MORAVIAN GEOGRAPHICAL REPORTS

VOLUME 17

NUMBER

4

2009

ISSN 1210 - 8812

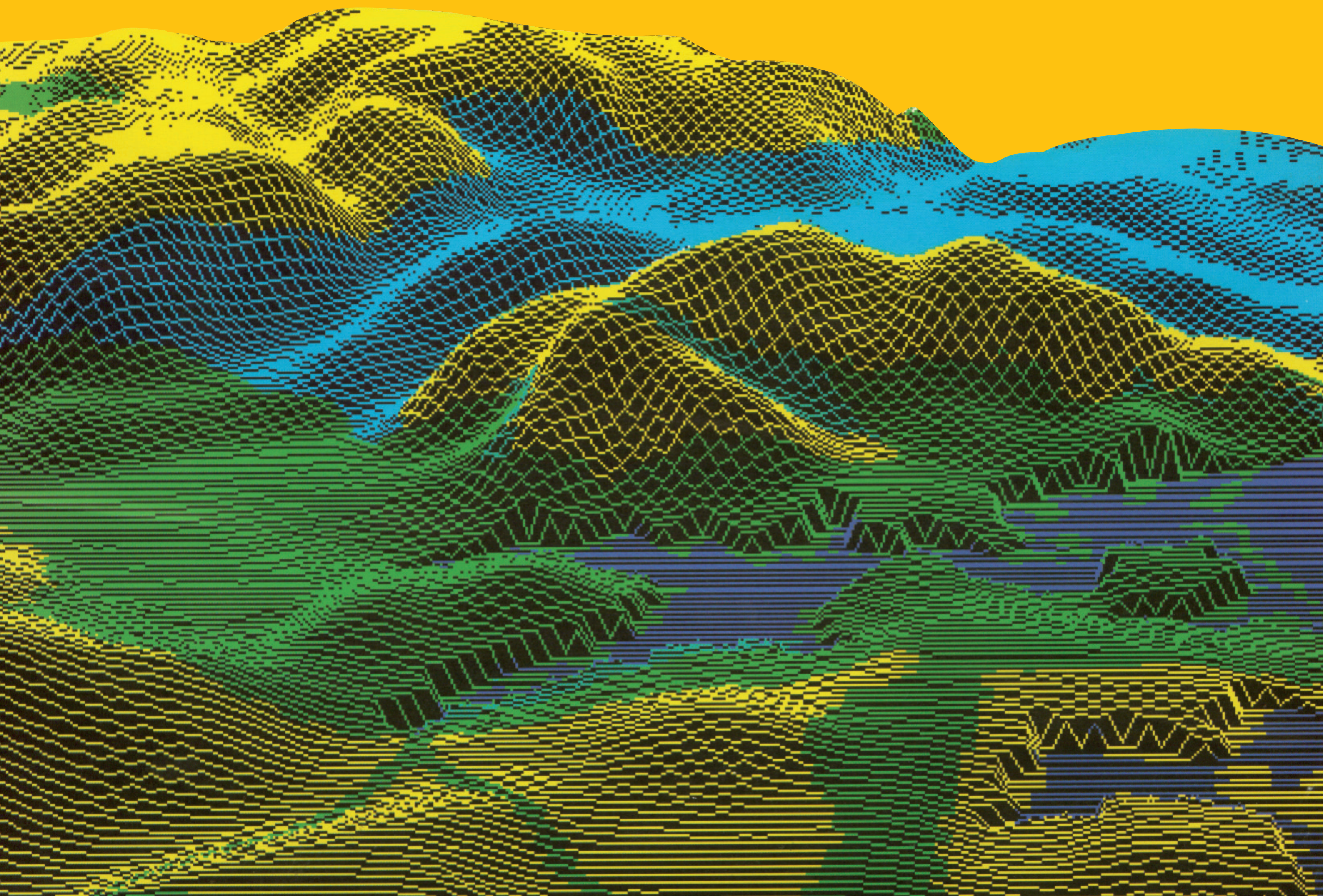

Fig. 2a: Thin-bedded flysch (claystones and shales) of the Istebná Formation (Silesian unit) (Photo: T. Pánek)

Fig. 2b: Weathered outcrops of sandstones of the Soláň Formation (Rača unit of the Magura group of nappes) situated in the headscarp area. (Photo: T. Pánek)

Illustrations related to the paper by T. Pánek et al.

MORAVIAN GEOGRAPHICAL REPORTS

PRICE

280 CZK (excluding VAT) per copy plus the postage
800 CZK (excluding VAT)
per volume (four numbers per year) plus the postage

PUBLISHER

Czech Academy of Sciences
Institute of Geonics, v. v. i., Branch Brno
Drobného 28, CZ-602 00 Brno
Identification number: 68145535

MAILING ADDRESS

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(home page) http://www.geonika.cz

Brno, December, 2009

PRINT

NOVPRESS s.r.o., nám. Republiky 15, 614 00 Brno

ISSN 1210-8812

Articles:

Reports

LATE HOLOCENE EVOLUTION OF LANDSLIDES IN THE FRONTAL PART OF THE MAGURA NAPPE: HLAVATÁ RIDGE, MORAVIAN-SILESIAN BESKIDS (CZECH REPUBLIC)

Tomáš PÁNEK, Veronika SMOLKOVÁ, Jan HRADECKÝ, Karel ŠILHÁN

Abstract

Frontal parts of nappes and overthrusts belong to the most exposed environments in the evolution of slope deformations. The frontal part of the Magura nappe creates a distinct morphotectonic and lithological boundary characterized by the occurrence of various types of slope deformations. A representative example of such a geomorphological situation can be found on the northern slopes of the Hlavatá Ridge in the Moravian-Silesian Beskids. Radiocarbon dating of peat bogs and lacustrine deposits of a fossil landslide-dammed lake enabled us to determine the chronology of a retrogressive landslide. The main phase of the landslide evolution took place ~1.6 ka BP; the secondary distinctly retrogressive reactivation of the landslide occurred in 0.8–0.9 ka BP. Our case study demonstrates dynamic Late Holocene geomorphic evolution in the area of the Flysch Carpathians and re-evaluates the chronology of landforms previously considered as of the Pleistocene age.

Shrnutí

Pozdně-holocenní vývoj sesuvů na čele magurského příkrovu: případová studie hřbetu Hlavatá, Moravskoslezské Beskydy (Česká republika)

Čela příkrovů a přesmyků jsou považována za jedno z nejexponovanějších prostředí pro vývoj svahových deformací. Čelo magurského příkrovu tvoří výrazné morfotektonické a litologické rozhraní charakteristické častým výskytem svahových deformací. Reprezentativní ukázkou této geomorfologické situace jsou severní svahy hřbetu Hlavatá v Moravskoslezských Beskydech. Radiokarbonové datování rašelinišť na povrchu sesuvu a jezerních sedimentů vzniklých v důsledku zahrazení blízkého údolí umožnilo vymezit časový vývoj retrogresivní svahové deformace. Hlavní fáze vývoje sesuvu se odehrála ~1.6 ka BP, sekundární výrazně retrogresivní reaktivace svahové deformace proběhla ~0.8–0.9 ka BP. Studie ukazuje dynamické pozdně-holocenní formování reliéfu oblasti flyšových Karpat a přehodnocuje chronologii forem reliéfu, kterým bylo původně přisuzováno pleistocénní stáří.

Key words: *landslide, earthflow, retrogressive evolution, landslide-dammed palaeolake, Magura nappe, Moravian-Silesian Beskids, Czech Republic*

1. Introduction

Frontal parts of nappes and overthrusts represent one of the most exposed geological environments in the evolution of various types of slope deformations (Carton et al., 1987; Dramis, Sorriso-Valvo, 1994; Burbank, Anderson, 2001). Such landslide-prone settings are connected with specific tectonic features of hanging walls and footwalls of thrusted sequences and – predominantly – with often largely lithologically different structure of overthrusted and underlying rock sequences (Hradecký et al., 2007; Esposito et al., 2007). A situation in which often highly permeable rigid rocks tectonically overlie weak (plastic, impermeable) formations is suitable both for the evolution of deep-seated failures (e.g. lateral spreading) in upper parts of slopes and for the activation of shallow landslides and earthflows in often undrained conditions at the base of the slopes. In some examples, rigid bedrock sinks to underlying weak formations and creates bulging and valley-anticlines as it was identified in many geodynamical settings (Záruba, Mencl, 1987; Martino et al., 2004). Slopes on the frontal part of the

Magura nappe in the Czech part of the Outer Western Carpathians exhibit numerous slope deformations – to the most extensive belong e.g. complex landslides near the villages Vidče, Tylovice (Rožnovská brázda Furrow), Hutisko Solanec (Vsetínské vrchy Hills) and Hlavatá (Moravian-Silesian Beskids).

The presented article discusses the evolution of a complex landslide situated on the northern slope of the Hlavatá Ridge (826 m a.s.l.) in the Moravian-Silesian Beskids. Our research benefits from widespread possibilities of radiocarbon dating of various landslide elements enabling the reconstruction of the Late Holocene chronology of the studied slope deformation. In addition to the contribution to understanding the Quaternary geomorphic evolution of the Moravian-Silesian Beskids, some findings of our study can be used as methodological remarks to the issue of landslide dating. We believe that the inferred Late Holocene dynamics of the studied slope deformation will become an additional proof of (previously unexpected) significance of the Holocene epoch for the overall shaping of the mid-mountain terrain of the Flysch Carpathians (see Pánek et al., 2009).

2. Regional setting

The Hlavatá Ridge is a conspicuous structural-monoclinal ridge situated in the southern part of the Moravian-Silesian Beskids (in the local geomorphic district called Mezivodská vrchovina Upland according to Demek et al., 1987), ~5 km SW from the village Bílá (Fig. 1). The ridge is of E–W direction. It is found between the altitudes of 826 and 791 m a.s.l.; its densely forested northern slopes are much steeper than the south-oriented slopes, which are partly forested and occupied by dispersed settlements and pastures.

Asymmetry of the ridge is controlled by its tectonic and lithological structure. The northern slope evolved on the front of the Rača unit of the Magura group of nappes, consisting predominantly of coarse-grained permeable sandstones of the Soláň Formation (Palaeocene) – here tectonically overlying shales of the Submenilitic Formation (Late Cretaceous-Palaeogene) representing the Fore-Magura Unit (Outer group of nappes) and shales of the Rožnov Formation (Late Palaeocene-Eocene) and the Istebná Formation (Late Cretaceous-Palaeocene) belonging to the Silesian unit of the Outer group of nappes (Pesl, 1988; Klomínský [ed.], 1994; Picha et al., 2006; Cháb et al., 2007) (Fig. 1b; Fig. 2 – see cover p. 2). Outcrops of the Magura nappe basal surface are identified in the upper two thirds of the slope, creating conditions for the evolution of upper steep escarpment on sandstones (> 25° inclination) and long concave base of the slope on shales (< 15° inclination).

The studied landslide complex consisting of three individual rotational-translational landslides is situated on the northern steep slope of the monoclinal ridge (Fig. 3). Length and width of the whole deformed slope is 580 and 800 m respectively; the whole failure covers ~35 ha. Headscarp area of the slope deformations is situated in the escarpment zone formed by sandstones of the Magura nappe, whereas the accumulation zone occupies predominantly gently inclined slopes underlain by shales of the Fore-Magura and Silesian unit.

The focus of our study is the largest landslide (580 × 220 m) of the three above described slope deformations (Figs. 3, 4). It is situated in the central part and its headscarp is in the highest position of the deformed area. The landslide eastern limitation is formed by a morphologically conspicuous fault of NNE–SSW direction (Fig. 3). The landslide morphology reveals at least two chronologically distinct deformations. Amphitheatre-like headscarp with rocky exposures almost reaching the ridge-line (790 m a.s.l.) can be associated with a younger generation of movements (Fig. 4a). Under the headscarp, a peat bog evolved in the near-scarp depression caused by the rotational movement of the failure. The peat bog is partly overlaid by a small (youngest) landslide body, which displaced the debris from the steep scarp area (Fig. 4b). The (younger) landslide accumulation forms a convex upward body (of earthflow character) with toe terminating roughly in the central part of the slope (Fig. 4c). On several sites, the earthflow blocked a fault-predisposed depression along the eastern (extended by an older landslide) margin and caused the emergence of several small (periodically overflown) peat bogs. The younger landslide partly overlies the older deformation, which is traceable down to the valley floor of the Lučovec Brook (660 m a.s.l.). The older landslide ends on the valley floor as a breached landslide dam above which remnants of lacustrine terrace have survived due to incomplete erosional removal of lake deposits after the valley floor reincision (Fig. 4f). Distal part of the landslide (just above the landslide dam) reveals a few, up to ~1.5 high, parallel waves of gravitational anticlines and synclines (Fig. 4d), similar to features described by Baroň et al. (2004). Some compressional undulations are occupied by small peat bogs (Fig. 4e).

