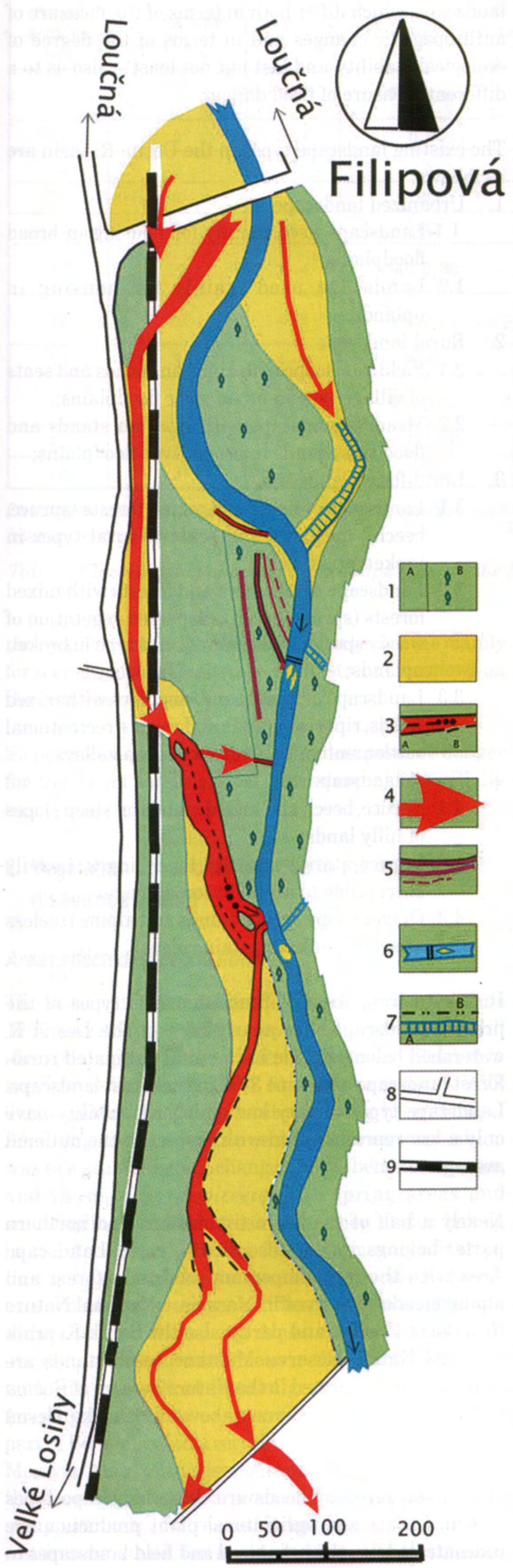

Fig. 5: Anastomosis of overbank flooding arms and development of extra-channels in the floodplain od Desna R. in the Šumperk basin near the village of Filipová founded after flood in July 1997.: 1-floodplain surface: A-covered with ruderal vegetation, B-with deciduous forest; 2-covers of crevasse splays deposits; 3-erosional chutes and crevasse channels: A-with bottoms differentiated into levels and with inner levee, B-narrowed by human activity; 4-overbank flooding arms; 5-flood palaeochannels; 6- braiding channel of Desna R. below a weir with mid-channel bars; 7A-channel of race, B-old flood dikes; 8- road embankment; 9- railway embankment (Original: Hradek, 2002).

The above indicates that apart from the alpine treeless area at the highest elevations the whole watershed should be covered with forest communities differentiated according to climatic and soil (trophic and hydrophilic) conditions. A more detailed and logical to ecological conditions is the geobiocoenological typification differentiated by Zlatník (1976). At an interval of altitudes from 284 m a.s.l. (mouth of Desná into Morava R.) to 1,491 m a.s.l. (Praděd), the watershed can be differentiated into 7 altitudinal vegetation zones of total ten specified by Prof. Zlatník for the territory of the former Czechoslovakia. The lowest altitudes in the southern corner of the watershed belong in the Oak-Beech (forest altitudinal vegetation zone 3 [FAVZ] – ca. 10% of the area). Uplands to about 600 m a.s.l. are occupied by communities of the Beech (FAVZ 4) at about 20% of the watershed area; these link up with the communities of the Fir-Beech (FAVZ 5) -most spread across the watershed. Altitudes between 900 – 1,100 m a.s.l. are inhabited by the communities of the Spruce-Fir-Beech (FAVZ 6) at about 15% of the area, and the altitudes above 1,100 m a.s.l. up to the upper forest boundary show the occurrence of the climax Spruce stands (FAVZ 7). A specific feature of the Hrubý Jeseník Mts. is the fact that the communities of FAVZ 8 – dwarf pine are missing here (mountain pine was planted artificially), and the montane spruce stands pass directly to the Alpine treeless (FAVZ 9). River and brook flats take up over 10% of the watershed between FAVZ 3 – 6.

Of trophic categories the most spread one is the AB oligotrophico-mesotrophic interseries and the B mesotrophic series; there are also more extensive segments of the communities of oligotrophic A series and mesotrophic nitrophilous BC interseries to nitrophilous C series. Most spread in the hydrophilous category is the normal hydrophilous series (3), with floodplains and spring areas belonging in the water-logged hydrophilous series (4) up to the wet series (5). Communities of the peatland series (6) are represented only in small segments. These superstructural units of geobiocoenological typification demarcate the frameworks of natural potential vegetation – groups of geobiocene types of which we can classify over twenty in this region.

Most abundant tree species of the original forest communities in the Desná R. watershed were *Fagus sylvatica* and *Abies alba*; *Picea abies* only at the highest altitudes. Floodplains were taken up by floodplain forests of colourful species composition, accommodated to varying moisture conditions and elevation. In addition to basic species of *Alnus glutinosa* and *Fraxinus excelsior* in the lowest and relatively driest localities, there were also *Quercus robur* and *Carpinus betulus*, *Alnus incana* and *Salix silesiaca* in mountain dells, etc. *Admixed species* would be *Acer pseudoplatanus*, *Tilia platyphyllos* and *Ulmus glabra* with *Salix fragilis* on moist places.

Current condition of vegetation cover

The above outlined condition was in the course of centuries changed by humans and their activities – although the impact is relatively lower than in other parts of the country. The watershed is characterized by a highly above-average forest cover percentage (cca 60 %) which is about a double of the percentage of forest land in the Czech Republic. However, there is a conspicuous contrast between the nearly treeless southern third of the watershed, the medium forest cover in the central third and the nearly continuously forested montane altitudes of the northern watershed part. Main species has become spruce – even at lower altitudes where it initially did not grow. Relatively frequent are extensive remainders of stands with natural tree species composition, namely beech stands and beech with maples, climax spruce stands at the highest altitudes.

One of areas most changed by anthropogenic activities within the watershed is the broad floodplain of Desná R. which is greatly disturbed by the reach of seats (Šumperk, Rapotín, Velké Losiny and other). A greater part of the floodplain has been converted to arable land, only from Velké Losiny upwards it is predominated by permanent grass stands (meadows and pastures). Floodplain forests got almost extincted and if they exist at all, their species composition has been changed (e.g. the prevailingly lime stand in the left-bank alluvium of Desná R. near the village of Filipová). In general, there are fine riparian stands preserved here though, dominated by *Alnus glutinosa* and *Alnus incana* with an admixture of *Fraxinus excelsior*, *Acer pseudoplatanus*, *Tilia platyphyllos*, at some places also *Ulmus glabra*, and with a herbaceous undergrowth of hydrophilous and submontane forest species of ample composition. An invasive neophyte spreading upstream the Desná River is *Reynoutria japonica* originating from East Asia.

5. Present landscape types

The Desná River basin can be differentiated according to relief types, species structure and distribution of actual vegetation formations into 10 types of the present landscape, which differ both in terms of the measure of anthropogenic changes and in terms of the degree of ecological stability, and last but not least – also as to a different measure of flood danger.

The existing landscape types in the Desná R. basin are as follows:

1. Urbanized landscape
   - 1.1 Landscape used mainly for housing in broad floodplains;
   - 1.2 Landscape used mainly for housing in uplands;
2. Rural landscape
   - 2.1 Field landscape with riparian stands and seats of village type in broad river floodplains;
   - 2.2 Meadow landscape with riparian stands and flood wastelands in broad river floodplains;
3. Rural-forest landscape
   - 3.1 Landscape of fields and mixed forests (spruce, beech), meadows and seats of rural types in broken uplands;
   - 3.2 Landscape of meadows and forests with mixed forests (spruce, beech), dispersed vegetation of woody species and seats of rural type in broken uplands;
   - 3.3 Landscape of forests and meadows with mixed woods, riparian stands and rural + recreational settlement on the bottom of deep valleys;
4. Forest landscape
   - 4.1 Spruce, beech and mixed stands on steep slopes of hilly lands;
   - 4.2 Spruce stands on hilly land ridges, heavily succeptible to air pollution damage;
   - 4.3 Open-canopy spruce stands and alpine treeless areas on peak mountain ridges.

It follows from the differentiation into types of the present landscape that nearly 50 % of the Desná R. watershed belongs in the harmonical cultivated rural-forest landscape and some 30 % in the forest landscape. Landscape types of very low ecological stability have only a low representation with respect to the national average.

Nearly a half of the basin (its eastern and northern parts) belongs in the Jeseník Protected Landscape Area with the most important mountain forest and alpine meadow reserves in Moravia – National Nature Reserve of Praděd, and partly also the Šerák-Keprník National Nature Reserve. Montane beech stands are conserved and protected in the Nature Reserve of Bučina pod Františkovou myslivnou above the Divoká Desná R. valley.

Most endangered by floods are those landscape types in which seats and agricultural plant production are concentrated, i.e. the urbanized and field landscapes in

Present landscape type	Representation in %	Geobiocoenological typification			Anthrop. impact intensity	Degree of ecological stability	Succept. to flood damage	Succept. to landslides
		FAVZ	Trophic sere	Hydroph. sere				
1.1	5	3 – 4	B, BC	4	5	0	5	0
1.2	3	3	B	3	5	0	0	0
2.1	10	3	BC	4 (5)	4	1	5	0
2.2	3	4	BC	4 (5)	3	2-3	4	0
3.1	20	3 – 4	AB, B, BC	3 (4)	3	3	0 (3 in valley days)	2
3.2	25	4 – 5	AB, B, BC	3 (4)	3	3-4	0 (3 in valley days)	1
3.3	3	4 – 5	B, BC	(3) 4	4	2-3	4	3
4.1	20	5 – 6	A,AB,B,BBC	3 (4)	2	4	0 (3 in valley days)	3-5
4.2	8	6 – 7	A,AB,B,BC	3	2	4	0	4
4.3	3	7 – 9	A	3	1	5	0	2

Classification scale of anthropogenic impacts, degrees of ecological stability and succeptibility to flood damage and landslides: 0-none; 1-very low; 2-low; 3-average; 4-high; 5-very high.

Tab. 1 : Classification of present landscape types in the Desná River basin

the broad river floodplains, and similarly also the mainly for recreation used landscape of forests and meadows on the bottoms of mountain dells.

Slope movements represent the highest possible danger for the forest landscape on very steep slopes of hilly lands.

6. Vegetation cover changes due to the impact of disastrous agents

Areas affected by debris flows

The most extensive debris flow tracks arisen in June 1997 particularly on the slopes of Červený vrch Hill above the upper reach of Hučivá Desná are situated in the Spruce-Fir-Beech (FAVZ 6) up to the Spruce (FAVZ 7), the main forest communities having been those of *Abieti-fageta piceae* whose original species composition was to a greater extent changed to the benefit of spruce, and those of *Sorbi-piceeta*. The spring areas and surroundings of tiny streams on steep slopes belong in the *Aceri-fageta-fraxini*. This community's biotope that got extended due to the sliding processes. Newly arisen clear-cur areas were difficult to reforest and had to be aforested with using *Alnus viridis* (= *Duschekia alnobetula*), not autochthonous in the region. This alder with the procumbent form of growth is in the Czech territory autochthonous apparently only in the southern part of Bohemia with a certain overlap to south-western Moravia. Alnus viridis is spontaneously spreading across the Jeseníky Mts. as a pioneer species, especially in stony channels of streams. It has developed a nearly continuous stand for example in a silted retention reservoir created by the stone dam on the upper reach of Hučivá Desná. The herbaceous undergrowth of alder stands with ample spring areas significantly differs from the undergrowth of surrounding spruce and spruce-beech forests. Important montane and sub-montane species occurring here are for example *Viola biflora*, *Valeriana tripteris*, *Lysimachia nemorum*, *Aconitum variegatum*, *Luzula sylvatica*, *Adenostyles alliariae* and other.

To compare with these old tracks, vegetation of a sand-boulder track of debris flow arisen most likely in July 1997 at a width of up to 20 m and depth of about 150 m was recorded in the lower part of the slope (exposition NE, inclination up to 30°) above the valley floor of Divoká Desná below the lower dam lake. Although the locality in the Fir-Beech (FAVZ 5) was partly forested (*Fagus sylvatica*, *Acer pseudoplatanus*), there are species which spontaneously spread here such as *Alnus viridis*, *Salix silesiaca*, *Salix caprea* and *Betula pendula*. Degree of coverage did not exceed 20 % in these tree species. An incontinuous herb layer (with cover of up to 30 %) is formed by *Calamagrostis arundinacea*, *Calamagrostis epigeios*, *Luzula nemorosa*, *Aruncus vulgaris*, *Petasites albus*, *Tussilago farfara*, *Gnaphalium sylvaticum*, *Hieracium murorum*, *Digitalis grandiflora*, *Senecio nemorensis* ssp. *fuchsii*, *Veronica officinalis*, *Cirsium palustre* and other. It is a colourful mixture of species with varying environmental requirements, typical of the initial stage of succession.

Areas affected by floods

Significant changes of vegetation cover are directly caused or initiated by floods. Similarly as other rivers in the Jeseníky Mts., the overflowing Desná R. tore off its riparian stands at some places in July 1997 and created new flood channels with a colourful mosaic of biotopes. The profile which is remarkable not only by its relief but also by its vegetation cover can be studied for example between Velké Losiny and Loučná nad Desnou. Before the flood, the broad right-bank alluvium was partly used as meadow and partly as arable land. During the flood, the floodplain got silted with sands and gravels and a 2 m deep flood channel developed in it, accompanied with a crevasse splay deposits belt up to 80 m wide. The splay surface was partly treated after the flood and the locality was left to natural succession with an exception of a smaller part improperly planted with spruce (Fig. 7).

A greater part of the area is at the present time represented by flood wasteland with tens of herb and grass species of which the most abundant are *Arrhenatherum elatius*, *Agropyrum repens*, *Phalaris arundinacea*, *Holcus mollis*, *Juncus effusus*, *Artemisia vulgaris*, *Cirsium arvense*, *Melilotus albus*, *Tussilago farfara*, *Tanacetum vulgare*, *Crepis biennis*, *Echium vulgare*, *Carduus crispus* and other. In addition to meadow and ruderal species, there are also some subthermophytes and xerophytes which got a foothold on arid gravels and sands, e.g. *Turritis glabra*, *Hieracium bauhinii*, *Herniaria glabra* and *Sedum sexangulare*. Sporadically occurring are washed-down species of higher altitudes such as *Aruncus vulgaris* and *Melandrium rubrum*. Of invasive neophytes, *Stenactis annua* is abundant at some places and *Reynoutria japonica* starts to occur only in patches so far. There is a numerous viper population (*Vipera berus*) living in the flood wasteland (Photo 12) and rare birds such as corncrake (*Crex crex*) and stonechat (*Saxicola torquata*) found their nesting biotope here.

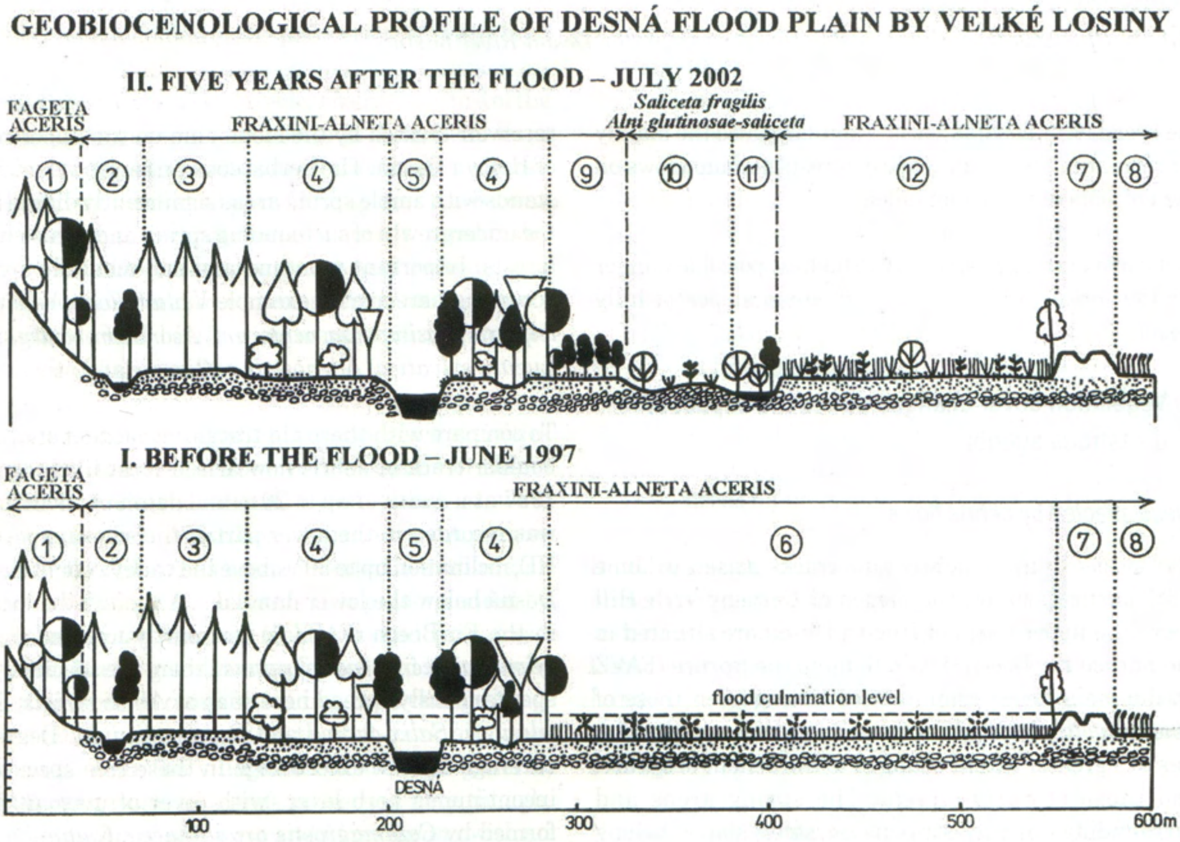

Fig. 7: Geobiocenological profile of Desná flood plain by VelkéLosiny
Latin names are used for the communities of potential natural vegetation. Italics are used to express flood-induced changes of potential biocoenoses. Numerals are used to mark existing biotopes (types of actual vegetation):1 - Mixed stands of Norway spruce (Picea abies), sycamore maple (Acer pseudoplatanus) and European beech (Fagus sylvatica) occurring on the steep valley slopes; 2 - Mixed stands of Norway spruce and alders (Alnus incana, Alnus glutinosa) on the stream banks; 3 - Norway spruce monocultures at higher floodplain elevations; 4 - Mixed floodplain forests of lime (Tilia cordata), sycamore maple, common ash (Fraxinus excelsior) and alders with the undergrowth of bird-cherry (Prunus padus) in the broad alluvium; 5 - Incised stream of the Desná River; 6 - Semi-cultivated alluvial meadows and pastures; 7 - Man-made railway and road embankments; 8 - Corn field; 9 - Continuous self-seeding of alders in the silted floodplain; 10 - Grass-herbaceous wastelands with willows (Salix fragilis, Salix purpurea) in the montane drier part of the flood channel with coarse cobbles; 11 - A continuous self-seeding of willows and alders in the permanently moist lower part of the flood channel; 12 - Ruderal grass-herbaceous wastelands with sporadic self-seeding of willows in the silted alluvium. (Original: Lacina, 2003).