3. Materials and methods

Our strategy to reveal the landslide chronology consisted in the dating of both peat bogs situated in different parts of the landslide body (both near scarp and intercolluvial depressions and gravitational synclines filled with organic deposits) and deposits accumulated behind the landslide dam in the Lučovec Brook. We consider

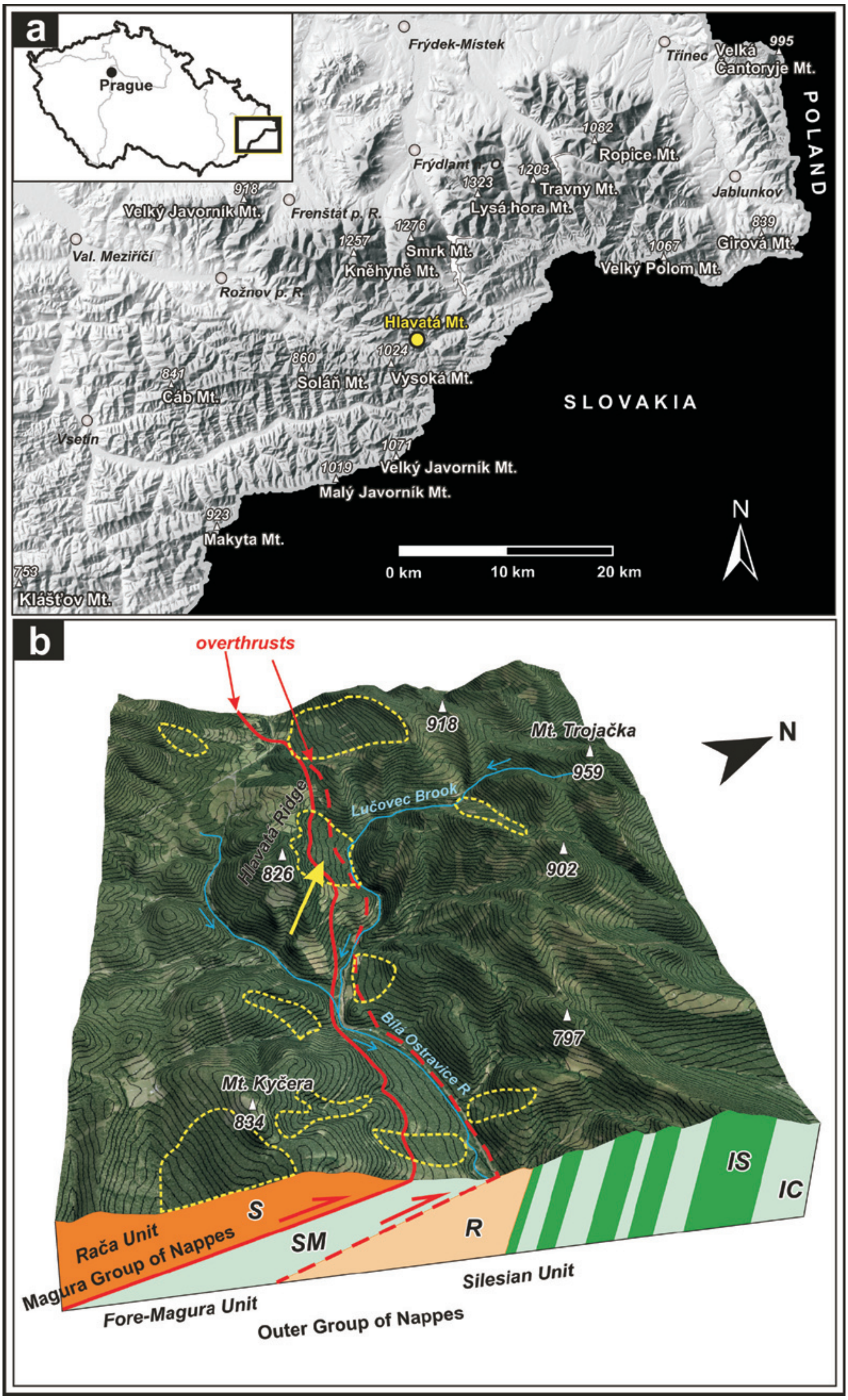

Fig. 1: (A) Localization of the study area in the Czech part of the Flysch Western Carpathians. (B) 3D oblique view of the surrounding area of the studied landslide with simplified geological structure: S – Soláň Formation (mostly sandstones), SM – Submenilitic Formation (mostly shales and sparse thin beds of sandstones), R – Rožnov Formation (mostly shales and claystones), IS – sandstones of the Istebná Formation, IC – claystones and shales of the Istebná Formation. Yellow dashed lines outline some large landslides situated in the vicinity of the Magura nappe front.

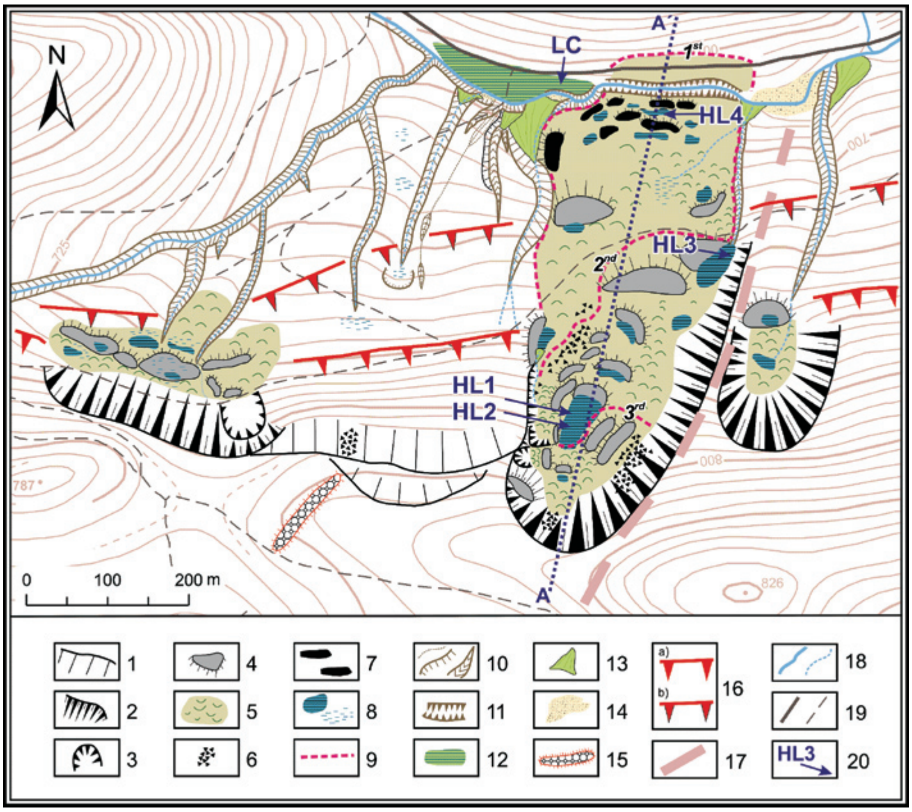

Fig. 3: Geomorphological map of slope deformations on the northern slope of the Hlavatá Ridge. 1 – oldest (most erosion-transformed – Pleistocene?) generation of headscarps, 2 – morphologically conspicuous headscarp of Holocene age, 3 – headscarp of minor (historical or recent) landslide, 4 – block of landslide, 5 – area of Holocene landslide with marked hummocky terrain, 6 – boulders, 7 – pressure folds, 8 – depressions on the body of landslide with swamp, 9 – outlines of individual generations of dated retrogressive landslide, 10 – gullies, 11 – breached landslide dam, 12 – area of landslide-dammed palaeolake, 13 – alluvial fan, 14 – gravel bar, 15 – anthropogenic stony accumulation, 16 – approximate position of the a) Magura nappe and b) Fore-Magura unit overthrusts, 17 – morphologically conspicuous fault, 18 – stream (continual, intermittent), 19 – road (asphalt, dirty), 20 – core site.

peat bogs, in accordance with Margielewski (2006), all swampy accumulations where organic deposits form majority of their volume. Organic remnants (e.g. buried trunks) suitable for direct dating of landslide deposits could not be found due to the lack of exposures in the landslide material. The dating of the landslide body occupying peat bogs and of lacustrine deposits behind landslide dams provides information on the minimum age of the slope deformation. However, the deposition on the valley floor behind the landslide dam is expected to be relatively fast and is supposed by many authors as a good proxy of direct dating of landslides (Haczewski, Kukulak, 2004; Bookhagen et al., 2005). Therefore, one of questions in our study is how long was the delay in the sedimentation within peat bogs situated on the landslide body in comparison with the sedimentation in the landslide-dammed lake.

Coring method was applied in each peat bog on the landslide body; radiocarbon dating was performed in three selected peat bogs of a significant thickness and abundance of organic material (Figs. 3, 5). Individual cores reached 180–400 cm and involved peat layers, gyttja, minerogenic horizons and colluvial material. Radiocarbon dating focused on the basal parts of peat bogs with the aim to obtain the landslide minimum age. Information on a lacustrine sequence behind the landslide dam and dating samples were collected directly from a natural exposure that had originated due to the Lučovec Brook lateral erosion. All studied sections were characterized sedimentologically. A total of 15 radiocarbon data of peat and wood remnants (Tab. 1) were performed in the Kyiv Radiocarbon Laboratory (Kyiv, Ukraine). Resulting ^{14}C ages were calibrated using OxCal 3.9 software (Bronk Ramsey, 2003).

4. Results

4.1 Landslide chronology constrained by peat bogs

The uppermost peat bog situated in the near scarp depression of the younger landslide reaches a maximum depth of 125 cm and besides peat and

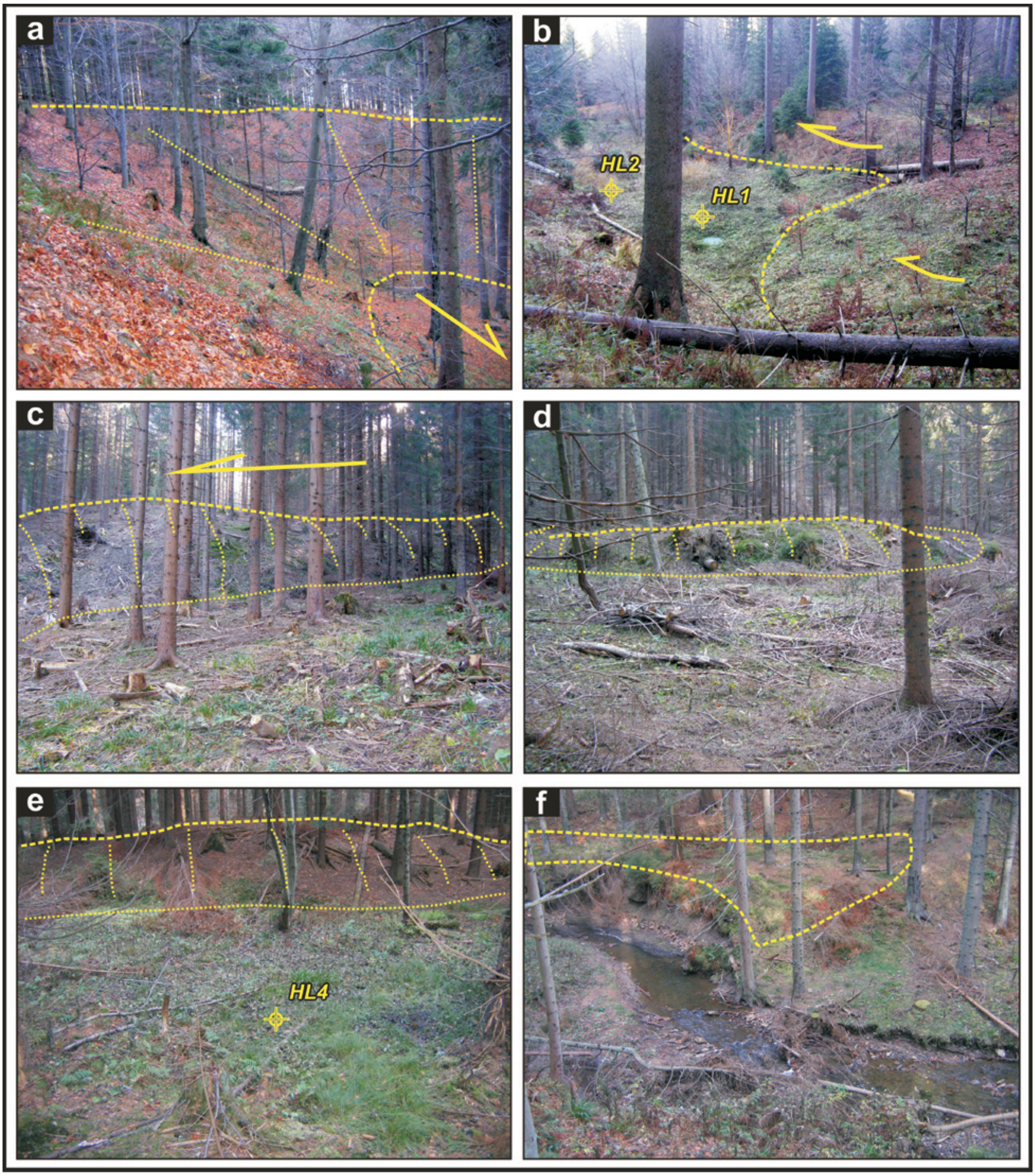

Fig. 4: Typical morphological elements of the studied slope deformation. (A) Amphitheatre-like headscarp of younger landslide protruding to the watershed area of the Hlavatá Ridge. (B) Near-scarp depression of the younger landslide with peat bog partly overlaid by minor retrogressive landslide. (C) Morphologically expressive margin of the landslide. (D) Pressure folds in a distal part of the older landslide. (E) Peat bog in the compressional part of the older landslide. (F) Remnant of lacustrine terrace just behind the landslide dam.

gyttja it contains large remnants of buried trunks (Fig. 5). Two cores, HL 1 and HL 2, performed on this site revealed ages of peat basal parts: 370±100 ^{14}C BP (2σ 1300–1850 cal. yr. AD) and 820±140 ^{14}C BP (2σ 900–1450 cal. yr. AD) respectively. Because of its deeper position (125 cm), the older age (in HL 2 core) approximates the landslide age better than the HL 1 core (90 cm) as the core was situated in a rather marginal part of the peat bog and it hence reflects delay in sedimentation.