Photo 12: Common viper (Vipera berus) is one of reptiles newly colonizing the Desná R. floodplain destructed by crevasse splay gravel after the flood of 1997 near Filipová. The alluvium was used for farming before the flood. Photo M. Hrádek

Self-seeding of woody species is concentrated first of all on slopes and partly also on the bottom of the flood channel which is at the present time not throughflown with water standing still only in its deepest depressions. In 2002, there were 12 woody species recorded here, whose height was up to 4 m (i.e. 5 years after the flood). Most abundant of them are *Alnus incana*, *Alnus glutinosa* and *Salix fragilis*; less frequently occurring are *Salix viminalis*, *Salix purpurea*, *Salix caprea*, *Populus tremula*, *Populus nigra*, *Betula pendula*, *Acer pseudoplatanus*, *Acer platanoides* and *Robinia pseudoacacia*.

The initial stage of succession suggests that the community most developing here is that of *Fraxini-alneta aceris sup*. The biotope for the communities of *Saliceta fragilis sup*. and *Alni glutinosae-saliceta sup.* which ceased to exist due to water course regulation was restored in temporarily acquiferous parts of flood channel. The succession occurring here is similar to the one recorded at studying the Bečva R. flood channel below the Beskydy Mts. The flood on the Desná River, too can be said to have had -apart from the disastrous impact on seats and their inhabitants- a favourable influence on nature as a natural agent of revitalization.

7. Conclusion

An inventory of destructional landforms in the upper Desná R. valleys corroborated its disposition to the origin of natural hazards. The analysis of landform residua whose origin in general dates back to the 20th century pointed to close relations between the valley floors and the valley slopes with respect to different geological and structural conditions, and confirmed a strong impacts of human activities. In the Hučivá Desná valley, serious structural and geological preconditions exist for the development of debris flows on eastern slopes, given particularly by unfavourable geotechnical properties of mica schist and high slope inclinations. Gravity – controlled creep contributes to the rise of slide and shear planes. The possibility of initiation of debris flow on valley sides stabilized by mixed forests is rather exceptional. Block fields on the western slope exhibit a trend towards a gradual motion down into the valley enabling sub-surface runoff by their structure with inner free spaces. Effects of the flood in 1997 manifested at minimum in the valley which is narrowed by the colluvial terrace; in contrast, erosion chutes were preserved here – most likely in consequence of the cataclysmatic effect of the flood torrent in 1921. The Divoká Desná R. shows a permanent activity of slope processes due to the favourable structural position of the both valley sides and high runoff coefficient even today, which is further intensified by improper deforestation of the rocky scarps of crested ridges, supplying the valley floor with debris. Existence of high-energy flood wandering of the channel indicates higher preconditions of the Divoká Desná valley for the development of floods. The trend was not alleviated even by the construction of the Dlouhé Stráně reservoir. Also, the tributaries joining the Divoká Desná below the reservoir can thoroughly contribute to the flood origin. In the broad floodplain of Desná, affected in Šumperk basin by agricultural activity, overbank channels developed during the flood in 1997 due to Desná flood arms separation. Extra-channels developed from the overbank flow and separated from the active channel rejoined downstream with other ones. Some channels of this anastomosing system were further deepened by headwater erosion of water returning into the active channel during the flood decrease. By reason of a great amount of carried gravel, the Desná River became a braiding stream after the flood.

Recorded natural hazards of the 20th century confirm the extraordinary significance of flood torrent in 1921 triggered by multiple debris flows. The recorded erosion and accumulation effects attributed to this flood are greater as those of the flood in July 1997, in the Hučivá Desná R. valley in particular.

The agricultural-forest landscape in the Šumperk basin was extended to the detriment of agricultural landscape. The impacts of the flood in 1997 were intensified by human interventions into the landscape. While the older floods of 1903, 1921? left their erosion overbank channels in a belt up to 50 m distant from the active channel, the flood in 1997, canalized by high embankments of communications, destructed the whole floodplain up to a width of 200 m. Species composition of the vegetation spreading in the affected areas through spontaneous succession corresponds to the ecological conditions of changed and newly developed biotopes. Research of biota clearly indicates that the natural hazards (high waters and mass movements) contributed to improved biodiversity in the Desná River basin.

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THE AUTOMATED TELLER MACHINE AS A NEW SERVICE (POLAND CASE STUDY)

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Abstract

The history of cash cards and especially of cash machines, is brief in Poland and not much longer in the rest of the world. At the present moment, the processes which take place too often escape researchers' attention. One of many such processes is the development of automated teller machine (ATM) services (Ilnicki, 2001; Retkiewicz, 2002). In Poland the development process of this phenomenon started taking shape at the beginning of the 1990s. Since 1996, however, a really dynamic expansion can be observed. This highly dynamic process is bound to raise questions about the classification of the ATM service: is it a service of higher rank, or is it becoming so widespread to be more correctly classified as belonging to the group of basic services? On the other hand, given that the service is, in some ways, a financial category, can the number and density of cash machines in a given area be used as an indicator of the relative wealth of the population of some areas compared to others?

Shrnutí

Bankomat jako nová služba

Historie platebních karet, především pak bankomatů, je ve světě i v Polsku relativně krátká. Procesy, které se zde odehrávají velmi často unikají pozornosti vědecké veřejnosti. Jednou z výzkumných oblastí je rozvoj služeb spojených s bankomaty. V Polsku jde o proces, který se začíná formovat teprve počátkem 90. let 20. století (dynamický rozvoj je však spjat až s rokem 1996. Vysoká dynamika procesu otevírá mnohé otázky související s klasifikací tohoto druhu služeb. Jedním z okruhů otázek je, zdali jde o službu na vyšším hierachickém stupni nebo lze bankomaty považovat za základní druh služeb všeobecně poskytovaných obyvatelstvu. Na druhé straně se zde objevují otázky, zdali je možné počet bankomatů a jejich územní hustotu použít jako ukazatele relativního bohatství jedněch regionů ve vztahu ke druhým.

Key words: *automated teller machine, ATM device, new services, voivodeship, Poland*

1. Introduction

As a kind of economic activity, services constitute a diversified conglomerate. It is the result of differences in localization of particular services and the demand for them. Therefore, there exist several ways to classify services (Jakubowicz, 1993; Nowosielska, 1994).

The level of economic development is one of many criteria for the classification of services (Katouzian, 1970). Taking this criterion into account, we can suggest the following division of services:

- new services – those which are connected with mass consumption of consumer durable goods and specific common services (education, science, health protection, computer industry, tourism, etc.);
- complementary services – those which accompany the process of industrialization (administration, finances, transport, trade, etc.), characterized by dynamic development due to technological progress; and
- old services – whose importance for the society diminishes gradually or completely disappears as a result of economic development (some crafts, military service, etc.).

There is no doubt that the automated teller machine (ATM) service should be classified as a new service, and that is why the first question for a researcher is whether it possesses the features of a basic service, or a service of higher rank, concentrated in larger urban centres. Such a question arises because new services have a tendency to appear in places where the demand for them is highest. Also, one must take into account the fact that in highly developed market economies, the ATM service belongs to the basic services group.

At the same time – since this service is connected with money, which is a financial category – the following question arises: would it be possible to distinguish areas of relative wealth as compared to other areas, assuming as a primary criterion the distribution of cash machines (suggested by the number of them) and their density (for a particular number of inhabitants in a given area). Cash machines are mounted in places where the cash flow is considerably intense, generated by individual consumption of goods.

The history of cash cards and cash machines is as short in Poland as elsewhere. The USA is regarded as the 'fatherland' of the first cash cards, which started to appear at the beginning of the 20th century. First they were issued in the form of paper booklets or metal plates. *Western Union* and *General Petroleum Corporation of California* were the first firms to issue the cards to their customers in 1914, followed by *Smart and Roebuck* in 1917. Their speedy development came in the 1940s and '50s, as the United States was experiencing rapid economic change, which resulted in steadily increasing demand for financial and bank products. The fast development of credit cards drew the attention of most banks, which became aware that they could be a perfect source of income. In the first stage, cards circulated locally, but then banks began issuing cards that could be used throughout the country and abroad. The first local credit card was issued by *Flatbush National Bank* in 1947, and the first card operating across the States was issued by *Franklin National Bank* in New York, in 1951.

The ATM as a device and the service connected with it are relatively new in Poland. Until the end of the 1980s, cash cards were accepted only in the larger commercial and service centres, such as hotels, restaurants and travel agents. *Orbis*, the all-national public travel agency, had already started dealing with cash cards in 1968, when they first signed contracts for card acceptance. The cash card was then an attribute of a foreigner, a sign of their wealth and broadly understood security. Polish banks started delivering cards in 1991.

Up till 1990, *Orbis* was the only organization issuing cards. Besides *Orbis Travel Agency*, the *Polish Airlines LOT* accepted payments by means of credit cards. As the number of tourists using cash cards started growing rapidly, a new company called PolCard was established on the basis of the former existing activities of *Orbis*. At present this firm is the largest accounts authorizing entity in Poland.

The same reasons which caused such a dramatic growth of popularity of the cash card in the rest of the world, proved to be the foundation of its widespread distribution in Poland. The main reason is dynamic economic development, which contributes to the greater affluence of the population. Other reasons should be seen in the easy flows of capital, people and information, all of which are typical characteristics of market economies. Additional important factors are the rising popularity of non-cash payments, and the progressive segmentation of the market, enabling each citizen easy access to a cash card (Zaręba, 1997).

From these generalizations, as well as interest in the considerable acceleration of the process, one may conclude that it would be reasonable to explore these matters more thoroughly.

2. Deployment of ATM devices

The number of cash machines at the beginning of the 1990s was extremely small. The rate of growth of the devices was very slow, resulting from the following factors (inter alia):

- high costs of cash machine installation;
- inadequate advertising and promotion of the service;
- lack of awareness, on the part of the population in Poland, of the advantages proposed by this facility;
- a limited number of issued cards; and
- scarcity in the network of service and trade units capable of accepting cash cards (Kucharczyk, 2000).

In 1996, however, there was an 'avalanche' of cash machines. Within the two next years, their numbers rose at the rate of 160 % to reach approximately 3,030 in 1998. The following four years witnessed an average increase of 20 % a year. The consequence of this violent burst is that there were by June 2002, almost 6.2 thousand cash machines in existence (Tab. 1). This means a doubling of the number in only four years. It is worthwhile to pay attention to the fact that the increase is proportional, which is demonstrated by the dynamics of change in the proposed three periods of not much more than 140 %. This may indicate that the process of steady saturation of the market with these devices is still taking place.

The unquestionable leaders in the "ATM potential" are three voivodeships: mazowieckie, śląskie and dolnośląskie. The high position of Lower Silesia Voivodship may be the result of several factors. A primary set of reasons includes the voivodship's third or fourth place in the ratings concerning general socio-economic development, the advancement of the transformation processes, scale of the foreign capital invested, participation in creating PKB and so on. Another reason is the existence of such a strong regional centre as Wrocław, which is a member of the group of the seven largest agglomerations in Poland. Wrocław has a concentration of almost 40 % of all of the devices in the voivodship. The border location of the voivodship is also important, as high tourist attractiveness and larger numbers of foreign tourists tend to visit Poland, contributing to the increase in the number of ATMs. These three voivodeships are followed in order by four provinces: wielkopolskie, małopolskie, pomorskie, and łódzkie. The situation is at its "worst" in five voivodeships: opolskie, warmińsko-mazurskie, lubuskie, podlaskie and świetokrzyskie region, in each of which there are not more than 100 devices on average. In the years 1998 – 2002 this order actually did not change at all. The only fact that would deserve attention is a clear relative fall in the number of cash machines in lubelskie and podkarpackie voivodeships, while the kujawsko-pomorskie and zachodniopomorskie progressed in the ranking of ATM potential.

The provinces with the largest number of cash devices form a clear letter "L" with vertices in pomomorskie, dolnośląskie and małopolskie voivodeships (Fig. 1). Such an arrangement is connected with the territorial differentiation of GDP per capita, especially if the territorial division of the country before the year 1998 is taken into account. This will be confirmed by territorial differentiation of the ATM potential inside sub-regions (NUTS 3 – Nomenclature Unit of Territorial Statistic) (comp. Fig. 1). In addition, the letter "L" arrangement will be reinforced if we classify regions in double-feature mode: according to the level of GDP per capita

Country/voivodeship	Total number of ATMs			Density of ATMs for 100 000 inhabitants		
	1998 (June)	2000 (June)	2002 (May)	1998 (June)	2000 (June)	2002 (May)
POLAND	3030	4337	6120	7.7	11.2	15.8
Mazowieckie	521	702	971	10.3	13.8	19.1
Śląskie	505	668	903	10.3	13.7	18.7
Dolnośląskie	262	405	576	8.8	13.6	19.4
Wielkopolskie	231	353	555	6.9	10.5	16.5
Małopolskie	242	384	518	7.5	11.9	16.0
Pomorskie	213	317	425	9.7	14.5	19.3
Łódzkie	128	246	378	4.8	9.3	14.3
Kujawsko-Pomorskie	118	199	290	5.6	9.5	13.8
Zachodniopomorskie	125	194	290	7.2	11.2	16.7
Podkarpackie	138	168	236	6.5	7.9	11.1
Lubelskie	149	170	223	6.7	7.6	10.0
Opolskie	90	127	169	8.3	11.7	15.6
Warmińsko-Mazurskie	88	132	167	6.0	9.0	11.4
Lubuskie	75	101	164	7.3	9.9	16.0
Podlaskie	56	89	131	4.6	7.3	10.7
Świętokrzyskie	55	82	124	4.1	6.2	9.4

Country/voivodeship	Place (according to density indicator)			Change of place:		
	1998	2000	2002	1998-2000	2000-2002	1998-2002
Mazowieckie	2	2	3	no change	- 1	- 1
Śląskie	1	3	4	- 2	- 1	- 3
Dolnośląskie	4	4	1	no change	3	3
Wielkopolskie	9	8	6	1	2	3
Małopolskie	6	5	8	1	- 3	- 2
Pomorskie	3	1	2	2	- 1	1
Łódzkie	14	11	10	3	1	4
Kujawsko-Pomorskie	13	10	11	3	- 1	2
Zachodniopomorskie	8	7	5	1	2	3
Podkarpackie	11	13	13	- 2	no change	- 2
Lubelskie	10	14	15	- 4	- 1	- 5
Opolskie	5	6	9	- 1	- 3	- 4
Warmińsko-Mazurskie	12	12	12	no change	no change	no change
Lubuskie	7	9	7	- 2	2	no change
Podlaskie	15	15	14	no change	1	1
Świętokrzyskie	16	16	16	no change	no change	no change

Source: Author´s analysis on the basis of http://www.karty.pl; http://stat.gov.pl and information acquired from official internet pages of various banks.

Tab. 1: Number and density of ATMs for 100 000 inhabitants and according to the proportion of persons employed in the tertiary sector.

If we add the mazowieckie, łódzkie and kujawsko-pomorskie voivodeships, which are next in the queue as far as the number of cash machines is concerned, we obtain a picture of the so-called concentration triangle of socio-economic activity.

Regressing the number of cash machines on the overall number of inhabitants in different voivodeships, we cannot overlook the significant and substantial[1] interdependence that is directly proportional. This interdependence is clearly visible for absolute values, as well as for calculated fractions of the population and ATM devices. The average value of the Pearson linear correlation coefficient (in a one-sided test at the level of $\alpha = 0.01$) equals 0.960. This is a confirmation of the general rule that distribution of services is positively correlated with the density of population. Nevertheless, a more careful analysis of the density of the population and the density of ATMs shows the general prevalence of the cash machines' number fraction over the population in regions with at least 300 devices. Below that number, the situation is reversed – a prevalence of population density over the number of cash machines is observed. The average surplus, in the period under research, amounted to 8%. This observation will quite clearly contradict the deduction formulated earlier about the ATM service being a basic service. This is especially so in that seven of the first ranked voivodeships "possess" almost 71% of the overall number of cash machines, with only 63% of the population. Attention should be paid, however, to the fact that this surplus of ATM concentration over the fraction of the population, has assumed diminishing tendency.

To solve the question of the basic character of ATM services, we shall be helped by confrontation of the population number with the indicator of the number of ATMs per 100 000 inhabitants. Correlation analysis yielded figures that are significant but not substantial. For the years 1998, 2000 and 2002, the coefficients were 0.623, 0.625 and 0.578, respectively. When we analyse the graphic representation of correlation coefficients, while omitting the mazowieckie and śląskie voivodeships, we will be struck by the visible lack of interdependence, which can be proved by the level of correlation coefficient. The mentioned lack of correlation in the group of 14 voivodeships seems to be a symptom of a change of character of interdependence – from directly proportional to inversely proportional, which proves the basic character of the ATM service. Therefore, a justified conclusion may be formulated that we are at present observing a process of transition: the ATM service is being transformed from a service of higher rank to a basic service. We also need to notice that at the present, a cash machine is becoming ubiquitous in urban areas, but not in the country. As a comparison, note that for 875 towns (Powiaty w Polsce, 1999) where cash machines are operating, only 90 villages have these devices. In the year 2000, there were only about half that number (48).

3. Availability of ATM services

It is not sufficient to simply state that a device has been installed in a particular area; the quality of operation and its availability are equally important factors. In the research period, a considerable increase in the density index is observable – from less than 8 machines in 1998, through 11 to nearly 16 devices per 100 000 inhabitants. This figure, although illustrating dynamic changes, still represents only 30 – 35% of the level typical for highly developed economies.