Difficult to interpret is the sedimentary record as well as the radiocarbon dates obtained in the peat bog situated in the central part of the landslide

Sample (depth below surface)	Laboratory number	^{14}C age (BP)	Calibrated age (years BC/AD)	Context of dating and character of material
LC 1 (180 cm)	Ki-12760	1630±70	1σ 380–540 AD 2σ 250–600 AD	Base of the lacustrine deposits (wood)
LC 2 (130 cm)	Ki-12756	1780±70	1σ 130–340 AD 2σ 80–420 AD	Base of the lacustrine deposits (wood)
LC 3 (100 cm)	Ki-12758	1780±70	1σ 130–340 AD 2σ 80–420 AD	Base of the lacustrine deposits (wood)
HL 1 (90 cm)	Ki-13699	370±100	1σ 1 440–1 640 AD 2σ 1 300–1 850 AD	bottom of peat bog (wood)
HL 2 (125 cm)	Ki-13700	820±140	1σ 1 030–1 300 AD 2σ 900–1 450 AD	bottom of peat bog (wood)
HL 3 (300 cm)	Ki-13701	960±100	1σ 990–1 190 AD 2σ 890–1 280 AD	bottom of peat bog (wood)
HL 3a (300 cm)	Ki-13702	610±130	1σ 1 270–1 450 AD 2σ 1 050–1 650 AD	bottom of peat bog (wood)
HL 4 (225 cm)	Ki-13703	1020±70	1σ 950–1 050 AD 2σ 880–1210 AD	rejected (peat)
HL 5 (212 cm)	Ki-13704	1230±130	1σ 670–900 AD 2σ 500–1 050 AD	rejected (peat)
HL 6 (130 cm)	Ki-13705	600±130	1σ 1 270–1 450 AD 2σ 1 160–1 530 AD	rejected (peat)
HL 7 (118 cm)	Ki-13706	1610±150	1σ 320–610 AD 2σ 50–700 AD	rejected (peat)
HL 8 (61 cm)	Ki-13707	970±180	1σ 890–1 250 AD 2σ 650–1 400 AD	rejected (peat)
HL 9 (58 cm)	Ki-13708	510±150	1σ 1 290–1 520 AD 2σ 1 150–1 850 AD	rejected (peat)
HL 10 (195 cm)	Ki-13709	1540±150	1σ 380–660 AD 2σ 100–800 AD	bottom of peat bog (peat)
HL 11 (183 cm)	Ki-13710	1250±200	1σ 610–1 000 AD 2σ 400–1 250 AD	Upper part of significant minerogenic horizon (peat)

Tab. 1: Results of radiocarbon dating

(HL 3). This 300 cm deep peat bog is situated in dynamic geomorphic environment close to the margin of the earth flow lobe and at the foot of the steep adjacent slope (Fig. 3). Dynamic slope environment is reflected in the core sedimentary record with numerous peat layers embedded by up to 15 cm thick sandy intercalations (Fig. 5). Two samples from the bottom part of deposits revealed ages of 960±100 ^{14}C BP (2σ 890–1280 cal. yr. AD) and 610±130 ^{14}C BP (2σ 1050–1650 cal. yr. AD). These data likely record a marginal depression enclosing by rotational landslide-earth flow with its source in the uppermost headscarp and they correlate (with a certain tolerance) with the above-mentioned peat bog in the near scarp depression. Other radiocarbon data from the HL 3 core are very difficult to interpret; therefore they were eliminated from other chronological interpretations. Multiply age inversions are connected with minerogenic horizons reflecting abundant income of eroded material from the landslide toe and adjacent slope. During such events, older organic material was washed to the sedimentary basin and contaminated the peat deposits.

The lowermost HL 4 core was situated in the compressional part of the older landslide. The peat bog reaches a depth of 200 cm and it contains peat, gyttja and a thick minerogenic horizon in its basal part (Fig. 5). The basal part of the peat bog deposits was dated to 1 540±150 ^{14}C BP (2σ 100–800 cal. yr. AD) and this age can be considered as a proxy to the minimum age of the older landslide which blocked the Lučovec Brook. Another dating from this core, situated 170 cm below the surface, revealed an age of 1 250±200 ^{14}C BP (400–1250 cal. yr. AD), it constrains a rather dynamic (~300 years long) period with abundant supply of erosional products from the exposed and unconsolidated landslide body into this newly established sedimentary basin.

4.2 Landslide chronology constrained by lacustrine evidence

Natural exposure on the left bank of the Lučovec Brook revealed a complete sequence of 300 cm thick fluvial and lacustrine deposits resting on bedrock formed by steeply inclined shales of the Istebná Formation. Its basal sequence is formed by ~100 cm thick imbricated fluvial gravels, which are sharply overlaid by gray clayey-silty lacustrine deposits reaching a thickness of ~100 cm. Three radiocarbon datings of wood remnants from lacustrine deposits revealed ages between 1 630±70 ^{14}C BP (2σ 250–600 cal. yr. AD) and 1 780±70 ^{14}C BP (2σ 80–420 cal. yr. AD) (Pánek et al., 2007).

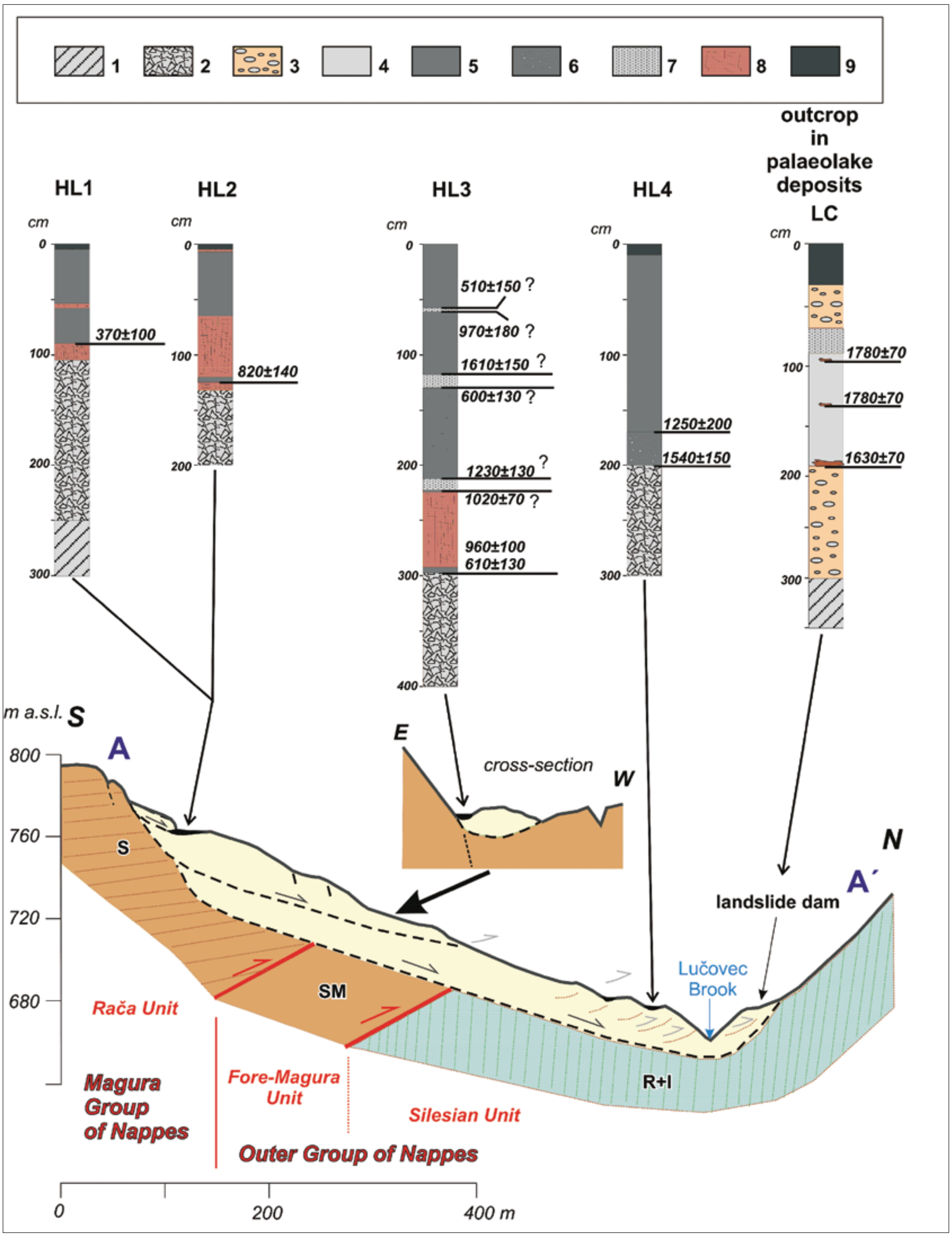

Fig. 5: Schematic profile of the landslide on the northern slope of the Hlavatá Ridge with displayed peat-cores (HL 1–HL 4) and interpreted exposure of deposits of the landslide-dammed palaeolake. Results of radiocarbon dating are expressed in ^{14}C ages, for calibrated ages see Table 1. Explanation of symbols used in studied sections: 1 – bedrock, 2 – colluvium and weathered bedrock, 3 – fluvial (channel type) deposits, 4 – lacustrine deposits (grey clays and silts), 5 – peat and gyttja, 6 – peat and gyttja with significant content of minerogenic particles, 7 – minerogenic sandy deposits, 8 – buried trunks and large pieces of wood, 9 – soil. For the explanation of the geology symbols see Fig. 1b.

These three almost identical ages obtained from different sections of the lake deposits are interpreted as obtained from a tree trunk protruding upward from the section base with its branches. The tree trunk resedimentation from older deposits can be rejected; the dated LC 2 sample is a cone, which is too fragile for the survival of erosion and transport. Dating results indicate that the valley floor was probably blocked sometime in an interval of ~80–600 cal. yr. AD. The lacustrine sequence in its upper part gradually passes to fluvial deposits indicating the infilling of the landslide-dammed lake capacity and consequent delta-type deposits progradation.

5. Discussion and conclusion

The dating of the basal section of lacustrine deposits in the landslide-dammed palaeolake and of the peat bog situated in the distal compressional part of the landslide well correlate and define time period of the origin of a larger (older) landslide affecting the northern slope of the Hlavatá Ridge. According to obtained data this event took place ~ 1.5–1.7 ka ^{14}C BP, i.e. with the probability of 95% (2σ) in an interval of 80–800 cal. yr. AD or with the probability of 68% (1σ) in an interval of 30–660 cal. yr. AD.

In comparison with other regional landslide chronologies, the period around ~1.5 ka BP seems to have favoured the evolution of large catastrophic landslides. Recently were dated to ~1.5 ka BP large (rather catastrophic) slope deformations of the Ropice Mt. (Moravian-Silesian Beskids; Pánek et al., 2009) and in the Hluboče Valley (White Carpathians; Klimeš et al., 2009). The broader time interval of 1–1.5 ka BP also includes the genesis of an expressive rockslide in the Jezerné Valley (Vsetínské vrchy Hills; I. Baroň personal communication) and some other slope failures in the Czech part of the Western Carpathians (Pánek et al., 2007). Many landslides spanning over the period of 1–1.5 ka BP (i.e. middle Subatlantic chronozone) were identified in the Polish Carpathians (Margielewski, 2006). According to the author, this chronological phase was characterized by extremely humid conditions preceding a more stable period of the Medieval Climatic Optimum (MCO) (Margielewski, 2006).

Another reactivation of the studied landslide occurred ~ 0.8 k BP, i.e. with the probability of 95% (2σ) in an interval of 900–1450 cal. yr. AD (with the probability of 68% (1σ) in an interval of 1030–1300 cal. yr.). This failure had a retrogressive character and shifted the headscarp of the older (i.e. 1.5–1.7 ka BP) landslide ~ 130 m upslope. Thus, this process led to significant reduction of the Hlavatá Ridge watershed area. The landslide was of a rotational character with liquefaction at the frontal part, which resulted in the development of earth flow, nowadays still markedly expressed by its lobate margins. Correlation of the younger event with palaeoenvironmental changes is rather speculative – its genesis rather falls to a climatically stable period of the MCO – but it may also be connected with the beginning of the humid Little Ice Age in the 13th and 14th centuries. Retrogressive evolution of the landslide continued until recent times, which is evidenced by a minor landslide partly overlying a peat bog in a near scarp depression and by tensional cracks above the headscarp.

Our study contributes to two important chronological aspects of landslides in the Flysch Western Carpathians. Firstly, large deep-seated landslides often covering the entire length of mountain slopes in the Flysch Western Carpathians are much younger than it was previously assumed and their activity continued until recent times (Baroň et al., 2004; Margielewski, 2006; Pánek et al., 2007, 2009). Older studies (mostly pre-1997 ones) usually consider bedrock landslides in a wider regional context of the studied site solely as of Pleistocene age (Buzek et al., 1986). Despite the fact that the information on the Holocene (and very often Late Holocene) age of deep-seated landslides in the Flysch Western Carpathians is not absolutely new (see Baroň et al., 2004; Margielewski, 2006 and references therein; Pánek et al., 2007, 2009), the presented article brings other useful field evidence for such conclusions.

Another important contribution of our study concerns the frequency of deep-seated landslides. Due to their high magnitude – low frequency character, it is impossible to infer the frequency of sudden activations of deep-seated landslides in the Flysch Carpathians from historical archives or eyewitness account. However, the radiometric dating of old events may help constitute the frequency of such events and help in the field of landslide hazard assessment. Although chronological data are still scarce, first studies show that the occurrence of major events on particular sites usually recur in an order of several hundreds to thousands of years (Baroň et al., 2004; Margielewski, 2006; Klimeš et al., 2009). For instance, our study indicates the recurrence of the younger landslide after ~ 800 years; the catastrophic Hluboče landslide/earth flow (White Carpathians) of April 2006 arose on the site of the older deep-seated landslide dated to ~ 1.4 ka BP (Klimeš et al., 2009).