At the same time, the structure of spatial differentiation has changed noticeably and, in one sense, it has become better-ordered, as well (Fig. 2). As one of the measures of availability, an indicator of density of ATMs per 100 000 inhabitants may be taken into account. This indicator is the resultant of population numbers and the number of ATMs. Since in most regions the population number has stabilised, availability will clearly be determined by the changing number of places where electronic distribution of money is possible, and by the dynamics of these changes. While researching availability of bank services, we noticed a change of order in the hierarchy of regions, much greater than could be observed by the analysis of the distribution of teller machines (comp. Tab. 1). For all voivodeships, a quarter of them on average did not change their position in the hierarchy. If we disregard voivodeships with the highest (3) and lowest (3) indicator values, those regions, where the dynamics of changes of the number of devices in the period 1998 – 2000 was at least 150%, and in the years 1998 – 2002 was not smaller than 200%, showed considerable increase in availability. Throughout the research period, six regions on average showed a regress of their position on the scale of density indicator. These are: lubelskie, opolskie and śląskie voivodeships – with a systematic fall in hierarchical position, lubuskie and podkarpackie regions which kept their positions after an initial fall, and finally, the małopolskie region which slightly fell in hierarchy after an initial rise. It is interesting to notice the position in the second place of the mazowieckie voivodeship, which was at first rather stable, then falling to the third place in 2002, behind the regions of dolnośląskie and pomorskie. This fact further proves our conclusion, which suggested that the ATM service

[1] In dissertations on this subject, 'substantial' interdependence would indicate that the absolute value of Pearson's linear correlation coefficient $|r_{ij}|$, should amount to at least 0.707; the coefficient of determination would then result in a level of explanation of 50%.

has transformed from being initially a service of higher rank to becoming a service of a basic character.

From this analysis, it can be concluded that within four years, a great transformation has taken place. Its essence can be presented as follows: isolated entities characterised by the highest levels of ATM density (pomorskie, mazowieckie, dolnośląskie, - opolskie - śląskie) were transformed first into a compact conglomerate in the shape of a letter "L", largely correlated with GDP per capita (2002), and then into an area reflecting, in a very broad sense the social-economical development and concentration of advantages deriving from political transformation (2002). This will be even more clear if the observed entity is represented as a sub-region (comp. Fig. 2, NUTS 3 2002). We notice the clear-cut division of the country's area into northern, western and southern parts, characterised by the highest density indicators, and middle and eastern parts with much weaker results. Such a division of the area of Poland with regard to its social-economic aspects, reflects the policies conducted in the past by invaders of annexed Polish territories. At the same time, attention should be paid to the factor of domination of sub-regions by the largest conglomerations, namely Warsaw, Lodz, Poznan, Cracow, Wroclaw, Gdansk-Gdynia-Sopot and the Upper Silesia conurbation. The above mentioned sub-regions not only exhibit greater concentrations of the number of ATMs (comp. Fig. 1), but also the highest levels of the density indicator (greater than 22 machines per 100 000 inhabitants). The different values of these indicators for the core area and the surrounding regions may be a factor identifying differences in development - of the so-called "agglomeration shadow", reflecting the attractive power of the core area.

A disturbing conclusion for the eastern territories, together with the świętokrzyskie area, is their homogeneity and qualification for positions at the bottom of the list. This corroborates again the well-established existence of considerable differences between the eastern and western parts of the country, in the context of the widely understood development of the social-economic situation.

4. Conclusion

The availability of new services that are cheap, efficiently used and adjusted to the requirements of the market economy is nowadays one of the more important factors of intense economic development, easy availability of developed consumption services gives the society the feeling of a higher standard of life and greater security (Okulus, 1998).

Bank services, as is the case of ATM services, are non-material and are related to the use of money as goods of a specific sort. This analysis of the number of cash machines in terms of their regional configuration, as well as their density per 100,000 inhabitants, unequivocally shows that:

- the present stage of development of the ATM service may be regarded as being transitional from the higher rank service to the basic kind; and
- the calculation of the density of cash machines seems to corroborate an assumption that the ATM service may be used as an identifier of relative wealth of some regions in comparison to others. This statement can be even better demonstrated by the fact that the ATM device is derivative of the expansive development of some banks, as well as the whole financial sector, whose progress is closely correlated with the level of GDP per capita (Przybył, 2000).

Some of the generalised conclusions drawn from this analysis, in relation to particular localities, have proved equally interesting[2]. They allow us to formulate the following conclusions:

- the ATM network is characterised by relatively uniform distribution all across the country, with distinct domination by more important settlement units together with their surroundings;
- systematically, the regional diversities of both the number and the intensity of the cash machines per 100 thousand inhabitants decreases. The coefficient of variation decreased from 74 to 65 % for the absolute number of ATMs, and from 26 to 22 % for the intensity indicator respectively;
- the national network is the resultant of the network of the biggest banks;
- the ATM network distinctly reflects the so-called triangle of concentration of social-economical activity; and
- on the level of particular localities, no clear connection can be observed between the density of distribution of cash machines and their number in particular settlement units.

The high speed of development of the service is proof of the continuation of the progress of the ATM network, and the gradual saturation of the market with services of that kind. The fact that the service is being transformed from a concentrated one into a basic type, will change the focus of research into the phenomenon in the future. The change may be away from a focus on the device itself, to the number, amount and time of non-cash transactions by means of cash cards.

[2] For a detailed examination of this issue, see the dissertation by M. Kucharczyk (2000).

Fig. 1: Distribution of ATM by voivodeships and NTS 3 units (arithmetic scaling)
Source: Author's research

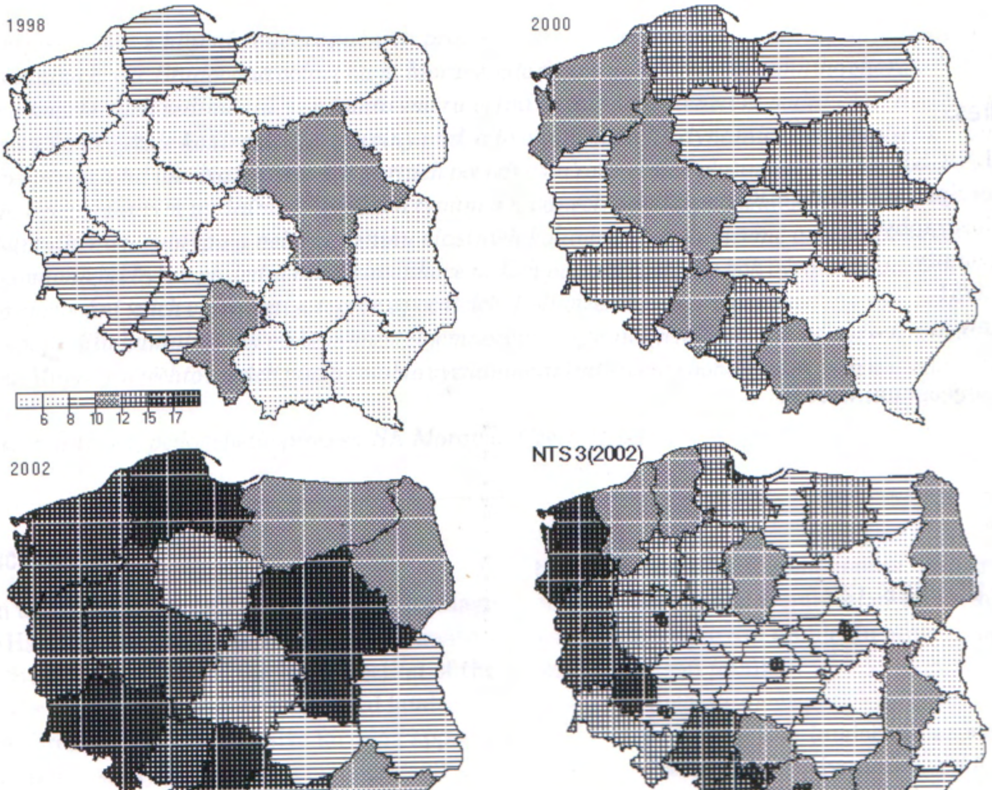

Fig. 2: Number of ATMs per 100 000 inhabitants
Source: Author's research

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DYNAMICS OF PEDOGENETIC PROCESSES EXAMPLED IN THE HARASKA RIVER DRAINAGE AREA (SE MORAVIA)

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Abstract

Water erosion, as one of the main degradation processes of agricultural land and agricultural soil, changes more and more the character of the soil cover. The studied area in SE Moravia, with predominant soils of Chernozem character from loose Tertiary and Quaternary sediments, is highly affected in this respect.Intensive water erosion causes differentiation of soil cover into two still more contrast groups of soil. The process depends on the dynamics of relief development, on the type of farming and on the historical development of land use. In convex parts of the drainage area and on watershed plains a retrograde development of soils takes place. Undeveloped soil subtypes and types develop, and accumulation subtypes of Colluvisols occur in the valley bottoms and subslope concave sections of slopes. The latest version of our soil classification, in accordance with the leading world soil taxonomies, has ranked Colluvisol with evolutionary young Fluvisol. Their mapping and specification of their characteristics are only at their beginnings. Colluvisol is predisposed by its position in the relief, and its thick profile cumulates both a huge volumes of fine-earth fraction and organic materials, and also of some important nutrients such as phosphorus. Mapping of these new soils could significantly update the system of soil evaluation in our country.

Shrnutí

Dynamika půdotvorných procesů na příkladu povodí Harasky (jv. Morava)

Vodní eroze, jako jeden z hlavních degradačních procesů zemědělské krajiny a zemědělských půd, stále více mění charakter půdního krytu. Studovaná oblast na jv. Moravě, kde dominují půdy černozemního charakteru z nezpevněných terciérních a kvartérních sedimentů, je v tomto směru velmi zasažena. Intenzivní vodní erozí dochází k diferenciaci půdního krytu na dvě stále kontrastnější skupiny půd, a to v závislosti na dynamice vývoje reliéfu, typu hospodaření a historickém vývoji land use. Na konvexních partiích povodí a na rozvodních plošinách dochází k retrográdnímu vývoji půd směrem k nevyvinutým půdním subtypům a typům a na dnech údolí a podsvahových konkávních částech svahů k tvorbě akumulačních subtypů a nebo ke vzniku vlastních koluvizemí. Koluvizemě v souladu s hlavními světovými půdními taxonomiemi byly v poslední verzi klasifikace našich půd zařazeny po bok vývojově mladých fluvizemí. Jejich mapování a zjišťování jejich vlastností je teprve v počátcích. Koluvizemě jsou predisponovány svou polohou v reliéfu a ve svém mocném profilu kumulují jak velké množství jemnozemě, organických látek, tak některých důležitých živin, jako např. fosforu. Mapování těchto nových půd by mohlo významně aktualizovat i bonitační systém našich zemědělských půd.

***Key words**: Colluvisol, pedogenetic process, SE Moravia, Czech Republic*

1. Introduction

The region under investigation belongs to the drainage area of the Haraska River which is through the Trkmanka River a right side tributary of the lower section of the Morava River (Fig. 1). Moderately undulated landscape with lack of forests and with intensive farming appears to be suitable for studying the contemporary soil and relief processes and landscape modelling.

The rate of pedogenetic processes comes from the effect of pedogenetic factors in time. Four basic pedogenetic processes can be observed in the soil body as postulated by Buol (Buol et al., 1974) – mass increase, mass decrease, translocation of soil components, and transformation of soil components. Domination of the first or second leads to isotropic soil profile. In other cases it results in anisotropic soil profile.

Soil and relief are two landscape aspects that show opposite developmental dynamics. Soils, with regard to the degree at which their profile develops, i.e. deep soils with anisotropic texture, (which means that their horizons are well differentiated and morphologically discernible), originate mainly on a stabilised land surface. Moreover, at such places where geomorphogenesis is slowed down, the soil profile often provides signs

Fig. 1: Situation map

of polycyclic or polygenetic development. Such a development can be evidenced by the relics of old soils which originated under different climatic conditions. Contrary to that, at places where the dynamics of the relief development is high and cuts down pedogenesis such as on steep slopes with erosion and landslides or sedimentation planes of valley bottoms, the soils appear in an initial state (Leptosol, Regosol and Fluvisol). The development of such soils often becomes retrograde, i.e. from developed to undeveloped forms.

Studies of the dynamics of pedogenetic processes are based on topographical (1:10 000) and pedological (1 : 5 000) maps. All field investigations in geomorphology and pedology are then going to improve the map documentation, and provide basis for an evaluation of intensity and space extent of the present state of pedogenesis. The traditional approach to see the soil cover through "reading" the soil maps at large scale is to be changed.

Survey in pedology deals mainly with the morphological evaluation of soil pits to a depth of 1 m in a catenary topographic profile. This means that it is a representative section in the relief which is portrayed in it, going from watershed planes through slopes to concave fields and fluvial plains. The characteristics of morphology (horizon thickness, colour, texture, structure, gravel content) are supplemented with analytical data. In our view, most important are pH, the extent and saturation of the sorption complex, granularity, contents of carbonates and phosphorus.

2. Soils and pedogenetic processes in the Haraska River drainage area

The drainage area of the Haraska River, regarding pedogeography, belongs to a regional unit of soil cover structure of Chernozem eolian sedimentary areas. Chernozem of different forms of areal washing is dominant, combined with rendzic Leptosol and humus-carbonate soils, Cambisol and Gleyic Chernozem. The arrangement of polypedons regarding the combination of soil-type units is relatively regular, although with stretched or even zonal contours. The contrast between the individual soil-type combinations is medium, conditioned mainly by erosion and sloping; heterogeneity is medium (Němeček – Tomášek, 1983). In detail, we observe that the zonal character is even better expressed in pedological maps of complex agricultural survey, i.e. at a larger scale maps 1:5000. In maps, the stretching of contours in the smaller units, which are related to subtypes, varieties, and soil substrate forms after our new soil classification (Němeček et al., 2001), is mainly parallel with the contour lines. The fact that Chernozem soils are dominant is obviously due to ancient agricultural exploitation of the land. The period of forest climate in the climatic development of Holocene was not decisive for the soil development, because the natural period of non-existing forests at the beginning of Holocene represented an almost uninterrupted continuation of steppe culture times. Anthropogenic effects in pedogenetic processes are long standing and well observable in the area. The collectivisation period in farming accelerated erosion in the first place.

Agricultural use of land is intensive, the land is mainly arable. Regarding the phenomenon which we are going to discuss, it is necessary to mention that the limit arable land slope gradient of 12°, traditionally accepted and respected in evaluation of our agricultural soils (see the system of soil evaluation of ecological soil-units – BPEJ, main soil units Nos. 40 and 41), is significantly exceeded in this area. Ploughing takes place on slopes inclined up to 17°.

Chernozem areas with soils of Tertiary calcareous parent rocks and of Pleistocene eolian sediments the most decisive process is the accumulation of organic material in the humus horizon of mollic type. Due to intensive bioturbation, humification and activation with microzoo-edaphone, the profile thickness is more than the reach of ploughing, i.e. over 30 cm, and fractional composition of humus materials in mineral organic complex shows an overbalance of humic acids. In depressions where humidity is increased, Chernozem soils pass to Gleyic Chernozem with signs of oxyreduction processes and often also greater content of humus. At sloping places where morphogenesis is faster than pedogenesis, rendzic Leptosol and humus-carbonate soils are in majority. Their components that cannot be disregarded are Regosol and Leptosol.

Accelerated removal of soil particles in the direction of superficial water runoff reflects in the colluvial process. The process becomes increasingly important. Similarly to the French classification system in pedology (Référentiel pédologique, 1995), soils that originate in this process are attributed to a newly introduced unit of Colluvisol (Němeček et al., 2001). Such soils are defined as originating from humification in accumulations of edaphic sediments - colluvials. Their properties are not well known and their distribution will not be found in pedologic maps. Parameters of soils that originate from colluvials are more favourable in terms of pH, saturation in sorption, physical parameters including specific mass and water supply in the profile (i.e. water which is physiologically available), and also in the parameters of horizon thickness and those of the whole soil profile.

2. 1 Geomorphologic characteristics of environment where Colluvisols originate

The material washed out and removed from the slopes is accumulated at their feet in accumulation cones, fluvial plains or river accumulation terraces, or becomes sedimented in lakes and water reservoirs. Only a part of the total volume will gradually reach the ocean. Because of that, there is no linear relation between the volume of material dissolved and carried away in the flow and the denudation intensity in the given drainage area (Allen, 1997). The same author provides an example of US territorial estimate that 90% of the material released by weathering and erosion remains sedimented within the river and valley systems.

One can generally say that the most favourable conditions for Colluvisol to originate appears in a terrain considerably broken and sloping (Référentiel pédologique, 1995). We can differentiate convex, straight and concave parts of the slope profile where, at its bottom, Colluvisol originates. All the three parts provide conditions for specific processes (Schumm, 1991). Under conditions of the Haraska River drainage area, the profile in its convex part shows following processes: creep, superficial removal, mechanical and chemical weathering and deep erosion. It is therefore the area where the material is being removed. The transport takes place across the straight slope sections no matter it varies in width or is not developed at all. Apart from that, the straight sections provide conditions for landsliding. As for erosion processes, it is ditch erosion, suffosion and creep that can appear here. As for accumulation processes, it is accumulation of colluvials and outwash cones which are of utmost importance in our considerations.

2. 2 Origin and development of Colluvisol

Colluvisol, together with Fluvisol belong in the reference class of FLUVISOLS. These are soils without distinctive diagnostic horizons, with the exception of accumulation horizons of organic materials. They can be diagnosed by the periodical sedimentation which results in irregular or increased volume of humus to a depth of 1 m, and sometimes in stratification of the soil profile (Němeček et al., 2001).

We do not specify any particular reference horizons in colluvial soils. *Humus horizon* is due to cultivation – Ap-arable (created by ploughing and current cultivation) to Az-anthropogenic (created by distinct anthropogenic activities). Regarding *Colluvisol*, the horizon is specifically Azx (due to the accumulation of humic horizon material). Thickness of the accumulated humus horizon must exceed 0.25 m, if not so, the soil cannot be classified as Colluvisol (Němeček et al., 2001).

According to the French classification, the soil developed from colluvials is to be regarded as Colluvisol only in the case when other signs characteristic of other types of soil are not diagnosed, and regarding the thickness, only in the case when the colluvial material exceeds 0.5 m from the surface. If the colluvial sediments do not reach the thickness of 0.5 m, we speak of the colluvial soil. If the soil buried under colluvial soil can be identified, we use terms such as calcificated Colluvisol, Colluvisol on calcareous Fersialsol, etc., (Référentiel pédologique, 1995).

Colluvisols can be divided into several specific soil subtypes and varieties. Soil subtype should be understood as a distinctive modification of the soil type. The definition is formulated to cover both agricultural and forest soils. The subtype level does not respect features related to the different use of soils applied at a depth of 0 – 0.2 m. The subtypes indicate a central conception of soil type (modal), transition to other soil types, transition to semihydromorphic or hydromorphic soils, modification of the type due to distinctive features of saturation of sorption complex, modification specified by distinctive features of granulometric composition, modification specified by distinctive features of anthropogenic activity. The subtypes have an adjective attached and placed behind the noun, which indicates the soil type. They are marked with a minuscule in the symbol.

Colluvisols are differentiated into the following subtypes:

- Colluvisol *modal* (m) medium heavy
- Colluvisol *gleyic* (g) medium redoximorphic features
- Colluvisol *calcic* (c) containing carbonates in humic profile
- Colluvisol *arenic* (r) light granular composition, sandy or loamy-sandy soil
- Colluviusol *pelic* (p) heavy granular composition, loamy-clayey soil

Colluvisol preserves qualities of original soils and their substrates. They are deposited at slope toes. It is water after intensive precipitation and ice thawing which provide slow downslope transport. As for chemical properties, the soils are predominantly humic up to a depth of more than 50 cm, mostly eubazic to mesobazic. In a pedological transect (catena) passing in the landscape from the watershed centre to the centre of fluvial plain, the three-dimensional body of the soil is formed by unilaterally oriented material exchange (Němeček et al., 1990). Having had analysed soil samples in representative places of such a catenic profile, Šefrna and Bičík (1998) presented significant changes of some qualities of soils, providing an example of soils from granite, loess and slate in the Kocába River drainage area. The volume of clay and loess, sorption potential, as well as humus content grow towards the toe.

Representation of Colluvisol in maps is insufficient. Accumulation forms of different types of soils, especially those of eolic materials, were respected even during the campaign of Complex Soil Survey organised in the 1960s. However, field records cannot be fully used for reconstruction of their the then distribution because some important signs and properties such as horizon depths, colours and granular composition were not recorded. Geological maps recording the distribution of Quaternary substrates at a detailed scale are of little use for pedology because the geological view about colluvial materials is much broader, notably it includes even the solifluction slope sediments of Pleistocene (Růžičková-Růžička, 2001). Contrary to that, the pedological view can see it as recent to Holocene soil sediments of erosional or gravitational character.

2.3 Geological-geomorphological conditions of the Haraska River drainage area

The Haraska River drainage area is situated in the Ždánický les Hilly land. From the geological point of view (Collective of authors, 1967) the region is built particularly of molasses facies of Upper Eocene and Oligocene sandstones. According to Stráník (1987, 1993) the prevailing orientation of tectonic faults is NW – SE. The relief of this part of the Ždánický les Hilly land is represented by a system of smaller platforms and interjacent crests lying at a niveau of 300 to 400 m a.s.l., with the highest one called Přední Kout, (410 m a.s.l.). The Paleogene group of beds shows a relatively high variation of inclinations. It is neither horizontal nor subhorizontal position. Platforms appear then as a belevelled surfaces resulting from erosion-denudation processes. Saddles are mostly wide and shallow. The valley pattern orientation of NW – SE and NE – SW dominates over the one of N – S and W – E, while only NW – SE orientation can be linked to the tectonic bisection of the geological basement. Deep valleys with steep slopes and considerably wide bottoms prevail. The bottoms are filled with sediments of fluvial plains or outwash deposits. Slopes of erosion-denudation origin prevail.

Regarding the current morphogenetic processes, river and gully erosion is important in the soil development. Czudek (1987) presents an example of buried gullies from the vicinity of a nearby village of Pavlov which exemplifies dynamics of geomorphological processes at the time of their development and filling. He considers the agricultural activity of man during the Upper Holocene (e.g. deforestation) as a main factor. At the same time, he proves that such a development can be documented not only for the period of the last centuries but even before. Space analysis of present erosion phenomena (Vilímek, 2002) provides an evidence that they do not follow the general tectonic pattern of the area, i.e. the NW – SE system does not prevail. Erosion lines are almost regular. It is important that they correspond with the valley pattern only occasionally. Old gullies got developed on slopes frequently in the direction of maximum slope gradient with no correlation with the valley system, frequently even in forests. Therefore, it may be a result of older anthropogenic interference such as the case of hollow ways deepened by erosion, local deforestation, etc.

Hrádek (1989) defined spring basins as geographical units where one finds transport of both material and energy as a result of climatic conditions or due to human activities, which can be combined. The majority of spring basins in the drainage area of the Haraska River leads really into valleys full of outwashed sediments and even shorter erosion cuts developed at places. Erosional cuts in the spring basins did not develop as a direct result of steepness. There are other effects that play a role.

Fans developed usually in the upper part of the Haraska River drainage area, at the mouths of shorter and steeper tributaries, often found as gullets, while in the lower part of the drainage area side valleys enter the Haraska River fluvial plain smoothly, showing no serious step in the bottom gradient.

Slope movements make trouble only locally. Usually, they are found at places artificially reshaped. There are three places of this kind (E of Šitbořice, NW of Boledradice, and NE of Diváky). In all these cases, systems of agricultural terraces were built up there and slopes separating individual horizontal platforms were chosen exceedingly steep – close to 40°. As a result, they are affected by slope movements. A similar terrace system SW of Borkovany has suffered with intensive rain rill erosion to the depth of 0.5 m only as yet. Nevertheless, potential threat of slope movemets is present. Another artificial remodelling of the relief NW of Klobouky, called out by the need of enlarging local dump and by building up some smaller objects, induced a landslide in the steep head slope. There is a threat that this may continue because another construction work contains an artificial wall of almost vertical inclination.

Seismic activity which, generally taken, comes to result in soil compaction, is low in the Haraska River drainage area.

3. Results

A number of profiles have been demarcated in the area so that, at their points, they would register the intensity of the youngest pedogenetic processes leading mainly to the origination of Colluvisol. Representative toposequence points were arranged with probe bar to be placed in the watershed plain, convex, straight, and concave section of the slope and in the fluvial plain. Two representative transversal sections are presented in the following schemes (Fig. 2 a, b). Individual probes were assigned to reference units of the soil classification system according to their morphological features and analytical physico-chemical properties.

On the basis of the survey in other parts of the drainage area and comparative relief studies, accumulation and erosion effects were registered. These two effects with opposite functions influence significantly the volume of humus in horizon Ap of arable soils, and produce a mosaic of alternating light reflections on aerial photographs. This is documented in an orthophotomap with 3-D representation (Fig. 3).

4. Discussion

We can conclude that the concave parts of slopes contain humic soil sediments of a thickness more than one meter as a soil substrate. These positions are represented with soil types of *Colluvisol* in a mosaic of *modal, carbonate and gleyficated* subtypes. During the succession of Colluvisols a part of highly humic and saturated fine-grained particles penetrates deeper and deeper and, as a buried soil, it is deprived of its original value. Decreasing edaphic turbulence with an increase in microbial vitality carries away partially expedient properties of the soil, and of the conserved geological layer. Spatial arrangement appears as a soil catene where Colluvisol passes to colluvial subtypes of other soil types (*of haplic Luvisol, Chernozem, rendzic Leptosol, possibly also Cambisol*). An example of such an erosional catene follows in the scheme (Photo 1 – 4).

Such are the facts needed to render even the role of the soil in the landscape. The best way could be to develop a definition of local soilscape unit on the basis of proximate segments that concern geology, soil, geomorphology, landscape, and ground exploitation. In our case, we consider Colluvisol and the concave shape of the slope and dry bottoms of side valleys which contain soils of

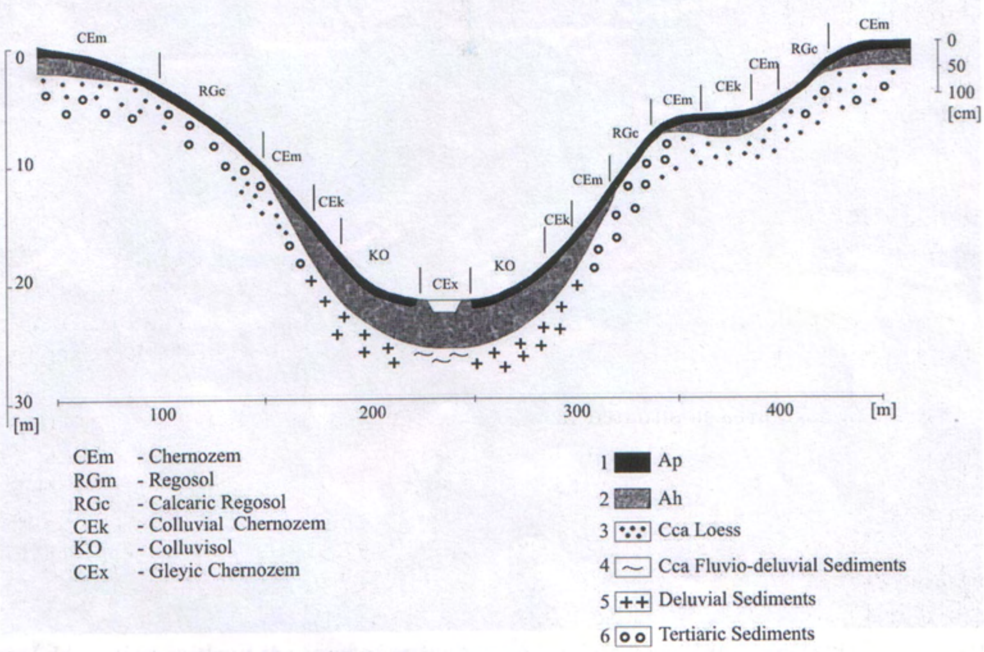

Fig. 2a: Transect No 1 The Haraska River valley in the spring area.

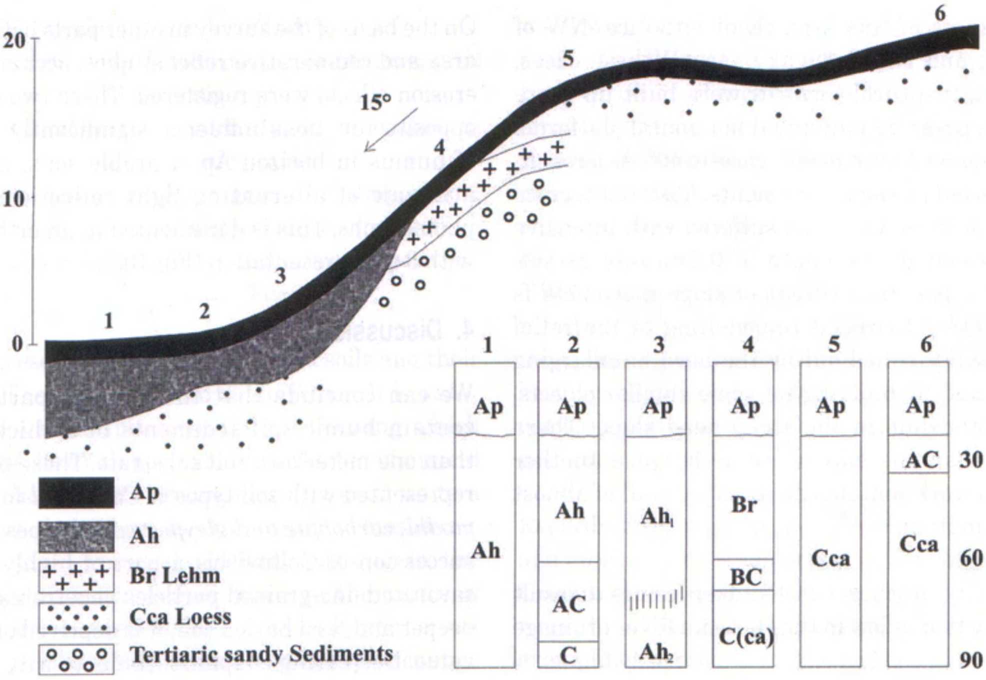

Fig. 2b: Transect No 2 Spring basin of the Haraska River upper reach.

eolic substrates, colluvial or rainwash sediments, in a landscape *with monotone arable soil exploitation* that was intensive from the very prehistorical times of agriculture. This unit brings about a significant accumulation of carbon and phosphorus in the landscape that appear in the form of insoluble solid particles of organic material, which makes the unit similar to a fluvial unit. Other important factors may be found in different residues of farming. The search should cope with the use of agrochemicals and fallout of allogene materials. However, analytical data in this segment *are missing.*

Such units are not specified from the point of view of production capacity. That is a reason why in most cases the soil evaluation maps classify them in BPEJ as Chernozem or Gleyic Chernozem lying in their neighbourhood. Tests for the natural production capacity were not made originally. That is why we do not have more information about their fertility. Regarding the

Fig.3: Orthophotomap of the Haraska River drainage area. 3-D display shows well eroded and colluvial soil parts.

Photo 1: Intensive and long term agricultural usage as arable land has lead to the development of thick colluvisoil in the lower part of the slopes. Photo L. Šerfna

above mentioned physico-chemical properties and the effect of setting in the relief, one can assume a better soil quality, as a whole, due to deep humus horizon and accumulation of fine particles which produce high kation exchange capacity and reserves in available nutrients, although in such a depth that it becomes unimportant for rhizosphere. Groundwater is more readily available to cultural plants on Colluvisol mainly in years characterised by dryer vegetation periods. On the other hand, we can often find a massive sedimentation of mineral subarable outwash sediments which cover the original humus horizons thus worsening the soil quality. What matters is the succession of the colluvial process with erosional rejuvenation of the adjacent slopes.

Photo 2: Lateral dry valleys without the cover of vegetation show widely various mosaics of soil units formed by the process of erosion and colluviation. Photo L. Šefrna

In the area under investigation which is built mainly of eolic and fine neogene sediments with the high content of carbonates, colluvial sediments are fine-grained, highly humic, carbonatic, and sorption saturated. This provides an evidence of the relatively balanced soil removal and sedimentation, when the transported material retains its mollic character due to deeply humic soil substance of Chernozem character on watershed platforms. Convex parts, hit deeply with erosion and rejuvenation, have lost their humus horizon totally at many places, and become similar to rendzic Leptosol and Regosol. With respect to production, the difference does not seem serious because of easy ploughing, reserves in carbonate components and other nutrition reserves in the parent rock.

5. Conclusions

Human activities affect the soil cover both directly and indirectly. Direct effects are mostly destructive. Indirect effects are diverse but most significant is the change of the vegetation cover. Transformation of the original forested grounds to the "cultural steppe" of our rural landscape accelerated the effect of the climatic factor. In other words, the prevailing presence of the cultural steppe in our landscape is not balanced with high precipitation totals. Thus, removal of soil particles is increased. Therefore, in the terrain which is broken in elevations, the most important degradation process is water erosion which, as to the volume of the transported soil material, exceeds wind erosion. Other effects such as technological compaction, contamination with extraneous elements or different changes in the soil regime, are not distinctive and their manifestations do not represent serious degradation factors.

Energy acquired by agricultural production on the deforested surface should be appropriately invested to antierosional measures. It is not so, and therefore the soil cover suffers from distinctive differentiation into fields deprived of fine soil particles with shallow soil profile and into fields enriched with soil sediment accumulations. Soil cover increases its contrast not only typologically but also with respect to production quality and ecology. Even other important functions of the soil in the landscape are changing at a high rate. It is primarily its water retention potential, fixation of carbon, buffering capacity.

Reconnaissance of properties and distribution of Colluvisols in our territory is very important because their significance and areal extension in our pedosphere is increasing. The colluvial process affects exclusively the agricultural land and the intensive production of soil composed particularly of the loose Quaternary and Tertiary fine-grained sediments accelerates the process. The colluvial process produces significant changes in the structure of soil cover. Primarily, there is an increase in contrast between the soil of convex relief near the watershed and the soil of concave slope sections and that of dry valley bottoms. It will be useful to find an appropriate method of Colluvisol mapping and introduction to soil maps at medium and large scales in the future. For this purpose, a good acquaintance with geomorphology of the area in question will be most appropriate, as well as an introduction of the relief models that may solve problems of predisposition in accumulation processes of the area, combined with erosion intensity calculations. The requirement that Colluvisol should be introduced to the classification system of agricultural soil quality is justified because soil of this type has different fertility than other soil types.

This research was financed by GAČR Agency, grant No 205/00/0782.

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THE GRANITE LANDSCAPE OF THE KRUMLOVSKÝ LES FOREST, SOUTH MORAVIA AN EXAMPLE OF A VARIETY OF STRUCTURAL CONTROLS

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Abstract

The Krumlovský les Forest is an upland within the south-eastern margin of the Bohemian Massif, built of Precambrian / Early Palaeozoic granite. Both major and minor landforms reveal various instances of structural control, exerted by tectonics, lithology and jointing. The morphological boundaries of the upland are fault-controlled and the entire upland is best considered a horst. The subdued nature of the upland surface, the scarcity of tors and small dimensions of individual boulders, are compatible with the lithological properties of underlying granite, its dense fracturing and long history of deformation. There is a distinct hierarchical pattern of structural control, with the role of jointing becoming more significant for the development of smaller landforms.

Shrnutí

Žulový reliéf Krumlovského lesa na jižní Moravě. Příklad mnohotvárnosti strukturní kontroly krajiny

Krumlovský les je vyvýšeninou na jihovýchodním okraji Českého masivu tvořenou granitem prekambrického až mladopaleozoického stáří. Makro- i mikrotvary jeho reliéfu ukazují různé úrovně strukturní kontroly od projevů tektoniky, přes litologii až k puklinatosti. Morfologické hranice elevace jsou vázány na okrajové zlomy a celou vyvýšeninu je proto možno nejlépe považovat za hrásť. Slabě zvlněný ráz temenního povrchu, nízký počet skalních tvarů i malé rozměry izolovaných balvanů ve vrcholové části vyvýšeniny jsou spjaty s litologickými vlastnostmi podložního granitu, jeho silným rozpukáním a dlouhou historií jeho deformace. Z hierarchického uspořádání strukturní kontroly reliéfu je patrné, že puklinatost se uplatňuje především při vývoji menších tvarů.

Key words: *Czech Republic, Bohemian Massif, Krumlovský les Upland, granite landforms, hierarchy of structural controls, tectonics, jointing.*

1. Introduction

Granites belong to the most common rocks outcropping at the Earth surface and usually tend to produce distinctive morphology characterised by such classic landforms as steep-sided inselbergs and bornhardts, castellated tors, pedestal rocks or extensive boulder fields. Likewise, there are curious minor features of granite surfaces, including rillenkarren, tafoni and weathering pits, which have attracted scientific attention for more than two hundred years already (cf. Wilhelmy, 1958; Thomas, 1974; Godard, 1977; Twidale, 1979, 1982 and further citations therein).