Methodological contribution of our study consists in the dating of various types of datable landslide elements. The comparison of the ages of palaeolake and peat bog basal layers shows a rather minor difference (~ 100–240 years) indicating a slight delay of the peat bog growth after the genesis of landslide. This time difference is within a radiocarbon dating error. Thus, our example favours the dating of peat bogs on the surfaces of landslides as relevant proxies to landslide chronological evolution. This finding is important in relation to the region of the Flysch Western Carpathians where the landslide chronologies are based almost exclusively on a "minimal principle" realized by the dating of basal sequences of the landslide peat bogs (Margielewski, 2006).

Acknowledgements

This research was funded from a grant project of the Academy of Sciences of the Czech Republic, No. KJB301870501: "Quaternary geochronology of slope deformations of the culmination part of the Western Beskids: absolute and relative dating of landforms", and by the University of Ostrava (Foundation for Support of R&D Centers).

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TYPOLOGICAL DATA IN THE PROCESS OF LANDSCAPE POTENTIAL IDENTIFICATION WITH USING GIS

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Abstract:

Landscape potential expresses landscape suitability for a particular use, but also the level of landscape usage. This level follows from the knowledge of landscape stability. Each type of landscape has a specific spatial composition and a specific internal structure, both of them being conditioned by natural factors, processes and economic activities. Map works that serve to describe the landscape typology in the Czech Republic are maps of soil ecological units for soil rating (BPEJ), groups of forest types (SLT) and groups of geobiocoene types (STG). Analysis of relations among the typological data is one of key steps in determining the landscape potential. Thanks to their spatial character and great heterogeneity, these data are analyzed in the environment of geographical information systems. The preparation and proper analysis of the data in digital form require knowledge both in the field of geoinformatics and biology. Data structures of typological data, possibilities of their processing and analyses in GIS environment (classical desktop or web applications) are explained in the paper. The model area is a northern part of the PLA White Carpathians.

Shrnutí:

Typologická data v procesu stanovení potenciálu krajiny za použití GIS

Krajinný potenciál vyjadřuje vhodnost krajiny k určitému využívání, ale zároveň i míru tohoto využívání, která pak vyplývá z poznání stability krajiny. Každá krajina má své specifické prostorové složení a vnitřní uspořádání. Ty se liší díky působení přírodních činitelů, procesů a hospodářské činnosti společnosti. Významnými mapovými díly, které napomáhají typologii krajiny v České republice, jsou mapy bonitovaných půdně ekologických jednotek (BPEJ), souboru lesních typů (SLT) a skupin typů geobiocénů (STG).Mezi těmito typologickými daty existují vztahy, jejichž analýza bývá jedním z ústředních kroků stanovení krajinného potenciálu. Díky svému prostorovému charakteru a veliké heterogenitě se jejich analýza provádí v prostředí geografických informačních systémů. Příprava a vlastní analýza digitální podoby těchto dat však vyžaduje znalosti jak geoinformatické, tak i biologické. V příspěvku jsou objasněny datové struktury těchto dat, možnosti jejich zpracování a analýz v GIS, a to jak v klasických desktop, tak i webových aplikacích. Modelovou oblasti je severní část CHKO Bílé Karpaty.

Keywords: *landscape potential, analysis, typological data, White Carpathians, Czech Republic*

1. Introduction

Landscape is a complicated dynamic spatial unit influenced by the many factors. It requires constant attention and care for the sustainable conservation of their values, which allow existence of human society. Landscape definitions are many. For this contribution, the following one seems to be the best: "Landscape is a set of specific biotic services, geobiocoenoses, hydrobiocoenoses and techno-anthropoceonoses. Technoanthropocenoses are understood as systems made up of the community of people and synantropical cultivated plants, animals, all technical, cultural and social facilities used by the community, and environment which the community interacts with" (Hadač, 1982), eventually " The earth's crust with relief, air, water, soil, biota, and human with his creations interact themselves and come together in the landscape. Scenery is also a mosaic of diverse ecosystems (geobiocenoses and hydrogeobiocenoses)". (Buček, Lacina, 1995).

Human society uses different types of landscapes differently. The degree of recovery of the landscape consists in the physical or biological terms, which different landscape types provide. At the same time, the degree of recovery consists in the ability of regeneration of the landscape. The landscape potential (i.e. capability of landscape to satisfy community needs without detriment, depletion, disturbance or total damage to landscape production capacity) can be determined based on the typology of landscapes. The impact on the surrounding landscapes should be minimal and also sustainable during the time period. A harmony needs to be found between the natural structure (natural background – consisting of homogeneous natural units – geosystems) and the functional structure (land use).

Landscape potential is an important indicator. The determination of the landscape potential is a base for landscape planning in some countries. For example in Germany (Neff, Haase, Jäger, Mannsfeld in Izakovičová et al., 1997) all considerations about the ecological optimization of land use and resources depend on the landscape potential.

The situation is different in the Czech Republic. Landscape planning is not supported by the law yet. It is voluntary and individual documents are elaborated at varied quality.

At present, efforts are focused on the solution of this problem. The knowledge of landscape potential may greatly simplify the decision-making on land use planning and sustainability. It also may help to sustainable development in the area.

2. Landscape potential

The concept of landscape potential was formulated in the 1970s by the German Geoecological School (Neff, Haase, Jäger, Mannsfeld in Izakovičová et al., 1997). The Slovak physical-geographical and landscape ecological school (Drdoš, Kozová, Izakovičová, Miklós in Izakovičová et al., 1997) linded to it in the 1980. The gradual development of this concept and understanding of its definition is described in the following paragraphs.

The term of landscape potential in geography was introduced by E. Neff in 1966 (in Izakovičová et al., 1997). He understood this term as a sum of all landscape properties. These properties create prerequisites for the economic assessment of landscape with its energy and materials forming the structure.

E. Neff described it as "area-economic potential" (i.e. the potential of certain areas, which can be used). The term "natural potential" or "potential natural area" (within the meaning of space consisting of only the natural elements of nature) was afterwards used in German landscape ecology.

Since the potential relates to the landscape as a whole, it includes in a number of cases anthropogenic aspects and consequences of its implementation manifest in both natural and socio-economic environments, it has been defined as landscape potential in our country.

In the concept of German landscape ecology, the definition of landscape potential was also worked out by Haase (1978), who named it a natural-spatial potential and characterized it as follows: "Natural space with properties of its substances, latent energies and processes, i.e. with a structure and dynamics of its own has a capability of satisfying the community needs. This capability relates to production. It is referred to as a utility potential of natural space or as a potential of use."

The notion of potential became later distinguished from the original concept in the German landscape ecology (Neff, 1966; Haase, 1978) where it referred to economic usability of the natural part of landscape space. It was necessary to develop a new approach to landscape for a new understanding of landscape potential as a part of the landscape that can be used to such an extent that occurrence of irreversible changes in its structure and capacity for continual regeneration is prevented.

Humans are part of the landscape and their relations to it are complex. The first relation is that of subsistence because humans are born in the landscape and are connected with it in their biological and spiritual life; landscape is their home and provides for them air, water, food and affects their thinking. This relation urges humans to protect the landscape. On the other hand, the landscape is a direct or indirect subject of the work of man who is the creator of material goods. This so-called exploitative relation forces humans to use the landscape ever more intensively with no regard to its limited resources. The term of landscape potential in environmental protection has to be derived inevitably from the relation to subsistence rather than from the exploitative relation of humans to the landscape. This is why it includes in addition to aspects of appropriateness for exploitation also the aspect of exploitation rate.

The theories of the Slovak landscape-ecological school (Izakovičová et al., 1997) also come from this concept. In this theory, the landscape potential represents availability of different landscape uses, but also the degree of use, which results from the knowledge of landscape stability. When the landscape potential is respected, the reproductive ability of its renewable resources is preserved. It is necessary to distinguish "natural resources" from the potential. Natural resources are considered as a part of inanimate and living nature, which can be used in the process of production and reproduction. These natural resources can be irreversibly depleted (measured by length of the existence of human civilization) while the potential allows only such a use of these given natural utility conditions at which their quality is not excessively impaired and a possibility is left to the landscape to continually restore its potential because respecting the landscape potential guarantees its sustainable development.

3. Typological data

Each landscape has a typical spatial composition and internal structure given by natural factors, processes and economic activities of human society. Typology is looking for general characteristics that distinguish a concrete landscape from the surrounding landscapes, but combines with landscapes of similar properties. The aim of typological segmentation of the landscape is to define the types of areas with relatively homogeneous conditions in one or more characters.

A common factor limiting the establishment of a complex typology is the lack or absence of suitable thematic materials and sometimes the fact that they cannot be properly compared (Romportl, 2005). Therefore, it appears useful to use typological data in the GIS environment.

Three groups of geographical objects can be distinguished in the landscape, which make it possible to classify the landscape into zones and regions (Tuček, 1998):

- node – a relatively small area with a large concentrations of social activities and all kinds of transportation (people, products and information),
- network – a route used to connect the nodes - such as communication,
- surface – a two-dimensional area unit – such as forest.

Based on a typical location, typical pattern of geographical objects of networks, nodes and surfaces on the Earth's surface, it is possible to define a specific type of landscape. Biogeographical differentiation is a kind of landscape classification characterizing the types of ecotopes, i.e. landscape units with similar constant ecological conditions. It came to existence as a reaction to the need to specify territorial units with relatively permanent homogeneous ecological conditions, despite a possible difference of their current biotic characteristics. Types of ecotopes are in the Czech Republic classified in the following three concepts of different schools:

3.1 Rated soil ecological units (BPEJ)

Rated soil ecological unit of agricultural land is a five-digit numerical code expressing the main soil and climatic conditions that affect the productive capacity of agricultural land and its economic valuation. Information about BPEJ is used primarily for agricultural purposes, but can be used in the processing of complex land consolidation projects, or for other purposes. The BPEJ system applies for the whole territory of the Czech Republic.

The Decree No. 327/1998 Coll. issued by the Ministry of Agriculture stipulates BPEJ characteristics and a procedure for their management and updating. The Decree also confers the management and updating BPEJ to the land offices, whose task is to detect changes in soil and climatic conditions through field research and to carry out their evaluation on the basis of which new boundaries of different BPEJ are precised or newly demarcated in maps, or the BPEJ numerical code is changed.

The evaluation of agricultural land was made from 1974–1980 for arable land, pastureland and grassland (forestland was not included in the evaluation). Results of the soil evaluation are registered in the national database. BPEJ isolines and their codes are plotted in SMO-5 maps (national maps on a scale 1 : 5 000) and are available in the form of vector data too. Data about the representation of BPEJ on individual parcels are available at cadastre register and land offices. Administrator of the BPEJ system is the Research Institute for Soil and Water Conservation, Prague-Zbraslav (VÚMOP).

3.2 Forest Typology

Forest typology is a classification system introduced to differentiate between various management methods on forest lands. It is a nationwide database of permanent environmental conditions on a scale 1 : 5 000, which typifies the potential natural vegetation in relatively homogeneous territorial units in forests. It is important for the planning of forest management and at the same time a basis for establishment of the official price of forest land, taxes and other charges. This database is administered by the Forest Management Institute in Brandýs nad Labem (FMI).

The forest typology system dwells on the horizontal and vertical division of natural conditions and on the definition of homogeneous units:

- Forest type (LT) – basic unit, a set of natural and modified biocoenoses and their developmental stages,

including the environment. It is characterized by soil properties, characteristic species combinations of the concrete phytocoenosis, occurrence in particular ecological conditions (humidity, climate) and by the potential yield class of tree species. Unlike the Group of forest types, the Forest type includes a third figure to express the serial number of the Forest type within the Natural forest region.
- Group of forest types (SLT) – higher typological unit associating forest types according to their ecological affinity expressed by commercially important site characteristics.
- Primary management group of stands (HS) – association of the groups of forest types with similar characteristics, namely target forms of management and target tree species composition. It is used for practical purposes.
- Natural forest region (PLO) – association of lower units to units with similar and development-related natural conditions. PLO affects the tree species composition, their production potential and other characteristics relevant for the formulation of forest management principles. There are 41 Natural.

3.3 Group of geobiocoene types (STG)

Group of geobiocoene types is a basic application unit. It is an association of geobiocoene types with similar constant ecological conditions. It provides a reference basis for assessment of the degree of synanthropization, i.e. the rate to which natural characteristics are affected by humans. The geobiocoenological system is based on Zlatník's theory of the forest type as a type of geobiocene associating various biocoenoses within certain homogeneous ecotopes (Buček, Lacina in Löw, 1995).

A long-term objective of geobiocoenology is to contribute to the creation of harmonious cultural landscape through the gradual creation of groundworks for sustainable landscape use. The most important step is the creation of geobicoenological maps, which represent a spatial model of the natural condition of geobiocoenoses in the landscape.

Unlike other typological data, no authority administers STG and a national database does not exist. Individual organizations have to prepare STG themselves and this is why the data are not available free. STGs provide a reference basis for the assessment of the level to which the natural characteristics are affected by humans.

Basic units of the system are as follows:
- geobiocoenosis – terrestrial community of plants and animals in their mutual relations with abiotic environment components; a territorially defined ecosystem,
- geobiocoene – unit of natural geobiocoenosis and all geobiocenoses originating thereof and altered to varied degrees, including their developmental stages,
- geobiocoenoid – terrestrial ecosystem severely altered by man without the capacity of self-regulation

3.4 Selected conversions of typological data

In the creation of typological map, a synthesis is made and explanations of results from specialized surveys in agriculture (BPEJ) and forestry (SLT), which are available on detailed scales for the whole territory of the Czech Republic.

In this conversion, it is recommended to use framework translation charts contained in the "Tool for the translation of forest, agricultural and geobotanic habitat units into groups of geobiocoene types" included in the supplement to the "Handbook for designers of local territorial systems of ecological stability" (Lőw et al., 1995; Maděra, Zímová, 2005).

The translation chart cannot be used mechanically in the unification of various documents. Translation charts provide only a certain a unifying directive to be used only by experts with erudition in life sciences in the production of maps of the groups of geobiocoene types. Individual appraisal of specificities of the concerned territory is always a must.

A Framework Translation Chart for the conversion of the groups of forest types to the groups of geobiocoene types was set up by ÚHÚL (Löw, 1995). Translation chart for the conversion between BPEJ and STG can be constructed only for the trophic series (the second figure in the STG code) and for the hydric series (the third figure in the STG code).

Since the information about the soil-forming substrate is not obligatory in BPEJ, more options exist for how to interpret the BPEJ data. The conversion table is based on the main soil units (Kynčl, 1993).

Programming support for the rapid and validated conversion currently does not exist at the present. Data processing in GIS allows streamlining work with large heterogeneous data sets from various typological surveys. Desktop applications allow to partly speed up the process by manual selection of typological codes in the attribute tables of individual layer and a mass completion of corresponding new codes according to relevant translation charts and incorporation of these reclassified layers into the complex procedure of landscape potential establishment.

For web-based solutions, there is no automated expert system either. This is why a system has been developed on the principles of map server, which displays individual typological data and after calling up the information window provides basic information about the typological unit with interpretation to the relevant code and with the conversion to STG. The polygon shape can be displayed and the whole enquiry can be printed (Fig. 1) (Pietrasová, 2008). The system is available at http://gislib.upol.cz/dprace/magisterske/pietrasova08/mapserver/client.php. This solution is only the incorporation of existing translating charts according to available methodologies. Artificial logics and extensive knowledge base are missing so far. Interpreted and converted typological data can be then used in the process of determining the landscape potential.

3.5 Landscape potential assessment

Determination of area potential represents exploration of landscape abilities to meet the needs of society without subsequent impairment or limitation of landscape production capacity. The effect of use is with respect to time sustainable and its impact on surrounding landscapes is minimal. To establish the landscape potential means to find and define harmony between natural structure (natural background) and functional structure (land use), which change in space and time.

A basis for the establishment of landscape natural potential are natural prerequisites of the concerned area for a certain anthropic activity. This means that through a purposeful evaluation of parameters of the landscape natural structure we can obtain information about graded, spatially differentiated suitability of plots for a concrete function and degree of land use.

Natural potential of an area is determined either for a particular activity or for a group of activities pursued as a "complex landscape potential" by the form of ranking branch potentials or by their aggregation (Weichhart, Weingartner, 1983; Batelková, Kolejka, Pokorný, 1996).

Determination of the landscape potential is always a process of multiple criteria evaluation whose subjects are relevant characteristics of geosystems (Izakovičová et al., 1997). The process of evaluation has to respect certain general principles:

- to provide goal and purpose of evaluation,
- to determine an evaluation criteria, i.e. select landscape parameters to which the evaluation relates,
- to set up the scope of evaluation,
- to define a method for agglomeration of partial surveys in multiple parameter evaluation
- to select a method for the presentation of results (Mansfeld, 1983).

It is necessary to identify possibilities of actual utilization of the detected potential in area development. "Free landscape potential“ (Kolejka et al., 2001) can be called a part of the detected potential that represents an actual territorial reserve in a further development of the concerned activity while "Fixed landscape potential“ is understood to be a proportion of the detected potential, which is already currently utilized for the concerned function (activity) in the territory, or is "constantly" engaged by another activity. In the natural or near-natural landscape, there is only the free landscape potential. In the cultural landscape selectively used by humans, the free potential is or may be significantly limited in terms of area size to the benefit of the fixed landscape potential, especially if the hitherto land use is in a good accordance with natural prerequisites.

At a high measure of compliance between the natural (primary) landscape structure and the functional (secondary) landscape structure, the fixed landscape potential predominates over the free potential.

Outputs from the assessments of landscape potentials according to Mansfeld (1983) are data about:

- structural landscape diversity (content and spatial heterogeneity),
- usability of area (suitability of the landscape for use including preferences, functionality and availability of areas),
- degree of anthropogenic transformation (degree of the conversion of ecosystems, land use structure, degradation, etc.),
- impacts and their extent (sources and action fields of effects, conflict situations in relation activity – natural environment and activity – other activities),
- carrying capacity (sensitivity of the natural environment to individual activities, thresholds for intesities of use, delimitation of functional areas according to degrees of carrying capacity and intensity of use).

4. Research area

Research area is located in eastern Moravia at the border with Slovakia in the eastern part of Zlín region. It represents five cadastral areas – Valašské Klobouky, Poteč, Nedašova Lhota, Nedašov a Návojná. According to the information of cadastral office, its total area is 5,440.35 hectares. About a half of the landscape is covered by mainly coniferous and mixed forests. Forests cover the highest elevations (ridge of the Královec Mt. in the central part and ridge of the White Carpathians in the south-eastern part of the territory). In lower elevations, the land use passes into grasslands, pastures and arable land. Distribution of landscape types shows Table 1.

Land use	Area (ha)	Share %
forest	2622.745	48.28
grassland, pasture	1354.192	24.93
arable land	844.137	15.54
intravillan	344.126	6.33
orchard, garden	197.443	3.63
special-purpose developments	64.832	1.19
shrubs	3.533	0.07
water bodies	1.437	0.03
Total	**5432.450**	**100.00**

Tab. 1: Representation and area (ha) of land use (calculated in GIS)

Residential areas are mostly concentrated in the valley of the Klobucký potok Brook with the villages Valašské Klobouky and Poteč and in the valley of the Návojenský potok Brook with the villages Nedašova, Nedašova Lhota and Návojná. Regarding the pattern of housing areas, these villages represent mostly the street type villages with houses lined along both sides of local communication the importance of which is only local (main road runs through the settlement or along its perimeter). Nedašova Lhota is known as Wallachian chain village (Hrdoušek, 2003) where homesteads are linked at irregular distance along the road or brook without an apparent plan or form small clusters. Farm buildings form rear parts of these villages. Fruit orchards and fields of moderate size usually occur in the surroundings.

5. Identification of landscape potential in GIS

The outcome from the establishment of landscape potential in the research area is the identification of sites potentially suitable for the given use and at the same time of sites whose current use does not correspond with the natural conditions.

The methodology developed by Kolejka (2001) and the methodology of "Landscape planning – LANDEP"" (Ružička, 2000) were used as a basis for the methodological procedure for the determination of landscape potential. The procedure is in ArcGIS Desktop 9.2 as a freely available toolbox and script in the language Python. An essential prerequisite for determining the landscape potential are input data (vector layers) carrying the information about geological structure, humidity, soil trophism, terrain slope and climate. At the same time, these layers include the appraisal of natural features for the chosen activities.

The layer of current land use is necessary for finding local reserves and conflict areas. An important input layer is also raster layer of slope gradient (pixel 25 m), which determines the size and distribution of pixels in the newly created grids. The whole calculation of the landscape potential is made in a grid. A layer of "sample" development limits of the territory (limity.shp) has been created for the final visualization, which provides "inviolability" of areas defined in this way. These are namely nature conservation areas – small-scale strictly protected areas, 1st zones of PLA White Carpathians, ÚSES (territorial systems of ecological stability, built-up areas of municipalities and special-purpose developments.

Input data for the determination of the natural structure of five cadastral areas of interest are maps (layers) carrying the information about soils (trophic series), geological setting, slope gradient of terrain, humidity conditions of soil and climate (Tab. 2).

Data on soil properties were classified on the basis of typological maps of BPEJ and SLT. From them, a layer of the occurrence of each type of natural geosystems was developed (Fig. 1).The natural geosystems are characterized by a code with five items representing five variables (slope, climate, geological substrate, soil moisture, soil trophism). There are altogether 305 types of natural geosystems identified in the research area.

The individual parameters of natural geosystems were evaluated for the purpose of calculating the values of natural potential for individual functions (skiing, sports grounds, golf courses, arable land, grasslands

Layer	Format	Scale range	Number of entities
geology	ESRI shapefile	4	368
climate	ESRI shapefile	3	4
soil moisture	ESRI shapefile	4	167
paedology - trophism	ESRI shapefile	7	702
gradient	ESRI shapefile / GRID	4	2467

Tab. 2: Summary of input layers for the establishment of the landscape potential

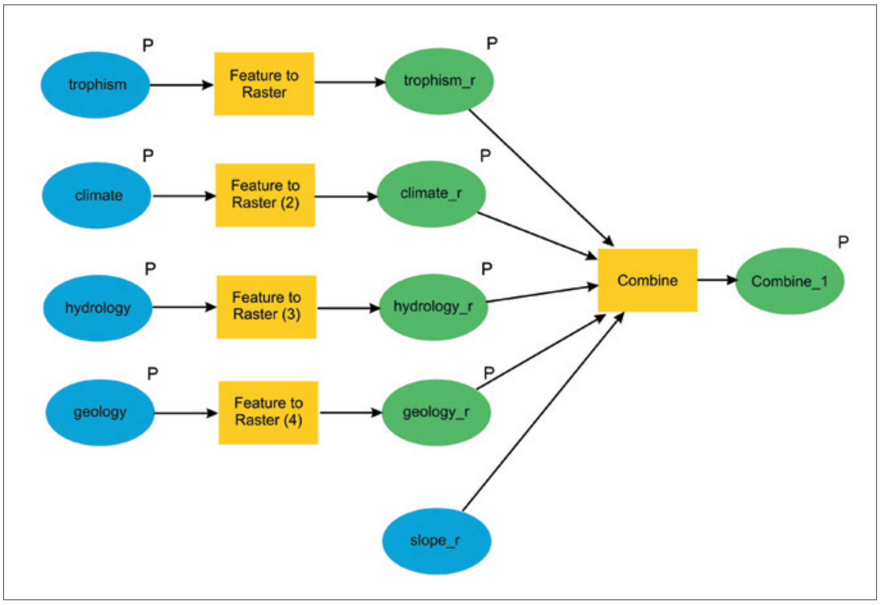

Fig. 1: Model of the determination of unique natural geosystems in ArcGIS

and pastures, orchards and commercial forests) (Fig. 2, Tab. 3). For this, a scale of 4 degrees was used (0 to 3 points):

- 0 – unsuitable for the concerned function (activity or use)
- 1 – low suitability,
- 2 – medium suitability,
- 3 – high suitability.

Results from the partial assessments of geosystem suitability for a concrete function were agglomerated through the mathematic operation "Product" for a particular function with using map algebra in GIS (Janíková, 2009).

The results ranged from 0 to 243 possible points (Fig. 3), which were for better clarity categorized into 5 groups according to the area suitability for the given activity or use (Tab. 4).

The results of landscape potential evaluation were then compared with the current functional use of the area (Fig. 4). Groundworks for drawing up the functional structure of the area (landuse.shp) were data from the ZABAGED 1 database (www.cuzk.cz), from the field surveys and aerial photographs available via WMS service from the CENIA portal (www.geoportal.cenia.cz).

6. Results

The comparison of landscape potential maps with the current functional landscape structure revealed:

- area reserves for concrete activities, which occurs in cases when the current land use in the locality differs from the newly proposed most optimal use,
- functional conflicts when an apparent discrepancy occurs between the current and proposed land use – the function is realized in the locality in spite of

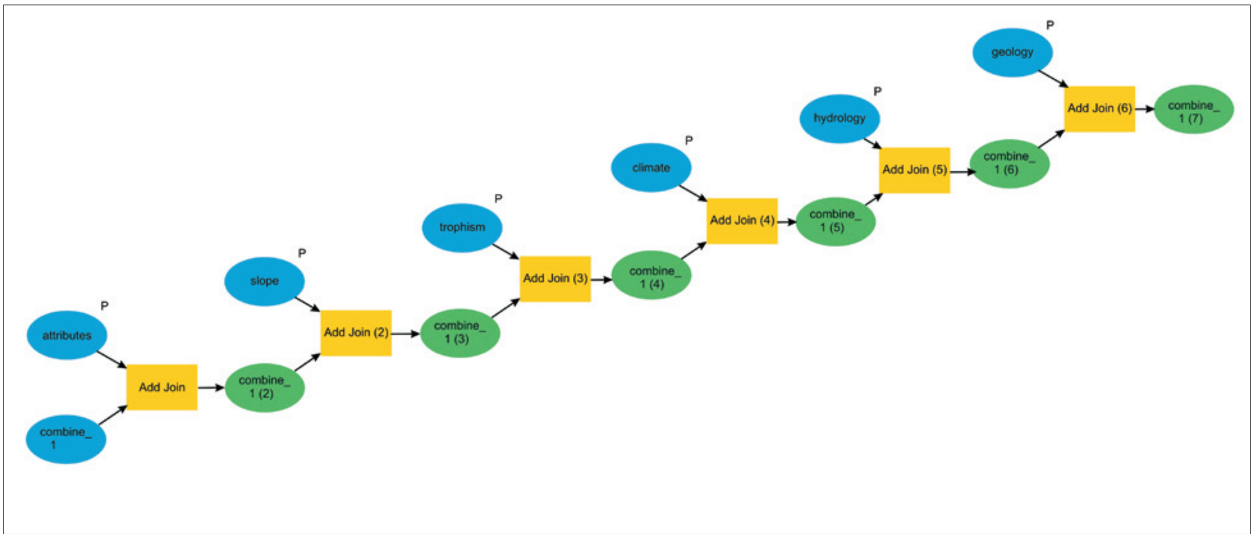

Fig. 2: Model of the estimation of values in ArcGIS.