Within the research on the evolution of granite landscapes two general approaches have been present. In one, fundamental controls on granite geomorphology are sought in the properties of granite itself, whether lithological (composition, structure, chemistry) or structural (jointing). In another one, characteristics of granite landforms are attributed to environmental controls, chiefly climatic ones, and claims have been made that each climatic regime is typified by a specific assemblage of meso- and microforms, resultant from specific climate-controlled processes (Klaer, 1956; Wilhelmy, 1958). Although the two approaches are not necessarily mutually exclusive, in practice the rock factor has often been downplayed by proponents of strong environmental controls. Therefore, for many granite landscapes structural control is yet to be demonstrated and the absence of reference to it in certain areas does not mean that such a control does not exist.

In this paper we will analyse granite geomorphology of the Krumlovský les Forest area, SW of the city of Brno, in the SE part of the Czech Republic, and will demonstrate a variety of geological controls on the landscape. There are two principal reasons behind our choice of the study area. First, the Krumlovský les Forest does not have distinctive morphology and lacks inselbergs, high tors, basins or spectacular minor features. Without doubt, granite landscapes which are less scenic have been investigated less too, and a view may have arisen that granite geomorphology is everywhere bornhardt and tor dominated. Second, the Krumlovský les Forest has featured in the literature already, having been the subject of a paper by Demek (1960). He clearly approached it from the point of view of historical climatic geomorphology, whereas we shall attempt to balance the former view through demonstration that structure *sensu lato* becomes the key to understand granite geomorphology of the Krumlovský les Forest. In fact, previously published observations by Hrádek (1993, 1995a) from the northernmost part of the area leave no doubt that geologic structure has played crucial control in geomorphic evolution of the region.

2. Study area and its geological evolution

The upland of the Krumlovský les Forest is located in the southern part of the Bobrava Highland, c. 25 km from the city of Brno. Its highest spot U Stavení, in the central part, attains 415 m a.s.l., whereas relative relief of the upland in relation to the adjacent lower ground is 100 – 150 m. Bedrock is composed mainly of granites and granodiorites which belong to the Cadomian Brno Massif of Late Proterozoic/Early Palaeozoic age, the Krumlovský les Forest variant (Štelcl-Weiss, 1986; Mitrenga-Rejl, 1993). In addition, there occur veins of aplites and pegmatites.

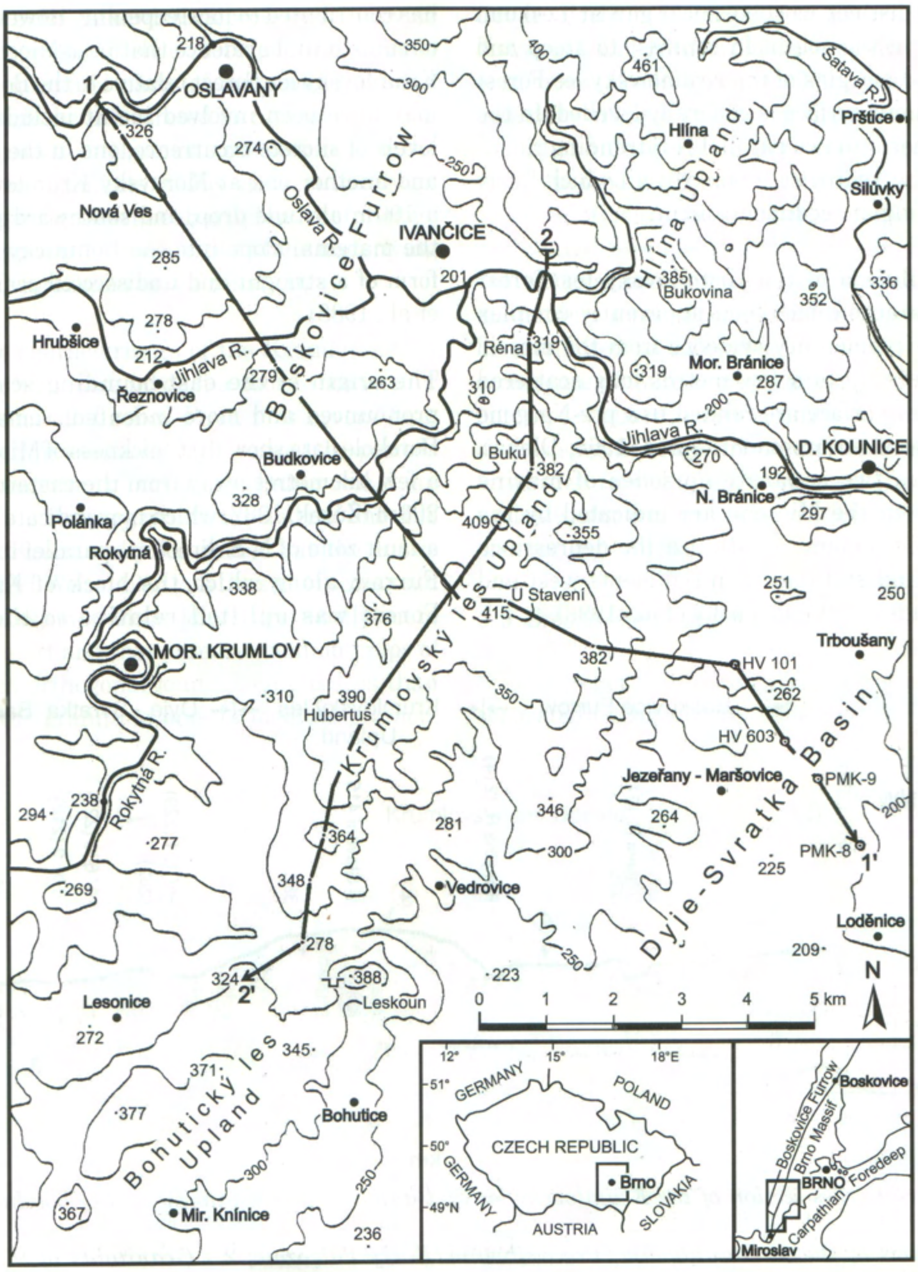

Fig. 1: Study area – topographical and geological setting. Lines of cross-sections 1-1´(Fig. 2) and 2-2´(Fig. 3) are marked

Outcrops of the Brno Massif occupy a NNE-SSW elongated, triangular area 70 km long between towns of Boskovice in the north, Brno in the south-east and Miroslav in the south (Fig. 1). In the west the Massif is bound by a steeply dipping fault line, along which it has been thrust over the narrow, linear sedimentary basin of the Boskovice Furrow during Variscan orogenic movements in the Late Carboniferous and Early Permian (Malý, 1993). By contrast, SE part of the Krumlovský les Forest dips beneath Miocene sediments of the Carpathian Foredeep, itself formed along the boundary of the Carpathians and the Bohemian Massif during the Alpine orogeny. The Brno Massif is cut by numerous NW-SE trending faults, along which the massif has been fragmented into a number of tectonic blocks, including one of the Krumlovský les Forest. Marginal faults of the Krumlovský les Forest run along the Jihlava river in the north and the distinct morphological gap at Leskoun and Vedrovice in the south. In contrast to steep and highly dissected margins of the Krumlovský les Forest upland, its summit surface is generally levelled. In the south it branches into two parallel N-S trending ridges separated by the Vedrovice Basin, within which Early Miocene (Ottnangian) sediments occur.

Long-term evolution of the Krumlovský les Forest area in the Cainozoic has been apparently complex as attested by fragmentary evidence from the massif. Silcrete boulders up to a few metres long scattered over the summit surface are related to a pre-Neogene terrestrial tropical environment (Jaroš, 1965; Dlabač, 1976), whereas two separate episodes of marine transgressions in the Miocene are indicated by the occurrence of Ottnangian clastics in the depressions within the upland and Badenian sediments west and north of it (Hrádek, 1993; Pálenský et al., 1996).

3. Landforms as controlled by structure and lithology

3.1 Gross geomorphic features of the Krumlovský les Forest

A characteristic feature of the Krumlovský les Forest area is morphological contrast between gently rolling upland surfaces in the central part and very steep marginal slopes (Fig. 2). Although both western and eastern margin have similar height, their inclinations differ. The western slope towards the Boskovice Furrow is steeper and has developed right along the contact between granites and Carboniferous to Permian conglomerates, which points to at least partial influence of lithology and unequal rock resistance. Hence the slope might be considered as a fault-line scarp, especially at Budkovice, where lateral erosion of the Rokytná river has contributed to its steepening. However, there exists circumstantial evidence that post-Miocene uplift of the Krumlovský les Forest relative to the Boskovice Furrow may have been involved too. It includes two altitude levels of silcrete occurrence, one in the upland surface and another one at Moravský Krumlov, separated by a 100 m altitude drop, and southward prolongation of the marginal slope into the Bohutický les area in the form of a straight and undissected scarp (Matějovská et al., 1988).

The origin of the east-bounding scarp, itself less pronounced and more indented, remains less clear. Borehole data show that thickness of Miocene sediments a few kilometres away from the eastern slope exceeds 200 m (Žůrek, 1987) which may indicate the presence of a fault zone of N-S direction, parallel to the Boskovice Furrow, along which the block of Krumlovský les Forest was uplifted relative to the Carpathian

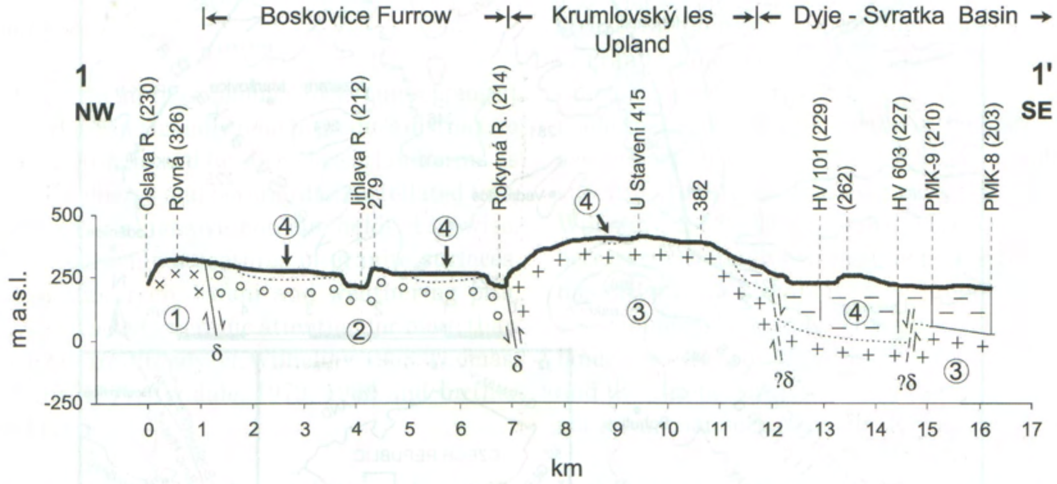

Fig. 2: Transversal cross-section of the Krumlovský les and adjacent areas. Information of boreholes taken from Žůrek (1987)
1 - Metamorphics of the Moldanubicum, Precambrium / Early Paleozoic; 2 - Granitoids of the Brno Massif, Precambrium / Early Palezoic; 3 - Conglomerates and sandstones of the Boskovice Furrow, Permo-Carboniferous; 4 - Gravels, sands and clays of the Carpathian Foredeep, Miocene. Quaternary cover ommitted

Foredeep. Therefore, the entire granite massif is best considered as an antithetic block within the belt of regional downwarp of the Bohemian Massif towards the Foredeep, as earlier suggested by Hrádek (1993, 1999). Thus, notwithstanding existing uncertainties, it appears evident that the general morphological prominence of the Krumlovský les Forest is attributable to post-Miocene differential tectonics, aided by differential lithologically-controlled denudation.

3. 2 Gently rolling upland surfaces

The upland surface of the Krumlovský les Forest, except for its northernmost part, is characterised by gently undulated topography with minimal relief. None of the elevations assumes the form of a distinct hill rising sharply above a plateau and no discernible breaks of slope exist. Likewise, depressions are wide shallow troughs with no clear bottoms and become valleys only in marginal parts of the upland. Such a type of relief might be interpreted as a consequence of protracted planation in the past, possibly before the Early Miocene as sediments of this age rest locally on the plateau. However, we argue that upland morphology is also compatible with the properties of the underlying granite and its long history of deformation.

There are three characteristics of the Krumlovský les Forest granite which have made it a poor candidate for any more differentiated relief. First, it is a very high degree of fracturing assumed during repeated periods of tectonic deformation in the Early Palaeozoic, Late Palaeozoic and the Tertiary, which affected not only the granites of the Krumlovský les Forest but the entire Brno Massif (Štelcl-Weiss, 1986). As the size of occasional boulders indicates, individual joints are hardly more than 1.5 – 2 m apart and there are frequent outcrops of granite in which orthogonal joint spacing is less than 0.1 m. Second, the granite is fine- to medium-grained, hence there is no significant differentiation in texture throughout the massif. Third, the content of potassium is rather low, 4.38 % on average (Štelcl-Weiss, 1986), and plagioclase very much prevails over K-feldspar.

The three features referred to above are decisive for decreased resistance to weathering and, above all, for little differentiation, or 'homogenisation' of the granite in respect to this process. Indeed, deep weathering must have been a crucial process in the development of granite topography of the Krumlovský les Forest, as attested by frequent outcrops of grus mantles across the plateau. Demek (1960) reports about thickness of grus up to 10 m in its central part. Unfortunately, few larger outcrops of grus exist nowadays which would allow for more detailed examination of weathering products.

Given little differentiation of granite itself, its disintegration, much influenced by textural properties of the rock (Migoń-Thomas, 2002), must have led to the generally uniform advance of the weathering front and its rather diffuse nature. Under such circumstances the resultant topography is expected to be lacking distinctive features of selective weathering such as bornhardts, castellated tors or elongated master joint-controlled basins. Occasional low ridges and separating depressions, for instance south of the Hubertus forestry, can probably be attributed to differences in joint density or to the occurrence of aplite veins within granite, as evidenced by outcrops of aplite along the ridges. Similar observations on this specific 'ridge-and-swale' topography have been forwarded from the northern part of the area, where variable joint density has been inferred from geophysical prospecting (Hrádek, 1995a; 1999).

3. 3 Graben-like structures

Specific relief features in the form of isolated massifs separated by zig-zag dry valleys occur in the northern

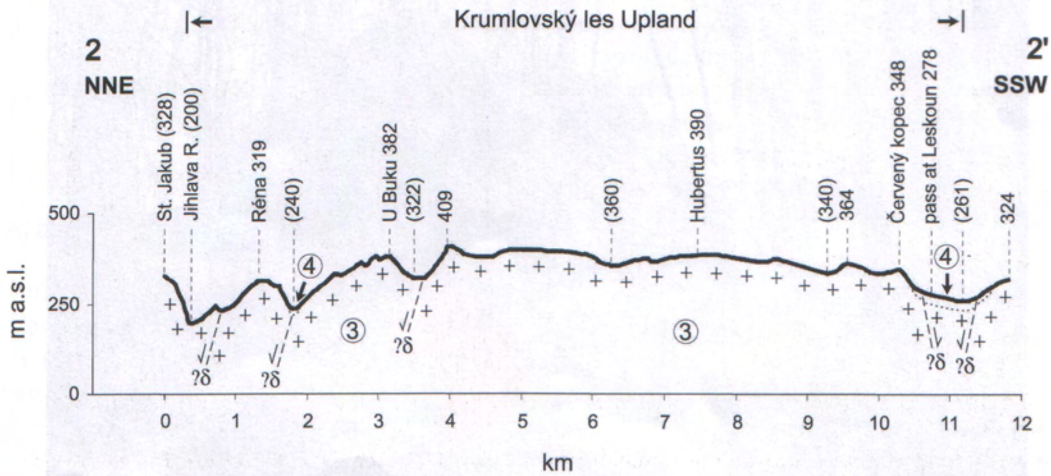

Fig. 3: Longitudinal corss-section of the Krumlovský les. Explanations as for Fig. 2

part of the area (Fig. 1). These bedrock elevations are U Buku (382 m) and Réna (319 m), the depressions are up to 200 m wide and to some extent filled by Quaternary scree and solifluction deposits resting on Miocene sediments (Demek, 1961). Overall morphology of the northern depression and its spatial relationship to the course of the Rokytná valley west of the Krumlovský les Forest suggest that it could be a palaeo-valley of Rokytná across the granite area, abandoned due to river diversion, possibly after the uplift of the upland. However, a similar palaeo-valley interpretation of the southern depression is difficult given its longitudinal profile (Fig. 3).

Recently, Hrádek (1993, 1995b) has advanced structural interpretation of relief of the northern part of the Krumlovský les Forest. In his opinion, there is a major NW-SE trending fault zone at the northern end of the area followed by the Jihlava river which flows in a deep gorge. Subsidence within this zone induced large-scale gravitational spreading in the adjacent parts of the uplands, both north and south of the gorge, which in turn resulted in the origin of individual bedrock blocks detached from the main body of the upland and delimited by gravitational trenches. Accordingly, Lower Miocene sediments have subsided into the trenches and are not in their original position. A similar gorge-like feature, 500 m wide and filled by a few tens of metres of Miocene sediments, occurs at the southern end of the Krumlovský les Forest. Nowadays, however, it acts as a wind gap, and no comparable gravitational trenches are present in the surrounding higher ground.

3. 4 Tors and boulder fields

Notwithstanding unfavourable conditions for selective weathering, boulders and low tors do occur in the Krumlovský les Forest, especially in its northern and southern part. Granite outcrops in the northern part are largely confined to the steep walls of gravitational trenches described above and are young features, subject to mechanical disintegration due to stress release. Those in the southern part, however, can be related to denudational processes acting upon the plateau surface itself.

The most common type of bedrock outcrop is a group of closely spaced boulders, usually not more than 2 m long, which crowns the elevation of the topographic surface. Noticeably, boulders are rarely stacked one upon another. Boulders have rounded edges, but signs of ongoing flaking or exfoliation are scarce. Their surfaces, albeit rough, do not bear any distinctive minor weathering features such as rills or pits. Very few boulders can be seen in the intervening depressions between the elevations.

Tors, understood as in situ bedrock outcrops with the original jointing patterns still recognizable, are very rare in the southern and central part of the area. The highest one is located on the top of 364 m hill and is 5 m high. It has an irregular shape, clearly influenced by the southern dip of dominant joints (Fig. 4). Low (< 3 m) asymmetric tor-like features occur close to plateau edges, on upland spurs and along the upper break of slope.