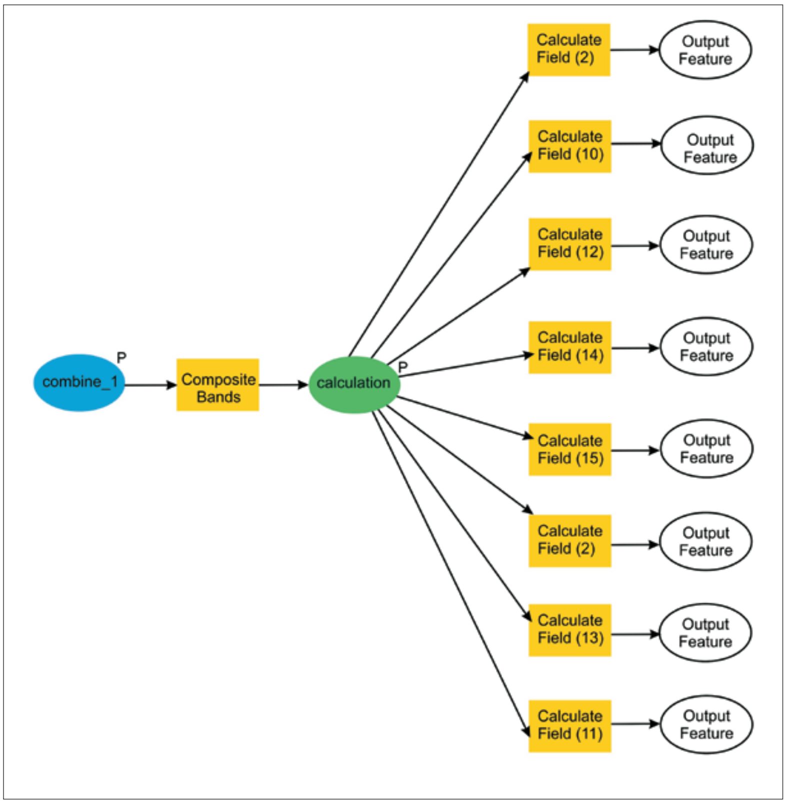

Fig. 3: Model of calculating the agglomerated results in ArcGIS

Variable activity		Geology				Climate			Soil moisture				Trophism							Gradient			
		A	R	D	F	M7	M9	CH	2	3	4	5	A	AB	B	BC	BD	C	CD	R	M	S	P
A	skiing	3	0	0	2	1	1	3	1	3	1	0	3	3	2	1	0	1	0	0	0	2	3
B	sports ground	3	0	0	1	3	3	1	2	2	0	0	3	3	3	2	1	2	1	3	2	1	0
C	golf course	2	1	1	3	3	3	2	1	3	0	0	1	2	3	2	1	1	2	2	3	0	0
D	arable land	0	1	2	1	3	3	1	1	3	1	0	0	0	3	2	3	1	2	3	2	0	0
E	meadows, pastures	0	2	2	3	2	2	3	2	2	3	0	1	2	3	1	3	3	2	2	2	3	1
F	orchard	0	0	2	2	3	3	1	2	3	1	0	0	1	2	2	3	2	2	2	3	1	2
G	forest	0	0	2	3	2	2	3	1	3	3	0	0	3	3	2	1	3	2	2	2	3	3

Tab. 3: Table of rating
Legend: codes of natural characteristics in headings of the rating table:
Geology: A – anthropogenic sediments, R – alluvio-fluvial sediments, D – deluvio-fluvial sediments, F – flysch
Climate: M7 – moderately warm, M9 – moderately warm, CH7 – cold,
Soil moisture: 2 – limited (modest), 3 – normal, 4 – waterlogged, 5 – permanently wet
Soil trophism: A – oligotrophic (acidic, poor), AB – oligo-mesotrophic (semi-poor in nutrients), B – mesotrophic (moderately rich), BC – mesotrophic-nitrophilous (semi-rich in nitrogen), BD – mesotrophic-basic (semi-rich in calcium), C – nitrophilous, CD – nitrophilous- basic)
Gradient: R – flatland and plateau (0–3 °), M – moderately sloping terrain (3–7 °), S – sloping terrain (7–15 °), P – steeply sloping terrain (over 15 °)

sum	**0–12**	**13–36**	**37–54**	**55–108**	**109–243**
Area suitability	unsuitable	unlikely	suitable	suitable above-average	very suitable
abbreviation	NEP	MVP	VHP	NAP	VVP

Tab. 4: Categorization of landscape potential results

the low natural suitability (landscape potential) of the area (Fig. 4).

The map of optimal land use was compiled from collected values of landscape potential (Fig. 5). This map represents a selection of the most suitable land use in given area. Function, which improves the ecological stability of the territory is regarded as the best one, if there are more than one optimal ways of land use in the area.

The order of functions according to the measure at which they influence ecological stability is as follows: Forest – Grasslands, Pastures – Fruit orchard – Arable land – Skiing – Sports ground – Golf. The map of optimum land use was also compared with the current functional structure and the area reserves were identified for the respective functions.

Each area is a cross-section of various interests (land use limits) that may have a significant impact on area development plans in the concerned area. In the reference area, there were defined only "sample" limits to development, because the determination of complex limits in the area is included in area development plans. The areas in which the sample limits to development were defined were mostly nature conservation localities – small-scale strictly protected areas, 1st zones of PLA White Carpathians, territorial systems of ecological stability, built-up areas in villages and special-purpose developments.

Through the composition of a layer of "inviolable" limit areas and actual area reserves for optimum functions of natural geosystems an offer comes to existence of the "recommended functional landscape structure". This offer comprises areas, which have to be exempted from the changes of functional use (in limit areas) and at the same time areas, in which a change is possible and advised thanks to the knowledge of the optimum function, which differs from the current use and this current use can be relatively readily and effectively

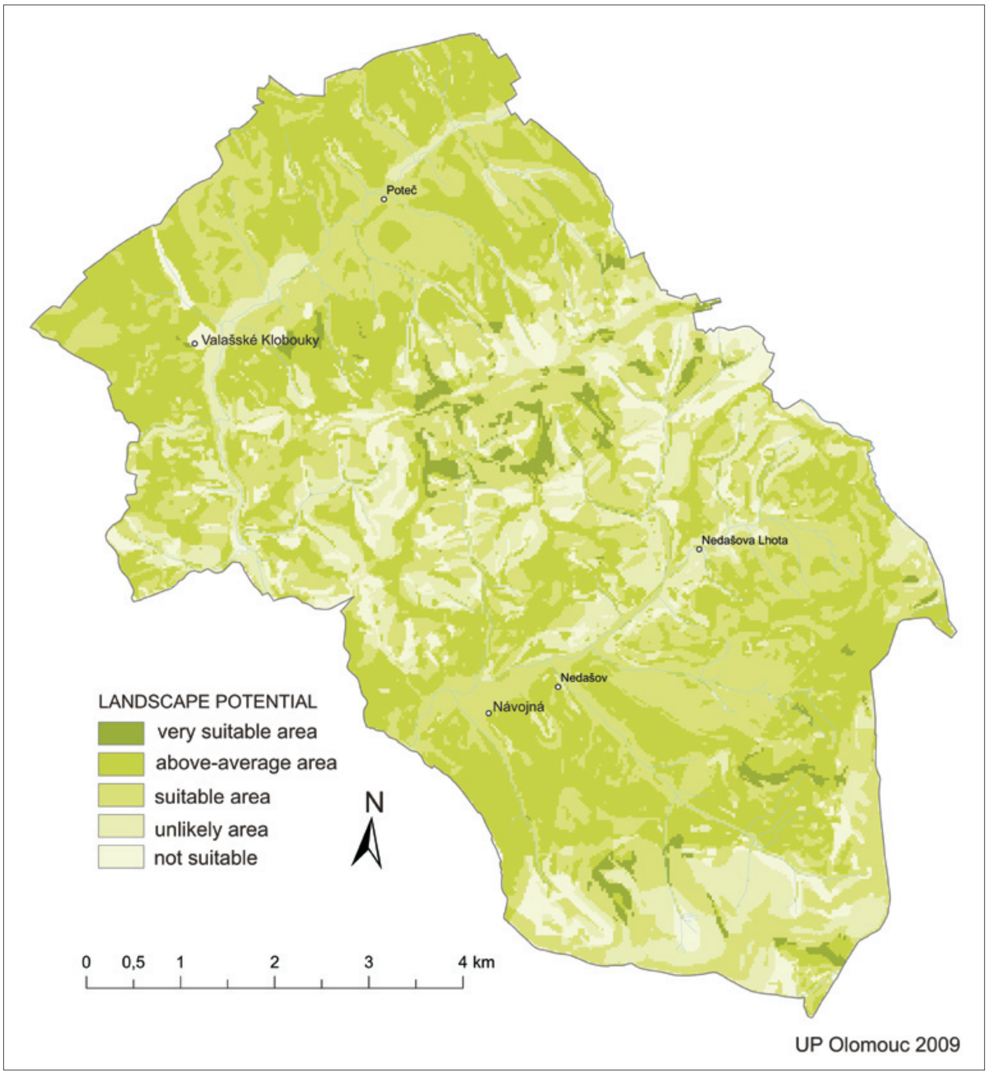

Fig. 4: Reserve and conflict areas of meadows and pastures (Source: author)

converted into the optimum function (in localities of actual area reserves).

The category "Forest" has the highest potential in the whole area of research. Up to 54% of the territory is valuated as „above average" or „very suitable" for the given use. Landscape potential for the category "Forest" is high especially in the central and southern parts of the study area. The map shows that areas unsuitable for forests are mostly along watercourses due to the occurrence of fluvisols and gleysols.

The comparison of landscape potential for skiing with the current land use disclosed territorial conflicts on two slopes currently used for skiing. Territorial reserves, i.e. sites suitable for skiing were identified mainly in the south-eastern part of the study area, because of shallow soils, steep slopes and suitable climate conditions.

7. Discussion and conclusion

The accuracy of results of the analysis highly depends on the quality, availability and accuracy of input data. The selection of input criteria is a challenge and is not entirely unambiguous the reason being a multitude of influences affecting the landscape status and use.

It is important to select input criteria on the basis of a defined assessment goal and even though the computer-processed output cannot be considered final and definitely correct.

The used approach and criteria should be understood as a method for the formulation of rough recommendations, which require assessment of concrete cases to be introduced.

During the decision making, it is necessary not to forget own knowledge about the resolved problem and to listen to the opinions of experts and the general

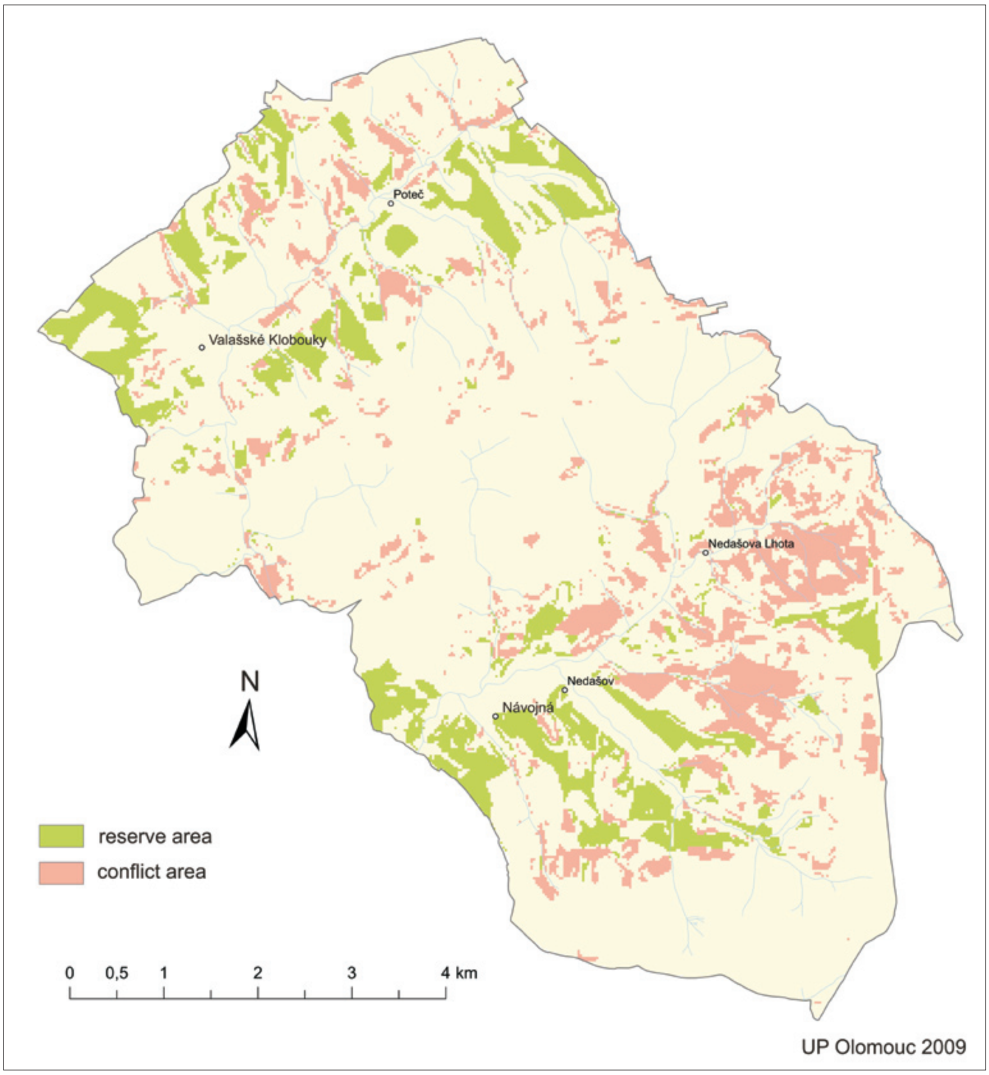

Fig. 5: Map of landscape potential of meadows and pastures (Source: author)

public who are both concerned by the proposed changes. Results are affected not only by input data, but also by the individual steps of the procedure, such as scale and the assessment of natural conditions itself, mathematical operations for identifying the landscape potential, the decision-making scheme for the proposal of changes etc. The choice of mathematical operation "Sum" can make a better use of the mutually equable position of individual assessed variables and divides the results into classes in a milder mode (differences between areas are very small). By contrast, the function "Product" that I used in the methodology could be characterized as more "stringent" since in the result it "eliminates" areas where at least one of natural conditions is unsuitable for the given use (being rated as 0).

The decision-making scheme has a great influence on the outcome of the proposal for land use changes. In this methodology, only a simple binary scheme was proposed. Nevertheless, it would be very useful for praxis to develop a graded decision-making scheme based on socio-economic, ecological and other analyses. Thanks to this scheme, the results would also include the measure of suitability of the implementation of the proposed change. This is however a matter of teamwork, which is beyond this research assignment.

In order to identify "inviolable" areas in respect of restrictions by developmental limit, a layer of just "sample" limits was designed, including primarily the conservation conditions in the territory. The correct establishment and identification of area limits is a part of area development documents based on valid legislation.

Determination of landscape potential by analyzing typological data in GIS environment appears to be a very suitable method for the disclosure of disproportions in the landscape potential and its actual use. The application of the presented method in the northern

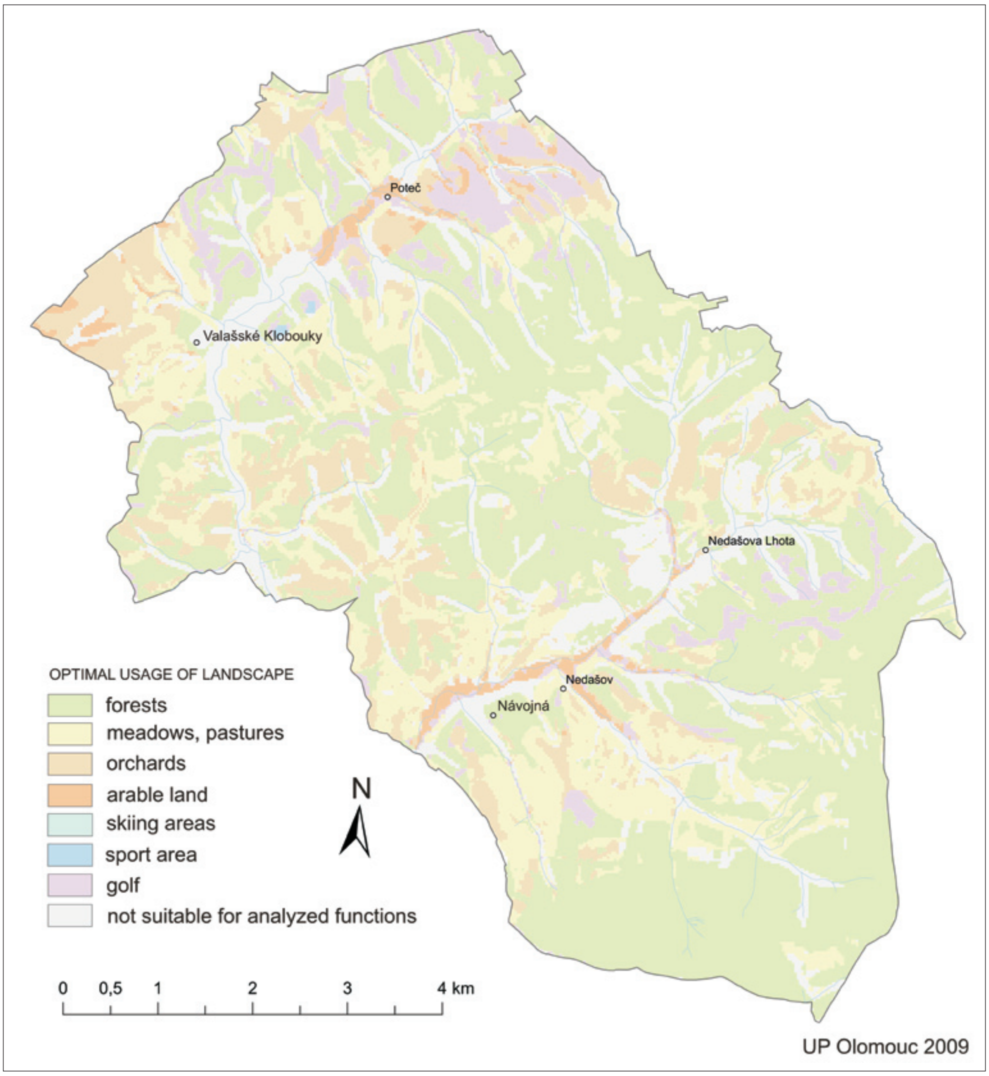

Fig. 6: Optimum land use according to landscape potential (Source: author)

part of the PLA White Carpathians demonstrated its necessity for a broader use in the territory of the Czech Republic because out landscape is not used in accordance with its potential at present and cannot guarantee sustainable development.

Acknowledgement

The research was supported by the Ministry of the Environment of the Czech Republic – grant No. SP/2d3/54/07.

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IMPORTANCE OF GEOMORPHOLOGY IN THE RESEARCH OF NATURAL HAZARDS AND RISKS

Vít VILÍMEK

Abstract

Geomorphology plays an outstanding role in research into natural hazards and risks related directly to processes in the lithosphere (rapid mass movements, erosion, volcanic and seismic activity, etc.). In addition, geomorphology plays an important role in the research of hydro-climatic catastrophes (e.g. floods). As in other geological sciences, quantification and dating of processes, as well as prediction based on modelling and knowledge of landscape evolution, are important in geomorphology. Palaeogeomorphology is yet another science that helps in the research of large-scale natural hazard and risk events. It is also very common to compare the size and frequency of various hazardous events to be able to predict their future occurrence.

Shrnutí

Význam geomorfologie při výzkumu přírodních ohrožení a rizik

Geomorfologie hraje nezastupitelnou roli ve výzkumu přírodních ohrožení a rizik, jež přímo souvisejí s procesy probíhajícími v litosféře, jako např. katastroficky probíhající svahové pohyby, eroze, vulkanická a seismická aktivita. Rovněž v případě hydro-klimatických katastrof má geomorfologie významnou roli při jejich výzkumu (např. povodně). Stejně tak jako u jiných geovědních oborů je v geomorfologii důležitá kvantifikace procesů, datování, predikce založená na modelování a výzkum geneze. Při studiu přírodních ohrožení a rizik se uplatňuje rovněž paleogeomorfologie, neboť je schopna pojednávat o minulých událostech větších rozměrů. V poslední době dochází velmi často ke srovnávání velikostí přírodních katastrof s frekvencí výskytu, a to za účelem jejich předpovídání.

Keywords: *palaeogeomorphology, natural hazards and risks, size and frequency relation, high mountains*

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1. Introduction and methodology

The main aim of this paper is to characterize the relation between geomorphological research and natural hazards, in what ways geomorphologists can contribute to research work in natural hazards and risks, and to stress some aspects of this interrelationship. Some examples were brought forward from home and abroad, especially from developing countries where natural hazards are of higher importance.

Several publications define terms such as natural hazards and natural risks but only few of them describe the category of geomorphic hazard. One of the reasons might be that all natural hazards blend between different specialisations and subspecialisations in terms of cause – consequence. Schumm (1988) defined geomorphic hazard as a "result from any landform change that adversely affects the geomorphic stability of a site". Another thing is how geomorphologists themselves usually define the term hazard. According to Slaymaker (1996) it is the "probability of a change of a given magnitude occurring within a specified time period in a given area". Brázdil and Kirchner et al. (2007) introduced the term geomorphic extremes in the sense of processes with extreme dynamics or large-scale destructive geomorphic processes. Their conceptual meaning is with respect to several Czech or foreign geomorphological publications from the late 20th century or most recent ones.

Initially geomorphologists contributed only little to risk evaluation (Morgan, 1992); nevertheless several studies were published in recent times (e.g. Hrádek et al., 1997; Kalvoda, 1998; Demek et al., 2006; Manners et al., 2007; Pánek et al., 2008; Fort et al., 2009). Other research works were focused on recent geomorphological processes in orogenetically active areas (e.g. Kalvoda [ed.] 1998; Kalvoda and Rosenfeld, 1998). Namely significant disasters or potential hazardous processes induce the demand of specific geomorphic studies. After the period of heavy rains in the Czech Republic in 1997 several landslides occurred. These events provoked not only hydrological research but landslide studies as well (Klimeš, 2008). The recent status confirmed the relevant interest of geomorphologists in hazard assessment.

The role of geomorphologists in natural hazard and risks studies is worthwhile, but not only limited to careful risk assessment, as it is important to make the best use of their geographical background for consideration of societal goals and cultural value systems. The advantage of geography is the wide range of scientific interest, and geomorphologists have the chance to assert themselves in large scientific teams dealing in geosciences (e.g. Vilímek et al., 2007; Klimeš et al., 2009). They can bring to the team all the aspects of physical geography, e.g. experience with meteorology, climatology, pedology, hydrology etc. Moreover, the risk approach to geomorphic hazards enables a fuller incorporation of both expert analysis and societal synthesis in the solution of the natural hazard problems (Slaymaker, 1996). He also suggested a scientific working plan for risk assessment coming out from the mapping of geomorphic hazard domains, and use of remotely sensed images proceeding assessment of vulnerability.

The role of geomorphology in the research of natural hazards and risks is well documented for instance by Alcántara-Ayala (2002). She also takes into consideration different methodological approaches. Natural hazards are perceived by both the society and scientists usually through the frequency of events and damages as presented by the media and also with respect to the growing vulnerability of the society or global changes. I Alcántara-Ayala made a proposal to "…promote the elaboration of vulnerability analysis within a risk assessment and management framework, where not only geomorphology, but also geomorphologists play a key role in the prevention of natural disasters".

One frequently asked question is whether or not the number of natural hazards is growing. This is not a matter for this article, but the problem of the relation between frequency and magnitude will be discussed later on.

2. The complexity of natural hazards studies

Natural disasters have to be studied in their complexity not only because of the system run but also due to the possibility of their direct/indirect mutual interconnecting. The position of geomorphological research with the large spectrum of interdisciplinary research (e.g. slope movements caused by extreme rainfall) is dealt with by Rosenfeld (1994).

Identification and quantification of rapid geomorphical processes is relatively simple, because in a short time period they cause damage (Demek et al., 2006). On the other hand, triggering factors are not always so simply identified – due to various interconnections between different types of processes. One example of the structure and link between diverse natural hazards was published by Kukal (1982) and improved a little by Vilímek (2003). We can have a look at the structure from the point of view of direct/indirect influence or strong/slight impingement (Fig. 1). The difference between direct or indirect influence might be illustrated by the mutually related flood – landslide. Flooding could be the direct triggering factor for landslides just due to the increased level of the water table in sediments and changes in pore-water pressure (but it is a complex relationship where e.g. precipitation rate must be taken into account). Vice versa, landslides have for flooding "only" an indirect influence (and only in special incidents). Several cases of huge landslides, which dammed the valley have been described worldwide; collapse or overflowing of dams (and the following accelerating erosion) could produce flooding down the valley. One example could be presented from the Czech Republic – after heavy rains in the Olešenský potok Brook watershed (July 2004), the dams of several ponds were partly destroyed (Fig. 2 – see cover p. 4) due to the overflow and erosional destruction of the dams (Vilímek and Šercl, 2006). Another event with really disastrous consequences is located in Cordillera Blanca (Peru), where an outburst flood from the Palcacocha lake during December 1941 took the lives of 5,000 persons (Vilímek et al., 2005). We do not know exactly whether the direct triggering factor for destruction of the dam was a landslide into the water or rather slow but continual erosion of the outflow from the lake due to increased precipitation. We can only eliminate earthquake, because no serious shaking was registered in the surroundings.

These interactions are very important in assessing the vulnerability of the area in question and in the management of risks. Many times during our fieldworks in the Andes, we were facing the problems that local people could not understand that the area inhabited by them is not safe because they live in a region with a high level of seismicity; and this may be a triggering factor for a huge landslide from the slope above. Nevertheless, the local authorities try to solve this problem through community education using school children to transmit the proper information to their families (Fig. 3).