Both shapes and distribution of tors and boulders reveals the influence of jointing patterns. Boulders have probably formed in the subsurface due to selective weathering of more massive granite compartments that by virtue of their massiveness have eventually given rise to low elevations and ridges. In accordance with the previous interpretation of intervening depressions as of more closely-jointed parts of the granite body, no boulders fields could have developed there. The degree of

Fig. 4: A tor in the southern part of the Krumlovský les. Note the absence of orthogonal joints. Photo P.Migoń

Fig. 5: One of the boulder field in the southern part of the Krumlovský les, with boulders showing variable degree of rounding. Photo P. Migoń

rounding of boulders varies, even within one boulder field (Fig. 5), which likely reflects initial rock texture rather than climatic conditions during weathering. Likewise, tors have probably formed in the subsurface, although a subaerial component must have been present too as attested by occasional weathering pits and indistinct rills. These surface features, however, are extremely rare in general, not attaining any larger dimensions either (the largest pit is 60 x 40 cm), which supports the hypothesis of a relatively recent excavation of boulders and tors and their limited lifetimes.

Within the upland surface no landforms visually resembling frost-riven cliffs and cryoplanation terraces have been found. No laterally continuous granite cliffs, nor block fields and sharp concave breaks of slope occur. There may be two explanations of this situation. Either the excavation of boulders and tors from the grus mantle is of very recent date (Last Glacial?), or cold-climate weathering of already existing granite forms has been incapable of changing their physical appearance and continued to exploit the structure towards the same final effect.

3.5 Cracked boulders

Granite boulders on the upland surface are often distinctly rounded from one side and angular from the opposite one; in other cases rounded boulders are split into two parts along a vertical fracture. They have already been noted by Demek (1960) and explained as follows. Rounded shapes were assumed during the phase of sub-surface weathering in a warm and humid environment of the Tertiary, whereas splitting would be the result of frost weathering in the Pleistocene. Hence the boulders in question would have had a long history and witnessed at least one major environmental change.

In our opinion it is not necessary to imply such protracted lifetimes of individual boulders, nor there is any convincing evidence for these. Ollier (1978) has described various instances of cracking developed in former corestones after they emerged at the topographic surface and has seen this phenomenon as rock mass response to the development of tensile stress in laterally unsupported boulders. Indeed, in the Krumlovský les Forest split boulders occur in exposed positions and many must evidently have lacked support except for a relatively small area of contact with an underlying boulder. In such circumstances, especially within larger compartments, fractures were developing within an overhang and eventually slices of rock have fallen apart producing a 'two-stage' boulder (Fig. 6). This process of mechanical breakdown caused by tensile stress accumulation is independent on climate and in fact, split boulders occur widely in frost-free granite areas around the world, from hot humid to hyper-arid environments, for instance in the Namib Desert (see Ollier, 1978; Twidale, 1982).

4. Hierarchy of structural controls

The examination of granite relief of the Krumlovský les Forest has revealed not only the variety of structural (*sensu lato*) controls but also their hierarchical pattern (Fig. 7). Gross morphology and the very existence of the upland is related to tectonic factors, which have been decisive for the long-term landscape development of the margin of the Bohemian Massif in the Cainozoic. The granite area of the Krumlovský les Forest is best considered an antithetic block bounded by NNE-SSW faults, developed within the regional downwarp of the Bohemian Massif towards the Carpathian Foredeep. The western boundary follows a Palaeozoic reverse fault, apparently rejuvenated in the Cainozoic. In addition, NW-SE to W-E tectonic zones mark the north and south boundary of the upland, respectively, and gravity tectonics within these zones is responsible for the development of trenches crossing the upland surface. Relative uplift of the Krumlovský les Forest must have been of order of at least 80 – 100 m, possibly more in the east.

For the development of surface relief within the elevated area lithology and jointing patterns become key factors. Petrological characteristics of granite, its fine- to medium grained texture and low feldspar content, along with very high density of fracturing, have contributed to the relatively uniform advance of weathering front and account for little differentiation of denudation relief. In fact, if other parts of the Bohemian Massif are considered, gently rolling watershed surfaces appear common in areas built of fine textured and heavily jointed granites, and stand in contrast to hilly or inselberg relief developed within coarse grained, feldspar-rich, massive granite (cf. Migoń, 1996).

Detailed morphology of the upland area further reflects the role of lithology. Low elevations, especially in the southern part, are often built of aplite veins within the host granite, which by virtue of their very fine texture and tight fabric are more resistant to subsurface weathering than the granite itself. It is likely that differences in jointing density produce similar geomorphic effect, but unfortunately the absence of any outcrops within the shallow troughs within the upland does not allow for testing such a hypothesis, although the absence of boulders there is significant.

The role of jointing appears clearly, however, if one moves to the lower hierarchical level, that of individual tors and boulder fields. Tors and boulders apparently occur in less jointed areas, where the size of individual compartments delimited by major joints is at least 1 m across. The shape of tors is influenced by the density and direction of joints. Predominance of dipping rather than vertical joints effects in the absence of angular castellated tors, whereas irregular shapes and height asymmetry are the rule. Finally, the density of fractures influences shapes of individual boulders and explains why rounded and angular granite blocks co-exist, whilst distribution of tensile stress within exposed rounded boulders affects patterns of their breakdown and splitting.

5. Conclusions

The granite landscape of the Krumlovský les Forest, despite its apparent monotony, provides numerous examples of structural control upon both individual landforms and patterns of geomorphic evolution. In this paper we have demonstrated that major features of upland relief,

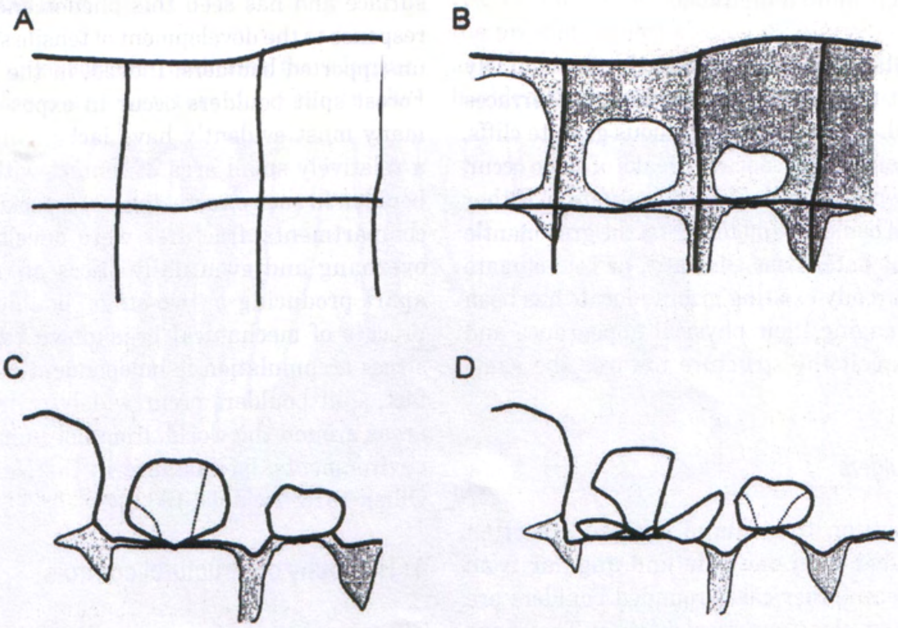

Fig. 6: A cartoon to illustrate the origin of split boulders throught the development of tensile fractures

A - unweathered, jointed rock mass;, B - differential weathering, especially along joints, corestones form in the subsurface; C - exposure of corestones and development of fractures in response to tensile stress; D - Fracture opening and boulder splitting.

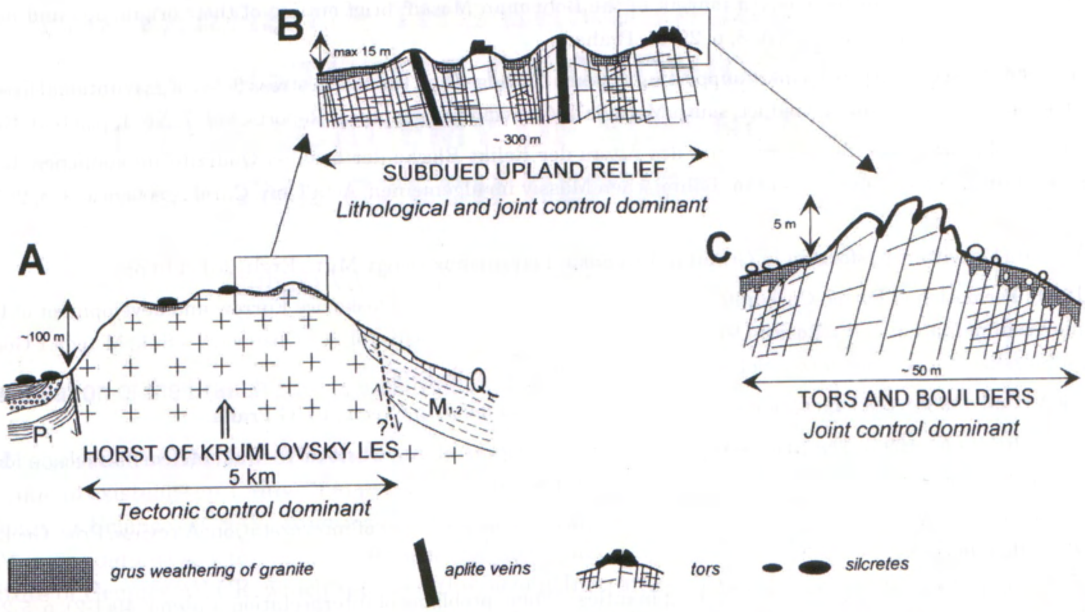

Fig. 7: Diagrammatic illustration of hierarchical control imposed on granite landscape of the Krumlovský les area
P1 – Early Permian of the Boskovice Furrow, M 1-2 - Miocene deposits of the Carpathian Foredeep, Q – Quaternary, mainly loess

including its subdued nature, scarcity of tors and small dimensions of individual boulders are compatible with the lithological properties of the underlying granite, its fracture patterns and long history of deformation. Gross relief and elevated position of the Krumlovský les Forest is the consequence of differential tectonics along the SE margin of the Bohemian Massif in the Cainozoic.

In the previous research of granite areas in the Bohemian Massif the main focus has been on identification of climate-controlled relief generations within the present-day landscape (Demek, 1960, 1976; Czudek et al., 1964; Votýpka, 1964; Věžník 1982), whereas possible structural controls have remained poorly known. Although in this paper we do not intend to dispute the scenarios of long-term landscape development proposed for those areas, we see the need to re-assess these in the light of geological data about the host granite itself. The case of the Krumlovský les Forest shows that geological factors may have played a much more important role in its geomorphic evolution than the rather vaguely defined environmental changes.

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10 YEARS OF THE BRNO BRANCH OF INSTITUTE OF GEONICS AT THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

Antonín VAISHAR, Oldřich MIKULÍK

1. Foundation of the Branch and its localization

The Brno Branch of Institute of Geonics at the Academy of Sciences of the Czech Republic (AV ČR) came to existence on 1 May 1993 in the course of transformation of the then Czechoslovak Academy of Sciences (ČSAV) from a part of the staff at the former Institute of Geography ČSAV. It was defined as a territorially detached department of environmental geography at the Institute of Geonics AV ČR, which replaced the former Institute of Mining ČSAV in Ostrava (Šňupárek, Konečný, 2002).

The Institute is a state allowance organization, partially funded by direct allowance from the state budget, partially from other sources of which most significant are funds from various grant agencies meant for concrete projects and receipts for technical expertises and studies carried out on the basis of commercial contracts.

The Branch headquarters can be found in a pleasant town quarter of Černá Pole, Drobného Street (Fig. 1). Another workplaces are situated in Brno-Jundrov, Veslařská Street.

Fig. 1: The building of the Branch. Photo A. Vaishar

2. Research projects

The Branch is a basic research workplace and there are several types of research projects running there. Some of them are worked on within the framework of the key scholarly research programmes at the Academy of Sciences of the Czech Republic, whose mission is to ensure the long-term concept of the Branch. Another type of projects are grant projects from various grant agencies, particularly from the Grant Agency AV ČR and Grant Agency of the Czech

Republic. International grant projects play a special role, especially those based on framework programmes of the European Union. The last important type of tasks are projects worked out to order for various governmental and private institutions and corporations.

1.1 Key directions

Project on **Regional evaluation of environment in the conditions of Czech Republic under transformation** was a general follow-up of the concept of the former centre for regional research of environment at the Institute of Geography ČSAV, which assessed development of urban and rural regions in southern and northern Moravia and their environment. Emphasis was put on the study of the town of Brno in new conditions, on the issue of restructuring consequences for the Ostrava conurbation, on the development in borderland regions of southern and eastern Moravia, on the issue of large-scale protected areas. The probably most extensive work the first period of programme existence was an unimplemented grant project proposal for the Atlas of the Czech Republic worked out for the Grant Agency of the Czech Republic in cooperation with a range of universities. The key direction project contained a number of sub-projects:

- *Development of environment in regions of different types;*
- *Geosystems in Czech Republic from the environmental point of view;*
- *Environmental studies in urban agglomerations and settlement systems;*
- *Regional differentiation of life quality;*
- *Remote sensing methods for environment;*
- *Regional information system and environmental cartography;*
- *Regional fundaments of ecological development (project of international cooperation).*

The existing scientific programme of the Branch dwells on the research project registered under the name **Structure and development of regions from environmental point of view**. The subject of study in this project are regional analyses and analyses of geographical problems in regions of different sizes – mainly in Moravia – in conditions of the transformation of economic and social mechanisms and its consequences and at the beginning of the existence of large units of regional administration and their functioning. Attention is paid to urbanized regions including large agglomerations such as those of Brno and Ostrava, rural (particularly marginal) regions, regions of large-scale nature protection, areas with the occurrence of natural disasters and areas with either existing or planned engineering works so that it is possible to assess the developmental dynamics within the whole system of settlement also in some specific natural geosystems, especially with respect to the relation of economic and social prosperity and possibilities of sustainable development. The research project splits into the following parts:

- *Environmental and social development of the Brno region;*
- *Landscape changes in the Ostrava region;*
- *Geography of small Moravian towns and their rural hinterland;*
- *Regional impact of natural and environmental risks;*
- *Natural environment of large-scale protected areas.*

2.2 Grant projects

The period of the very beginning included finishing of the grant projects transferred from the former Institute of Geography ČSAV, which were allocated to the Grant Agency of the Czech Republic, Grant Agency AV ČR and Czech Ministry of Environment:

- *Anthropogenic impact on course and character of karst water;*
- *Anthropogenic transformation of relief and possibilities of its assessment;*
- *Prognoses of groundwater in relation to geographical conditions;*
- *Evaluation of elements of the karst environment and its positive influence on infant organism;*
- *Possibilities of detecting climatic changes in the historical period;*

- *Complex geomorphological analysis of the Podyjí National Park;*
- *Danger to some towns, villages and important technical works in the Czech Republic caused by natural hazards;*
- *Development of slopes in periglacial period.*

Grant projects launched and finished during the Branch existence are as follows:

- ***Transformation of the border landscape in South Moravia*** (A. Ivan). The manuscript study included physico-geographical, socio-geographical and historico-geographical analyses of the model region of South Moravia, an analysis of some selected problems of natural environment, an analysis of the relation between the large-scale landscape protection and the landscape prosperity, an analysis of some social and economic issues (agriculture, recreation, borderline location, functional structure of district towns, entrepreneurial potential of the population).
- ***Climate fluctuation in Czech Republic: Monitoring of historical environmental changes*** (J. Munzar). Attention was focused primarily on the searching and analysis of the original sources and documents for a reconstruction of weather and climate in the territory of the Czech Republic in the period of 16th and 17th centuries, during which the beginning of a so called Short Glacial Epoch was said to have shown up in a greater part of Europe. One of major disclosures was the exploitation of the hitherto unused hand-written diaries with meteorological data. Results are valuable also for countries neighbouring with the Czech Republic. With regard to the topical character of the issue, it was also the historical floods that appeared in the limelight.
- ***The stability relations of supporting system of bridges and tunnels in stress fields of gravitational loosening zones (on the example of the Ivančice viaduct, South Moravia)*** (M. Hrádek). The research which was carried out together with experts from the High School of Mining-Technical University in Ostrava and from other institutions resulted in the following geomorphological conclusion: numerous tectonic and gravitational formations argely of tensile expansion- developed in the stress fields of the zones of gravitational loosening, which at some places even included a vertical (shear) component. The resulting process which led to the existing morphology of the valley can be called gravitational spreading meant to fill the valley. The vertical component of faults may be facilitated by the basal attitude of the rock massif at the level of valley floors that are heavily disturbed into debris which may contribute to the step-like sinking of blocks. A case study was elaborated in the Bobrava River valley, too.
- ***Geomorphological development of the relief in the Podyjí National Park and adjacent part of the SE margin*** (K. Kirchner). The research was focused on mapping the basic characteristics of the relief in the foreland on the marginal scarp of the Bohemian Massif in the Jaroslavická Upland on a scale 1:50,000. Studied were links between the geological structure and formations and the issue of tectonics. Lessons were learnt about tertiary sediments in the northern back-land of the National Park, about the distribution of fluvial sediments remaining in the deep river valley of Dyje, and about the nature of tectonic disturbance on the underlying rock. The localities of Ledová sluj, Králův stolec and Býčí skála were investigated by using the method of georadar. A geomorphological inventory of some relief formations in the Podyjí National Park was made within the environmental programme of the Czech Ministry of Environment in parallel to this grant project.
- ***Floods, landscape and people in the Morava River basin*** (A. Vaishar). This project of the Grant Agency AV ČR was worked on in 1999 – 2002 in response to the disastrous events occurring in the summer 1997. The project solution called for six case studies from Moravian regions with different characteristics of natural conditions, land use and course of flood waves. Floods are understood as an interaction of natural event, technological failure and response of human society. These were reasons to use the methodology of applied regional geography. A primary result of the project is mapping of the relation between the floods, nature and humans in the Morava R. basin including the very first outline of the comparison with the flood events occurring in Bohemia in 2002. The project made use of the historical documents about floods. Attention was among other also paid to land slides induced by the floods. The works resulted in a standpoint to various forms of flood damage prevention.

2.3 International projects

Projects of international character have been playing an important role in the research structure of the Branch since the very beginning of its existence. A brief description is presented below:

The cultural and economic conditions of decision-making for sustainable city (A.Vaishar). Research within the framework of CEC programme was coordinated by the Polytechnic University in Turin and carried out in cooperation with the Geographical Institute of the Hungarian Academy of Sciences in Budapest and with the Geographical Institute in Ljubljana. The project dealt with an analysis of traffic and transport issues, retail trade and public greenery in some cities (Brno, Budapest, Ljubljana, Bologna, Florence, Leicaster and Edinburgh).

Identification and assessment of old dumps in the space of Brno SouthWest by means of interpreting aerial and satellite photographs (P. Hlavinková). 235 sites were identified in the SE quadrant of Brno in cooperation with the Karl-Franzens University in Graz (within the framework of the Czecho-Austrian programme KONTAKT/AKTION), of which 90 exhibited signs of possible contamination that was later confirmed in the majority of them by detailed investigations. The sites were grouped into five classes of danger on the basis of the methodology of ETI models. The most problematic Class 1 and Class 2 include 54 sites. The project resulted in a digital cadaster of sites with old waste loads, used by municipal authorities of the City of Brno.

New prosperity for rural regions (A. Vaishar). The Research Support Scheme OSI/HESP project dealt with the problems of marginal (mainly borderland) regions in Moravia and Slovenia. The course of transformation and its consequences were studied in seven areas together with all related borderland issues and environmental aspects. The research employed methods of behavioral geography. Problems identified and documented were as follows: deepening marginality, worsening labour market situation, structural demographic degradation, absence of suitable developmental programmes, etc. Decisive for the solution of this situation is considered to be utilization of human resources. A necessary pre-requisite is realistic regional policy.

Danube pollution reduction programme (A. Vaishar). This is a project which was funded from the United Nations Development Programme. Being focused on the reduction of Danube catchment pollution it aimed at a better quality of water in the Black Sea and was cooperated on by experts from eleven countries. Within a wider team of Czech specialists, the Branch was responsible for working out characteristics of the Morava River basin and an analysis of socio-economic context of the whole issue.

Cooperative networks among medium sized cities in Central and South-Eastern Europe (O. Mikulík). In this project which was coordinated by the Institute for Regional Geography in Leipzig and financed within the framework of the INTERREG-II-C programme, the Branch worked on the issue of collaboration of five pairs of towns in the space between Ostrava and Katowice. Results were presented at the conference in Leipzig. There was among other concluded that at searching the forms of partnership in conditions of Central Europe it is not only the present conditions that have to be taken into account but also the development of relations in the whole 20th century.

2.4 Projects for social practice

Projects for social practice are based on contracts and ordered by various governmental and private institutions and corporations to meet their needs. The most significant works are listed below:

- *Geomorphology of the Morava River floodplain section from Hanušovice up to the confluence with the Bečva River;*

- *Study and assessment of river pattern development in the National Nature Reserve of Ramena řeky Moravy (Morava River Branches);*
- *A series of regional studies in the Protected Landscape Area of Žďárské vrchy (Hills) for the Ministry of Economy of the Czech Republic;*
- *Physico-geographical characteristics of water reservoir areas in Letovice, Boskovice and Těrlicko for HYDROEKO Agency;*
- *Some physico-geographical aspects for the revitalization of Dyje River floodplain for the same agency;*
- *A study into impacts of stone extraction and processing in the Leskoun quarry on the landscape and environment for District Council of Znojmo;*
- *A bio-geographical assessment of plans to modify the Leska watercourse for National Amelioration Office;*
- *A set of assessments in the region of Skalka u Pernštejna for ČEZ, a.s.;*
- *EIA groundworks for the concept of decontamination of sludge beds near Rožná for DIAMO o.z. GEAM Dolní Rožínka;*
- *Historical development of anastomosing river system as the main protection phenomenon in the Protected Landscape Area of Litovelské Pomoraví for the Czech Ministry of Environment;*

and other projects.

3. Moravian Geographical Reports and other editorial activities

Since the beginning of its existence in 1993 the Brno Branch issues twice a year a periodical named "Moravian Geographical Reports" in order to ensure continuation of the exchange of scientific literature with institutions abroad and to encourage experts from the Branch and from cooperating institutes to publicize their works in a high-quality periodical. The first 10 volumes had altogether 18 numbers with a total of more than 1,150 pages. The periodical has become a part of the Branch identity and the level of its publication language, editorial board composition and to a considerable extent also that of the structure of authors have gradually achieved parameters of international periodical.

The Branch has also issued a number of single publications of non-periodical character, monographs and proceedings with a total extent over 2,200 pages:

Studia Carsologica 6 (in English), Brno 1995, 150 pp.
Geography and Urban Environment, Brno 1995, 132 pp.
Natural Hazards in the Czech Republic, Brno 1995, 162 pp.
Rural Geography and Environment, Brno 1997, 167 pp.
Similarities and Differences in the Development of Towns in Czech and Slovak Republics after 1990 (in Czech/Slovak), Brno 1998, 95 pp.
Identification and Assessment of Old Waste Dumps in the Space of Brno-East (in Czech/English), Brno 1999, 132 pp.
Specific Features of Transformation Process in the Hinterland of Large Cities (in Czech/Slovak), Brno 1999, 80 pp.
The City of Brno in a Broader Context (in Czech), Brno 1999, 100 pp.
Regional Prosperity and Sustainability, Brno 1999, 209 pp.
Floods, Landscape and People in the Morava River Basin I (in Czech), Brno 1999, 81 pp.
Topical Aspects of Territorial Structure in the Czech and Slovak Republics (in Czech/Slovak), Brno 2000, 131 pp.
Vranov nad Dyjí/Jemnice : Region under transformation (in Czech), Brno 2000, 144 pp.
Floods, Landscape and People in the Morava River Basin II (in Czech), Brno 2000, 131 pp.
Nature and Society in Regional Context, Brno 2001, 174 pp.
Floods, Landscape and People in the Morava River Basin III (in Czech), Brno 2001, 108 pp.
Landscape, People and Floods in the Morava River Basin (in Czech), Brno 2002, 131 pp.
Czech and Slovak Regions on the Beginning of the 3rd Millenium (in Czech/Slovak),Brno 2003, 122 pp.

Total extent of studies issued so far on compact discs is about 550 pages:
Study and modelling of anthropogenic impact on the river pattern in the National Nature Reserve of Vrapač (in Czech);
Reports on anthropogenic impacts on the relief in the territory of the Podyjí National Park (in Czech);
Geography of Small Moravian Towns I (in Czech).

4. The CONGEO Conferences and other international cooperations

Most important events organized by the Branch are the CONGEO international conferences of geographers held in odd years. CONGEO Conferences organized up to now are as follows: CONGEO '95 "Geography and Urban Development" held in Brno; CONGEO '97 "Rural Geography and Environment" held in Valtice; CONGEO '99 "Regional Prosperity and Sustainability" held in Slavkov u Brna, and CONGEO '01 "Nature and Society in Regional Context" held in Tišnov. These conferences already represent a tradition of international events held regularly in a small Moravian town for several tens of geographers specialized in regional disciplines, who created a small international group of regular participants, which became a base also for other cooperations and international projects.

A similar tradition is that of the bilateral Czecho-Slovak Academic Seminars in Economic Geography organized jointly with the Institute of Geography at the Slovak Academy of Sciences by turns in Brno and Bratislava. There were seven such seminars held up to now.

Apart from the Institute of Geography, Slovak Academy of Sciences, other traditional partners cooperating with the Branch are Institute of Regional Geography, Leipzig, Institute of Geography and Spatial Organization of Stanislav Leszczycki of the Polish Academy of Sciences in Warsaw, Centre for Regional Research of the Hungarian Academy of Sciences in Pécs, and a number of other partners for single cooperations in concrete projects.

5. Paedagogical activities

Handing over the results of the scientific research to students is a logical component of the workplace's profile. Experts employed at the Branch give lectures or run other kind of educational activities at the departments of the Masaryk University in Brno, Mendel University of Agriculture and Forestry in Brno, Technical University in Brno and at the Ostrava University.

6. Working conditions and staff

Conditions of the workplace dislocation can be considered very favourable in terms of both the localization and working environment quality. The Branch is sufficiently equipped with the current computing, communication and transportation technique required to fulfil its tasks. The Branch library contains about 30 thousand items and is currently added new contributions both from the exchange of literature and by the purchasing new books published at home and abroad.

The existing staff of the Branch is as follows :

Bohumil FRANTÁL – Librarian
Sylvie HOFÍRKOVÁ – Physical geography
Mojmír HRÁDEK – Geomorphology
Eva KALLABOVÁ – Social geography
Karel KIRCHNER – Geomorphology
Alžběta KLÍMOVÁ – Sociology
Petr KLUSÁČEK – Regional geography
Barbora KOLIBOVÁ – Sociology
Jan LACINA – Biogeography
Stanislav MARTINÁT – Geography of agriculture
Oldřich MIKULÍK – Social geography

Jan MUNZAR – Climatology
Josef NAVRÁTIL – Geography of travelling and tourism
Marek NEKULA – Geography of lifeless nature
Stanislav ONDRÁČEK – Hydrology
František POKLUDA – Social geography
Evžen QUITT – Climatology
Zuzana ŠAFÁŘOVÁ – Geography of lifeless nature
Anna RAFAJOVÁ – Landscape, Biogeography
Antonín VAISHAR – Social geography
Jana ZAPLETALOVÁ – Social geography

7. Main tasks of the Branch at the doorstep of the 2nd decade of its existence

Entering the year 2003, the Branch has entered the second decade of its existence. Projects in which the Branch is the main research workplace or participates at some issues are as follows:

Landscape changes in the Ostrava region (key direction of basic research; O. Mikulík);

Landscape and environment in the Orlice river upper reach watershed (key direction of basic research; A. Vaishar);

Influence of underground mining damp-down on processes in lithosphere and environment (targeted basic research programme; O. Mikulík);

Geography of small towns (Grant Agency of the Academy of Sciences of the Czech Republic; A. Vaishar);

Euroregions and their relationships to the territorial self-government (Grant Agency of the Academy of Sciences of the Czech Republic; J. Zapletalová);

Geography of some natural extremes, their impacts and cartographical visualization in Moravia and Silesia (Grant Agency of the Czech Republic; K. Kirchner);

Mobilizing reurbanisation on condition of demographic change (EU Framework Programme 5; A. Vaishar);

Slope deformations in Czech republic – the regions of Vsetín and Zlín – Stage 4 (ordered by Česká geologická služba; K. Kirchner).

Intensive preparations are in progress for the conference CONGEO '03 on "Regional Geography and Its Applications" to be held in Frenštát pod Radhoštěm in September 2003, and for the 8th Czecho-Slovak Academic Seminar in Economic Geography on the "Topical Issues of Socio-Geographical Organization of Czechia and Slovakia before the accession to the European Union" to be held in Brno in November 2003. Editorial activities of the Branch in 2003 will result in two numbers of Moravian Geographical Reports and three proceedings.

From the viewpoint of long-term planning, decisive for the future of the Branch is most likely to be the capability of its integration into European scientific structures. This will among other also mean some integration efforts in the home country where the Branch will struggle for the foundation of some form of common workplace with universities and primarily an increased international effort aimed at integration into EU Framework Programme 6 – among other also by means of international conferences and bilateral cooperations.

The Branch will further continue to institutionalize the narrow team cooperation between the physical and human geographers by means of which it is building its own profile among the Czech geographical workplaces. From the viewpoint of its involvement in projects of different character, the even distribution of labour force and funding can be considered optimum, which also applies for other activities of the Branch – publishing, editorial, international, educational, popularization, scientific and organizational.

References

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THE 7TH SLOVAK-CZECH ACADEMIC SEMINAR IN GEOGRAPHY

Oldřich MIKULÍK, Vladimír IRA

The 7th Slovako-Czech Academic Seminar in Geography took place at the Institute of Geography, Slovak Academy of Sciences in Bratislava on 17 October 2002 its theme being focused on the "Time-Space Aspects of Transformation Processes in the Czech and Slovak Republics". Excursion to the area of Chvojnice, Vrboviec, Myjava and Brezová pod Bradlom was organized for the seminar participants on 18 October.

There were 14 papers presented at the Seminar, of which 5 were contributions of the Institute of Geonics AS CR and 9 were contributions of the hosting Institute of Geography SAS Bratislava. The morning session was presided by dr. V. Ira and its traditional organization gave enough space for the presentations of guests from the Brno workplace.

The opening paper "***Comparing the image of small Moravian towns***" was presented by ***E. Kallabová*** and ***F. Pokluda*** and discussed the specific issue of one segment of the settlement system, viz. problems of small towns. The term "image" is in general one of very frequently used words of today and it also appears incrementally in urban geography in various contexts. Town image is a phenomenon that can affect opinions, behaviour and decision-making of visitors, customers and developers. The presented research was focused on the assurance of internal (from the viewpoint of inhabitants) image of three small Moravian towns. Dominant identification signs of these towns were assessed on the basis of analysis of various input attributes, evaluated were also genius loci, affinity of inhabitants to environment in which they live and their opinions concerning the future development of towns.

In his paper on "***Transformation in the Czech Republic and its impacts into the microregion of Budišov area (Třebíč District)***" ***Petr Klusáček*** described this microregion of 65.4 km^2 with 8 cadastral areas, its changes and developmental trends associated with the transformation processes after 1989. He ended his presentation by summarizing negative and positive effects of transformation in the studied area.

The second couple of authors from Brno – ***B. Kolibová*** and ***O. Mikulík*** – presented a paper on a "***Sociological inquiry of workers in the coal mines of ČSM and Paskov-Staříč***". The summary of results is a part of long-term research projects focused on the assessment of regional environment changes in the Ostrava region. Shift in the perception of changes in the style of living after 1990 was studied among workers of two chosen coal mines in Paskov-Staříč (OKD a.s.) and ČSM (Českomoravské doly a.s.). The summary of lessons learnt about the changes in the style of living, perception of environment quality, value preferences etc. presented by dr. Kolibová was added characteristics of the two industrial localities, their introduction into the Ostrava region landscape and evaluation of their impact on environment quality, presented by dr. Mikulík.

The fourth presented paper was that by ***Stanislav Martinát*** on the "***Geographical aspects of agriculture transformation in the Frýdek-Místek District***" in which the author informed Seminar participants with areas with agricultural production in the district, with areas less favourable for agricultural production and price of agricultural land. Core of this paper was analysis of the structure of enterprising farmers in the period of transformation and prospects of agriculture with respect to its future incorporation into European structures.

The morning block of Czech contributions was closed by ***Pavel Šotnar*** and his paper on "***New industrial zones (Greenfields) in the Ostrava region***" in which the author tackled the issue of the establishment of industrial zones in this region. He presented an assessment of the standard of their development achieved within five years of their promotion. According to him, the lessons learnt can be used for more detailed studies on the impact of industrial zones onto social and economic environment in the region and for an improved attractiveness of investments in Czech regions affected by structural drawbacks.

The afternoon part of the Seminar was opened by dr. O. Mikulík who introduced a block of Slovak participants. The first of them to present his paper on the theme "***Perception of self-government activities and some aspects of life quality***" (on example of a public inquiry among the population of Považská Bystrica) was ***Ivan Andráško***. His contribution was to provide information on the life standard of inhabitants in a selected town as related to the activity of local self-government. Self-government was restored in Slovakia after forty years in 1990 and within 13 years it has become a stable component of the political and economic system. The author summarized results of his research based on questionnaires filled by inhabitants of the town of Považská Bystrica. Questions were constructed to capture satisfaction of the population with activities run by local authorities, knowledge of inhabitants about the local self-government authority and their participation in its activities. The fourth group of issues was concerning the subjective perception of life quality in individual town quarters.

"***Development of territorial disparities in the light of selected indicators***" (on example of Slovak regions) was the theme of the next paper presented by ***Mikuláš Huba***. The issue of territorial dissimilarities (disparities) which introduce elements of disharmony, unbalance and instability into the development of countries and their regions is ever more discussed in connexion with the concept of sustainable development and its implementation, but also in connexion with the decentralization of public administration and preparation for admission to the european Union although these disparities may in some cases play even a positive role – for instance with respect to natural and cultural diversity. In the case of selected indicators and territorial disparities calculated on their bases for individual years of the studied period, the author followed out from a presumtion that the disparities and their increase have a negative influence on development towards sustainable society. Analysis of disparities between the individual regions of Slovak Republic and their development corroborated that they represent a serious obstacle on the development of Slovakia towards the sustainable future. A twice as much alarming fact is considered by author the index of disparity showing an increasing tendency during the period under study according to a majority of indicators or at least the fact that at the end of the study it was higher than at the beginning. The relatively most favourable development of the index was recorded in the case of environmental indicators.

Vladimír Ira analyzed in his paper on "***Changes in the spatial distribution of Czech nationals living in the Slovak Republic in the period 1991 - 2001***" as a consequence of a multitude of political, economic and social factors, after World War II in particular. The core of assessment was focused into the period between the last census made in the common state of Czechs and Slovaks and the first census after the split of the Czecho-slovak Federal Republic. According to the census of 1991, there were 59,326 Czech nationals with domicile in Slovakia (1.12% of total population in the Slovak Republic). Of them, 89.1% (52,884), 10.2% and 0.7% (405) declared Czech, Moravian and Silesian nationalities. At the last census, there were 46,968 Czech nationals with domicile in Slovakia (0.87% of total population in the Slovak Republic) of whom 95% (44,620) and 5% (2,348) declared Czech and Moravian nationalities. The number is expected to be further decreasing with respect to unfavourable age structure and continuing migration trend between the Slovak and Czech Republics.

Daniel Kollár presented a paper on the "***Perception and evaluation of transboundary cooperation in the Slovako-Austrian borderland***". The field research was made in four borderland villages (Zohor, Záhorská Ves, Gajary and Suchhrad) in the Záhoří region, and in four borderland villages of Lower Austria (Marchegg, Angern, Dürnkrut and Hohenau). The selection set included 509 respondents (250 and 259 on the Slovak and Austrian side of the border, resp.). Empirical data were gained through questionnaires. 5 dependences were detected to exist in the borderland population on the basis of hypotheses specified methodologically: Dependence between the classification of transboundary cooperation and nationality – age of respondents – frequency of travelling to the neighbouring country

– existence of social contacts in the neighbouring country and command of language spoken in the neighbouring country.

Anton Michálek informed Seminar participants about the issue of "***Development and current condition of regional structures and regional disparities in Slovakia***". Slovakia is a country of great and ever growing regional differences. In order to study the regional disparities among Slovak regions availableeconomic and social statistic data of the regions were used, which were published by the Slovak Statistic Office. Method used was that of the comparison and quantification of relative values from 10 best and worst districts from the aspect of selected indicators. It was found out that the most developed districts are those situated in the western part of the country, and the most backward districts are those in the eastern or southern parts of Slovakia. Gained results have a cognitive and application significance for searching solutions, programmes and strategies focused on behindhand regions with low-standard economy.

"***A contribution to the demarcation of peripheral regions in Slovakia as based on the criterion of accessibility***" was presented by ***Daniel Michniak*** who specified three different levels of peripheral regions: as based on the accessibility of the Capital of Bratislava, accessibility of provincial towns, and accessibility of district towns. The group of peripheral regions with poor accessibility of Bratislava included municipalities above 400 km from the capital. The second group of municipalities peripheral to provincial towns included municipalities situated at a distance greater than 80 km from the provincial towns. The third group of municipalities peripheral to district towns included municipalities distant at least 20 km from the district towns. The demarcation of peripheral regions based on the accessibility of district and provincial towns is a good illustration to bring attention to shortcomings of territorial administrative division, particularly with respect to spatial equity.

František Podhorský informed about "***New political parties in the Slovak Parliament after 2002 elections***" since it was also some new political parties that got into the Parliament after these elections such as Smer, ANO and Communist Party of Slovakia. The first two are brand new political parties on the Slovak political scene; the Communist party returned to the National Council after 12 years and their success in elections was a surprise. In his paper, the author informed the Seminar participants about the geographical representation of voters for the new parties. SMER recorded a success in districts of middle and upper reaches of Váh, Nitra and Hron Rivers, and in north-eastern and eastern Slovakia – winning a total of 13.46 % votes and taking the third place. ANO won its votes mainly in the eastern part of the country (most votes originating from the middle Pohroní, piedmont of the Tatras and from the Košice basin) – totalling 8.01 % votes. Communist party gained 6.32 % of votes with its friends originating from the whole country and with the greatest support in the north-eastern part of Slovakia.

"***Specific regional features of Slovak population structure***" were discussed by ***Peter Podolák*** who assessed some basic attributes of the population ageing process and projected them onto the national and regional levels. A decisive role in the process of ageing play the fluctuating values of birth rate and fertility. Practically all used indicators point to the acceleration of population ageing processes in Slovakia which can be characterized as a country with the regressive type of population and insufficient measure of reproduction. From the viewpoint of regional differentiation of the ageing process, obvious variances exist between southern districts on the one hand and northern and partly also eastern regions of Slovakia on the other. Regions with a high share of older population are extending particularly in western and central Slovakia with the most pronounced increase in the share of post-productive population age being recorded in marginal districts of the north-eastern part of the country – Medzilaborce, Snina, and in the norther part of western Slovakia. On the basis of demographic analyses it is possible to predict in the future a further acceleration of the process of population ageing with serious demographic, socio-economic and psychological consequences.

The afternoon block of papers was closed by ***Vladimír Székely*** and his paper presentation concerning the "***Supplier links of firms in the region of middle Pohroní***". The contribution

Fig. 1: Photo from the working session. Photo O. Mikulík

attempted at an identification of the extent of local, regional or global supplier links of companies localized in the territory of the middle Pohroní. The author assumes that the existence of these links contributes to the formation of zones and markedly supports improved economic effectiveness of cooperating entities, which has a benefitial influence on the development of localities and regions. The primary collection of data about the supplier links was implemented through a questionnaire inquiry attended by 29 companies.

The last item of the whole-day programme was a discussion to the presented papers, forms of possible future cooperations and new ideas for the formation of prepared projects.

MOBILIZING REURBANIZATION ON CONDITION OF DEMOGRAPHIC CHANGE

Antonín VAISHAR

Large European cities fight the problem of their subcentral zones, those parts of towns, which came into existence in the period of industrialization and extensive urbanization within the space between the historical core and suburbs. Subcentral zones are one of the most valuable parts of the large cities. Typical is their very mixed character. We can find here both valuable and less valuable housing resources, quarternary services such as those of educational or medical character, tertiary establishments, valuable urban parks, important traffic infrastructure, fragments of industrial and other manufacturing premises. With respect to the presence of dwelling, services and job opportunities, the subcentral zones live all day and night. This is a difference as compared to the city downtown which gets unpeopled at night or the city suburbs which depopulate during the day. The subcentral zones are indispensable for the integrity and functioning of the city as a unit.

Combined with unfavourable demographic situation the contemporary processes of urbanization represent a considerable jeopardy for the subcentral zones. Inhabitants of these zones are ageing, average size of their household shrinks, young people show tendency to move out to city limits. At the same time, there is an economic pressure to convert a part of the housing resources into offices which would make use of the advantage of the close city centre. The situation results in the decreasing number of flats and in the decreasing number of their inhabitants. Should the subcentral zones further continue to lose the function of dwelling, their mixed character as well as their role within the organism of the large city would be disturbed.

Fig. 1: Delapidating suburban zone in the Leipzig neighbourhood of Plagwitz. Photo: A. Vaishar

The city of Leipzig – with 70 thousand flats vacant due to the above processes – initiated a project named Mobilizing Reurbanization on Condition of Demographic Change within the 5th framework programme of the European Union. The project attempts at answering the question of how to induce and promote reurbanization of subcentral zones. It is not a gentrification project which would mean a complete reconstruction of selected degraded town parts and development of a new, socially segregated quality of housing and services for the rich. Reurbanization endeavours to make use of the existing potential of the area while retaining its mixed character and complexity and aims at preservation or restoration of the dwelling function without disturbing the mixed character of the area.

The project has been joined by 13 institutions from eight EU candidate and member countries. Case studies are to be elaborated for the towns of Bologna, Leipzig, León (Spain), and Ljubljana. Research issues will be worked on by teams from the Centre for Environment Research, Ltd. – Leipzig/Halle, which is to be responsible for sociological and demographic issues at the assessment of which it will collaborate with the Department of Geography of the Queen Mary & Westfield College London, from the Department of Landscape Architecture at the Technical University of Kraków to take its share in environmental issues, from the Academia Istropolitana Nova Svätý Jur (Slovakia) to answer for elaboration of the set of reurbanization instruments, from the Institute for Town Planning of the Slovenian Republic that will take share in working out the architectonic issue of subcentral zones together with the Faculty of Architecture, University of Ljubljana. The Faculty of Economics at the University of Ljubljana will be responsible for the analysis of economic and juridicial issues of reurbanization in cooperation with the School of Environment and Development of the Sheffield Hallam University.

The Brno Branch of the Institute of Geonics, Academy of Sciences of the Czech Republic will be responsible for working out the issue of environment in the subcentral zones. Regarding the character of the project, it will be based on the concept of the dwelling environment (Mikulík-Vaishar, 1996). One of outputs will be a document with the working name *Quality of dwelling environment in subcentral zones of large European cities up to half a million inhabitants*. The document will be based on the comparison and generalization of knowledge from the case studies for the above mentioned towns and it should contain a list and quantification of problems found and ways to their solution. Acquisition of comparable data from all participating cities is considered to be one of the most demanding coordination stages of the project.

In order to make the comparison with a more comprehensive and deeper knowledge of the issue, we decided to work out a similar case study for the city of Brno. The study will have two levels: the whole town level will describe general trends in the development of the environmental issue, conditions of environment and barriers existing for its improvement; the level of two selected dwelling districts will include a detailed analysis and a public inquiry focused among other on explanation of seat preferences of the population. The Brno case study is going to be another output from the Branch within the framework of the project and will be worked on in cooperation with the Brno Town Council and the local Chief Architect Department.

Seen from the point of geography, however, it is not only the list of problems that is important but also the localization of these problems, their territorial concentration and neighbour effects which can either improve or worsen the situation. This is why it was decided to work out a comparison environmental atlas of five towns, which would be focused on these aspects of the issue. The atlas will be worked out jointly with the Department of Geoinformatics at the Faculty of Natural Sciences, Palacký University in Olomouc. The concept is based on an assumption that the cartographic visualization of environmental problems is from the argumentation point of view more important than the text reports.

The project was launched at an opening assembly of participants in Leipzig on 1 November 2002 and will run for the period of three years. Its solution splits into three stages: Stage 1 will have as an output a theoretical model of research and case studies for participating towns. The stage will end at a joint workshop.

Stage 2 will have the theoretical research model carried out on the basis of comparing results from the case studies, and filled with concrete lessons learnt both in the respective disciplines (sociology, demography, architecture, town-planning, economics, law, environment) and within the interdisciplinary discussions aimed at a good balance of the whole issue. As it is assumed that it will be difficult to achieve an even elaboration of all problems, the researchers will focus their efforts on analyzing the critical points of reurbanization. It is expected that at this point it will be necessary to return to the case studies and to analyze specific problems in the respective towns in a greater detail. This stage will be at the same time a starting point for the specification of a set of instruments to stimulate reurbanization and to develop an information and monitoring system. The second stage will end by workshops in the respective towns, whose sense will be to include in the solution of problems both the institutions of social practice and other experts. This will also launch the solution of another group of problems – communication, consulting and application.

Fig. 2: Presidium at the opening assembly in Leipzig. Speaker is Karsten Gerkens – chief coordinator of the project, Sabine Elling-Papenhagen – chief manager on the very right end. Photo: A. Vaishar

Stage 3 of the project will be devoted to the further perfection of the set of tools and the information and monitoring system which is going to be tested one year. The second main item of Stage 3 is the application of project results, whose importance is particularly emphasized. Another goal is to put together a group of expert councils – both members and non-members of the project consortium – which would function even after the project end. This will be greatly helped by an intensive workshop aimed at the acquisition of stimuli especially from experts outside the project teams of researchers.

The project and its results are expected to be widely promoted and publicized. There is a project website http://www.re-urban.com available as early as today, on which all those interested can follow the project proceeding. Arrangements are made for extensive use of all kinds of publicity for the project which is going to be closed at an international conference named Reurbanization and its chances in the new millennium.

References

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THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT IN THE NEW CENTRAL EUROPE: AUSTRIA AND ITS NEIGHBORS

Bryn GREER-WOOTTEN, Antonín VAISHAR

A recent international conference with the same title as above, was hosted by The Center for Austrian Studies (which acounts for the sub-title) at the University of Minnesota, Twin Cities campus in Minneapolis, from September 19 – 21, 2002. As stated by the conference organizers, it was the time (i.e., 13 years since 1989)…" for a broad academic discussion across national, institutional, and disciplinary boundaries of the major environmental and development issues faced by the countries of Central and Eastern Europe". This report presents a brief summary and general evaluation of the conference.

In terms of representation, the conference organizers cast their net quite widely, with some 42 authors currently resident in eight countries. Naturally, there were strong contingents from the 'hosts' (USA: 13, and Austria: 11), but a group of four pre-accession countries sent 17 (about 40% of the total) scholars, with especially strong representation from the Czech Republic (6) and Slovakia (6). Given the conference aims, it was expected that almost 70% of the authors were from universities, with a further 25% from research institutes. Surprisingly, perhaps, there were only two persons from Non-Governmental Organisations, and one lone government researcher. From a disciplinary perspective, economics and management science had the strongest presence (16), but there was a good spread across other social sciences (policy sciences and law: 10; geography: 7; sociology: 5) and the applied environmental sciences (4).

There was also a broad scope of issues discussed in the three days, as 29 papers were presented in a series of eight panels: (1) The Environment and Sustainable Development in Central Europe: General Considerations; (2) Business Management for Sustainable Development; (3) Implementation of Policies for Sustainable Development; (4) Central European Environmental Policies and European Union Enlargement; (5) The Economics of Sustainable Development; (6) Water Policies: Current and Future; (7) The Future of Agricultural Development; and (8) Environmental Challenges for Rural Communities. The individual papers grouped under these eight broad categories are still, at the time of writing (January, 2003), available on the conference web-site: <http://www.cas.umn.edu/2002%20Conference%20Update-May.htm>.

Whilst it is not our purpose here to evaluate this conference in a critical sense, some general findings may be of interest for readers of this journal, in terms of searching the web-site papers. A first observation concerns the overall objectives of the conference, as the potential balance between environmental and economic concerns was weighted towards the latter. In part this could be seen as a function of the disciplinary origins of the participants, but it is also a reflection of the dominant discourse found in discussions of sustainable development, in which 'development' is emphasized in comparison to the ideas of sustainability, with its equal concerns for socio-political context and processes.

It could also be related to the sponsorship of the conference, which included Austrian government bodies and the state Trade Office. In fact, the conference sessions were preceded by a half-day Business Seminar on strategies for entering the Central European market, albeit for 'environmental firms'.

Beyond organizational concerns, however, it must be noted that some of the academic presentations by economists demonstrated similar orientations. This appeared to be evident as well for those papers dealing with policy aspects of these issues, as the question of accession to the European Union has changed the nature of the discourse. It can be argued, for example, that it has brought a new dimension to discussions of environmental policy, especially with reference to the demands of the EU Chapter 22 framework, which emphasizes the so-called liberalization of such policies (increased use of market mechanisms, ecological tax reforms, etc.). Clearly, the socio-political context in which such discussions are located is a far cry from the dominant central planning mechanisms of the socialist era, which still inform the cultural context of environmental decision-making processes in most Central and Eastern European countries.

Such contextual frames are important for understanding the current debates on suatainable development in the 'New Central Europe', but some of the more empirical contributions may be more salient for readers of this journal. For example, there was an important set of four papers that dealt with water resource management problems, stressing their trans-boundary nature (i.e., the mis-match of ecological and jurisdictional boundaries). In addition, whereas most of the presentations in the first panels were more theoretical and analytical, the later panels contained papers with a stronger regional and local base. There was a tendency, as well, in later panels, for the methodologies employed to contain more case studies in terms of research design, including some important contributions based on participatory action research. For the latter, the socio-cultural determinants of local decision-making processes become paramount in understanding the move towards a sustainable society. Clearly, the contrast with the aggregate modelling evident for national-scale research is strong, yet at the same time it indicates that the "broad academic discussion" desired by the conference organizers was realised to a large extent.

At present, a sub-set of these papers is under review for a university press publication that is edited by the Centre for Austrian Studies Director, Gary Cohen, and Senior Research Associate Zbigniew Bochniarz. Readers of this journal should find much of interest in the forthcoming publication – after all, Moravia is one of Austria's closest neighbours, at least geographically!

REVIEW

Antonín IVAN

CHLUPÁČ, I. et al.: Geologická minulost České republiky (Geological history of the Czech Republic) Academia. Prague 2002, 436 pp., ISBN 80-200-0914-0

A group of distinguished Czech geologists lead by Prof. I. Chlupáč, DrSc. with Prof. RNDr. R. Brzobohatý, CSc., doc. RNDr. J. Kovanda, CSc. and RNDr. Z. Stráník, DrSc. published through Academia editors and with the financial support from the Academy of Sciences of the Czech Republic a modern, well-arranged account of geology of the Czech territory with many illustrations, based on the latest lessons learnt in the discipline.

With respect to the fact that the last accounts on the regional geology of the Czech Republic (CR) were issued nearly twenty years ago (Z. Mísař et al., 1983; M. Suk et al., 1984) and the scientific discipline showed a considerable progress in the meantime, the two books are partly out-of-date and obsolete (this particularly concerning the names of geological units and the regional geological division). Furthermore, geology as a discipline went through a "scientific revolution" in the 1960s and a new paradigm appeared – plate tectonics (including also earth mass recycling). In our country, it has brought among other a general acceptance of mobilism (including the theory of thrusts such as the Moldanubian overthrust), new terms such as microplates and terranes. A number of partial questions remain unresolved, though, which are subject to further research and discussions.

The work is based on the new, recently published regional geological division of the Czech Republic – discussed by expert audience and approved by scientific authorities – distinguishing two higher order units – the Bohemian Massif (I. Chlupáč – P. Štorch (eds.), 1992) and the West Carpathians (P. Čtyroký – Z. Stráník (eds.), 1995). The two superior units are briefly described in the introductory chapter named "Geological position and regional division of our territory - CR" (Fig. 4, p. 17; Fig. 6, p. 20). Fig. 4 exhibits a tiny although rather important oversight with the significant and unique outcrop of the Moldanubicum on the eastern edge of the Boskovická brázda Furrow (Miroslav horst) being erroneously marked as a part of the Silesicum (6c). Another problem is whether the Pannonian Basin can be considered a part of the West Carpathians. The introductory part ends with a brief "Outline of the geological development of our territory (CR).

Individual chapters (attention deserve also their unusual but very original and realistic headings) are arranged chronologically from the oldest periods to younger ones, starting with the Proterozoic and ending with the Quaternary. Each chapter starts with an information on the time period and more detailed division of the formation, a brief outline of the paleogeographical conditions, distribution and characteristics of bedrocks (in Czech territory), life forms with descriptions, drawings or photographs of guide or most common fossils.

Exceptional is the chapter on "Variscan (Hercynian) orogenic processes", including geological processes from the Upper Devonian to the Lower Permian – most important for the geological development of the Bohemian Massif. Here, the emphasis is put onto magmatism and thrust tectonics. In this connexion, it would perhaps be useful to mention the KTB continental bore in Germany, near the western Czech border (wider surroundings of the Cheb Basin) and its concrete results.

At the time of developing geology and its getting closer to other scientific disciplines such as physical geography (geomorphology in particular) into one comprehensive discipline of Earth sciences, it is worthwhile to point out the difference between the geomorphological classification of the Maleník block in north-eastern Moravia into the West Carpathians – while in the reviewed publication it is classified as a geological part of the Bohemian Massif (Silesicum).

Certain problems exist with the dating of Upper Cretaceous sediment deformations, which is put into connexion with the Laramian tectonics (Sub-Hercynian stage?), little known in our country. Problematic are particularly the manifestations of compression tectonics in eastern Bohemia (thrusts such as in the Kralice Graben), in the Lusatian and Kysperk Faults, Horní Poříčí Fault, thrust in the Blansko. Is it so that the Vienna Basin in which a pull-apart basin mechanism is presupposed is a part of the Pannonian Basin and a part of the West Carpathians, too? Some of the maps of the Moravian portion of the West Carpathians should bear a demarcation of the continued Tertiary structures in the Austrian (including the Diendorf Fault together with the direction of horizontal component) and Polish territories.

The text is illustrated with 283 pictures of which most are very well chosen black-white photographs, profiles, drawings, tables and 16 whole-page colour photographs. An important appendix is the list of localities and index of stratigraphical and regional names (p. 419 – 436). The choice of references is sufficiently extensive (18 pages) and focused mainly on recent works. In addition to publications in Czech language, there is a lot of works published in English, German, French, Slovak and Polish referred to in the work.

Print quality of the book is excellent and this general high quality is further highlighted by the coloured hardback and by the additional valuable information on the front end-leaf.

We can but congratulate the Czech geologists to this almost representative book. The publication is a valuable contribution not only for experts in geology and related scientific disciplines in the Czech Republic. It can also be much valuable for experts from neighbouring countries, especially from Slovakia and Poland, for whom Czech language does not represent a language barrier. The book would certainly deserve translation into a foreign language.

Photo 10: Braiding of the Desná R. in the partly regulated gravel channel with mid-channel bars left behind after the flood of 1997 near Filipová in the Šumperk basin.

Photo M. Hrádek

Photo 11: Two levels of erosional chute gravel floor in the Desná R. floodplain after the flood of 1997 near Filipová. The channel opens in a hanging position into a deeper crevasse channel overgrown with alders (in the background).

Photo M. Hrádek

Illustrations to M.Hrádek's and J.Lacina's paper.

Photo 3: Spring area of The Haraska River in the locality of the Transsect No. 1.

Photo L. Šefrna

Photo 4: A view at the south part of the Ždánický les Hilly land with lightly undulated terrain of prevailing Loess sediments with more than 90 % of arable land.

Photo L. Šefrna

Illustrations to L. Šefrna's and V. Vilímek's paper.