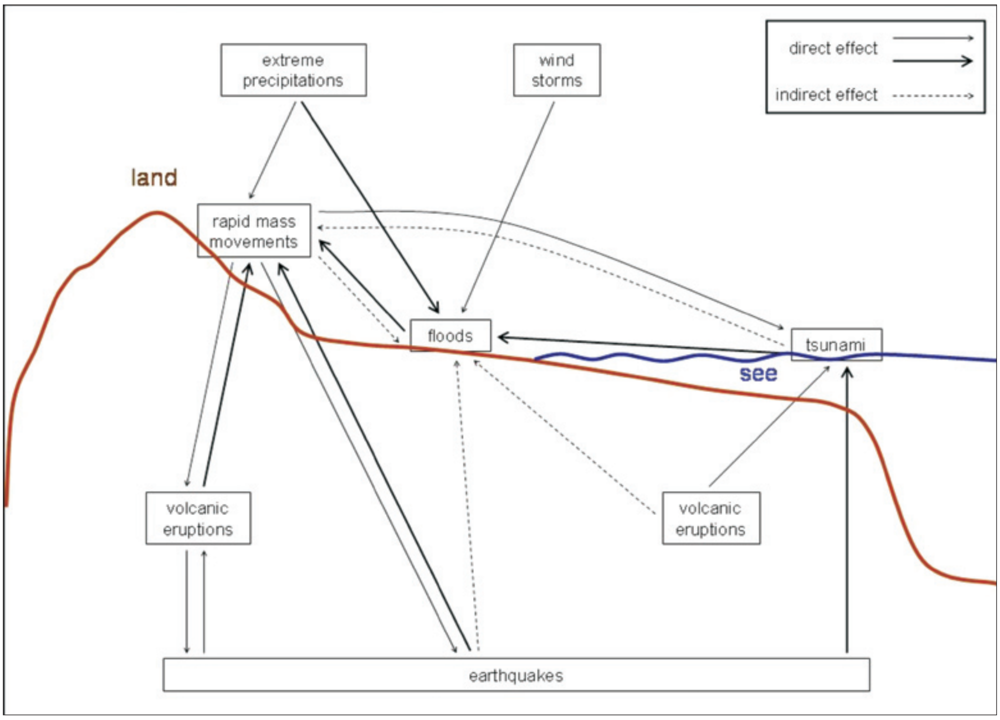

Fig. 1: The structure of connections between different types of natural hazards

3. High mountain areas

Many natural hazards are associated with the mountain environment, because of the high relief energy of that area (Fig. 4). Also endogenic processes play an important role as significant triggering factors for several processes. Even relatively slow mountain-building processes contribute to the increase of the potential relief energy. Various types of geomorphic processes are responsible for sudden and fast responses of external as well as internal changes in dynamic systems. The scientific base of physical geography (including geomorphology, but not only) represents an efficient instrument in understanding these natural processes (Vilímek, 2003). Earth-surface processes such as various types of landslides, floods (or glacial lake outbursts) represent natural hazards, moreover other processes such as deforestation, climatic changes or land degradation are liable to worsen the stability of systems (Fig. 5). Many processes are influenced by relief characteristics such as steepness of slopes, lithology or ruggedness of topography.

We can characterize geomorphic processes, which form landscapes according to their rate. Two basic groups were described e.g. by Demek (2008; first – slow processes, and second – rapid to catastrophic processes. Both rapid and slow geomorphic events may lead to relief disturbances; it is only a question of time. Kalvoda (1996) characterized unstable landforms as those, which "show a lack of equilibrium with the natural environment and try to obtain equilibrium

Fig. 3: A simple pictogram – example of an instruction manual for children to show them what to do during an earthquake. People should protect themselves close to the strongest constructed parts of the buildings

through modification or by means of particularly dynamic processes".

Slaymaker (1996) categorized different types of natural hazards into following groups: ”high magnitude and low frequency“, “low magnitude and high frequency“ events with a transitional category “continuous”. Nevertheless, most of the processes are involved in both categories. As only 3 categories out of 13 are considered to be purely ”high magnitude and low frequency“ (jokulhlaups, karst collaps, neotectonics), it seems that the table fails to characterize the diversity of various processes.

Fig. 4: The Vakhsh nape at the border between Pamir and Tien Shan mountains is one of world’s famous areas with strong mountain building, where exogenic processes (such as intensive erosion or slope deformations) are enhanced by endogenic activity (Photo V. Vilímek)

Fig. 5: Intensive erosion in the mountain range of Cordillera Blanca (Western Cordillera of the Andes) is a result of both land degradation and recent neotectonic uplift (Photo V. Vilímek)

4. Natural hazards and risks in the light of time and space

Geomorphic hazards are characterized by magnitude, frequency and area extent (Slaymaker, 1996). There is a general agreement across the geosciences about balance in the occurrence of natural hazards between high frequency events of low magnitude and low frequency events of high magnitude (e.g. Malamud and Turcotte, 2003). Regarding a more specific analysis, they point out that is a good agreement exists for medium and large events.

To verify (or refute) this theory, a representative set of data has to be checked – a sufficiently long series of data from monitoring, observation etc. This might sometimes be a problem, because monitoring is usually a question of the last decades and the quality of observed data decreases with their age. Brázdil and Kirchner et al. (2007) draw attention to the heterogeneity of documentary data about hydro-meteorological extremes from the period before systematic monitoring was introduced. They describe the spatial-temporal heterogeneity.

Geomorphology is a specific instrument, which can enlarge the set of data about prehistoric extremes. These data are not relevant for monitoring or direct observation by eye witnesses, but we have to bear in mind that large-extent geomorphic events leave behind relevant relief forms (of erosional or accumulative character) depending for a long period on the climatic-morphogenetic zone.

In the case of prehistoric events, geomorphological research can be useful – from a record in relief, we are able to identify events anterior to human memory. As an example we can give the present prediction models of volcanic activities of the Popocatépetl based on the sedimentologically and archeologically well-documented series of eruptions of this volcano during the last 22,000 years (Sheridan et al., 2001). But even this is insufficient in the case of Popocatépetl and a possible threat to the Mexico City agglomeration, because the eruption of the highest intensity occurred only once during the past 22,000 years, which is statistically insignificant (Fig. 6).

From this point of view, zoning is important. One of possible approaches is to determine the risk in the given area as "a function of the cumulative severity of damage from earthquakes, floods and so on, irrespective of the occurrence frequency of these events" (Bolt et al., 1975). In this case, time is not included as one of factors influencing the given process. The second possible methodological approach is to take into account the frequency of natural hazard occurrences. This enables a comparison to be made of scarcely repeating events of catastrophic impact with much more frequently occurring events of lower intensity. In such cases, the probability of occurrence in a given locality/region is related to the period of 100 or 1,000 years. According to the principle of mutual relationship magnitude – frequency as it was described by Wolman and Miller (1960), the quantity of work performed (as the sum of catastrophic events) is equal to the multiple of magnitude and frequency of occurrences of the event.

Fig. 6: Example of lahar on the slope of Popocatépetl from the volcanic eruption during the beginning of this century (Photo V. Vilímek)

According to Alexander (1993), the most extreme events occur too rarely to be of a greater significance and, at the same time, the most frequent are events of such a low magnitude that even their cumulative value is not significant.

In the case of very frequently occurring events of low intensity, we can state that there are certain threshold levels which must be exceeded so that the given event would have some impact – e.g. a visible erosional-accumulational development of a valley occurs only during floods exceeding a certain flow. A slope will become unstable only after exceeding a certain quantity of rainfall amounts, etc. On the other hand, the most extreme types of natural hazards, although occurring only very rarely, can have such an impact on the landscape that they will be identifiable even after a longer time (as they have a great erosional capacity and transport an immense quantity of material). For instance, huge prehistoric rock falls from Huascaran can be documented even nowadays (e.g. Plafker and Ericksen, 1978). Huge rock falls (again prehistoric) in the area of Machu Picchu can be also documented in the relief (e.g. Vilímek et al., 2005, 2007). It is nevertheless difficult to forecast such events.

With respect to forecasting and general impact on human society, natural hazards of average intensity occurring at an average frequency are very important: the society is able to prepare for facing them and they represent a sufficiently high risk to be taken into consideration.

5. Prediction

An important factor for prediction is the regularity of occurrence of such events. However, this is problematic. In some types of natural hazards (such as earthquakes), the theory is that accumulated tension must be released – either in shorter periods or once in a longer period with a higher intensity. This would be true only on the condition that the increase of tension is uniform. For instance, the movement of lithospheric plates should be uniform. The question also is, whether we have a sufficiently long time series to eliminate incidental events. In this case, records in chronicles can be useful (e.g. Brázdil, Kirchner et al., 2007). Elleder (2007) uses the example of historical floods in the Labe R. and Vltava R. basins to show that the frequency of historical records is a function of time, with an increasing tendency (from the last decades/centuries we usually have larger sets of data). In general, recent historical records are more credible.

Prediction, forecast and modelling of natural processes increasingly gain on importance with regard to climate variability (e.g. Benešová and Matějíček, 2007; Kliment and Langhammer, 2007). In spite of all the research and increasing technological possibilities, we often have to rely, during natural disasters, mostly on reducing the risk and impacts. Some processes, such as volcanic activities, are relatively easily predictable; although not at a sufficient precision as to time and intensity of eruptions (localisation is relatively easier). On the contrary, the prevision of earthquakes is very difficult as to their place, time and intensity. Neither floods are predictable in a longer time horizon. In dependence on actual or approaching precipitation we can model imminent floods, but only several days or hours in advance. Several approaches exist in the field of flood modelling (e.g. Beven, 1996, 2001; Jeníček, 2007). Conclusions published by the National Research Council (1995) make it clear that certain partial achievements in predicting the impact of climate on natural hazards were registered in connection with research into the variability of Earth's climate. An example thereof is annual prediction of the occurrence of the El Niño phenomenon. Communities dependent upon farming or fishing can, to a certain degree, prepare themselves for the coming situation. On the other hand, certain types of natural disasters are unavoidable, such as landslides (Vilímek et al., 2000) or floods.

The role of geomorphology in hazard prediction is in assessing hazard potential by defining zones of considerable surface changes. Several unpublished reports were elaborated about the morphostructural evolution of selected areas in the Czech Republic with respect to searching for a safe place for waste deposits from nuclear power plants. Scientific results of morphostructural analysis were published (e.g. Balatka et al., 2000). Other applied geomorphological research was connected with the area of open pit mines in north-western Bohemia. Stability and potential slope instability problems were a matter of interest of other unpublished reports. The scientific essence and description of recent processes was published in various publications (e.g. Kalvoda et al., 1993; Kalvoda et al., 1994).

6. Conclusion and discussion

The landscape character of certain areas predetermines by some means the type and intensity of geomorphic hazards. From the viewpoint of the place it is a given fact nevertheless the aspect of time is much more flexible. During past periods, the extremity of natural processes might be higher in a given place than we suppose from the historical record. This is why palaeogeomorphological studies are notable (e.g. Klimeš et al., 2009). Scientific experience from the 1997 and 2002 floods in the Czech Republic revealed that it is not easy to distinguish the rate of anthropogenic influence on the flood process. From this point of view, the paleogeomorphological record in the valley floor is very important. From the study of landforms and sediments, we are able to quantify the rate of extremity of the past processes. The effects of floods disappeared from the landscape very quickly if no constructions were touched, but means of geomorphological research are able to identify manifestation of rapid processes and significant surface changes.

Both space and time are categories closely associated with natural hazards and risks, although there is no causal relation. Uneven distribution of the different types of natural hazards on the Earth is given by the geophysical character of these events. Besides, human vulnerability includes the factor of space – geographical distribution. In the background of linear time scale we can register individual natural disasters, look for links between frequency and magnitude. Time, as an important factor, is also present in risk management. In general, these categories (space and time) can undergo dynamical changes and have therefore a specific role in studying natural hazards and risks.

The human aspect cannot be eliminated in this sense. Moreover, it gives a new proportion to natural hazards studies. Not only can human activities evoke geomorphological processes, but they can also accelerate processes that have already occurred or increase damages. The growing population density and the subsequent expansion to mountain areas increase the demand factor and price of buildings and infrastructure. Geomorphologists will probably not be able to predict the accurate time of natural disaster but they are able to specify areas (zones) with a higher probability of disaster occurrence. This might be useful in disaster management and spatial planning.

Geosciences can benefit from geomorphology because thanks to palaeogeomorphological research and/or with the use of dynamic geomorphology, geomorphologists can explore even older natural hazards reaching beyond the historical records.

Acknowledgement

This paper is based on research undertaken within the research project “Geographical Systems and Risk Processes in the Context of Global Changes and European Integration” No. MSM 0021620831 sponsored by the Czech Ministry of Education, Youth and Sport.

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SUSTAINABLE DEVELOPMENT OF RURAL MICROREGIONS IN THE CZECH BORDERLAND

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Abstract

Sustainability of the Czech Republic borderland microregions is studied from the demographic, economic, and social angles. The borderland countryside as a whole was pronounced sustainable; it is the individual habitations that may be endangered. Because of the physical barriers of the state boundary sustainment of economy with the aid of cross-border cooperation is only suitable for some microregions. We consider social sustainability, especially education, qualification, and the overall cultural standard of the borderland and its human capital as decisive.

Souhrn

Udržitelný rozvoj rurálních mikroregionů v českém pohraničí

Udržitelnost pohraničních mikroregionů Česka je studována z demografického, ekonomického a sociálního hlediska. Bylo konstatováno, že pohraniční venkov jako celek udržitelný je, ohrožena mohou být jednotlivá sídla. Udržení ekonomiky za pomoci přeshraniční spolupráce je kvůli fyzickým bariérám státní hranice vhodná jen pro některé mikroregiony. Za rozhodující považujeme sociální udržitelnost, zejména vzdělání, kvalifikaci a celkovou kulturní úroveň pohraničí a jeho humánní kapitál.

Keywords: *Rural borderland; demographic development; rural economy; human capital, the Czech Republic*

1. Introduction

Borderland becomes a current research territory from a number of perspectives. One of these are the changes in character of the state boundaries coming swiftly one after another. In our case since 1989 it has been the downfall of the Iron Curtain, the split of Czechoslovakia and the emergence of a new state border in the east of Moravia, the accession to the European Union and the related issue of Euroregions, and the accession to the Schengen Area; this process will no doubt be completed by the introduction of the Euro single currency. An interesting question is what has been the impact of all the above changes on the development of border regions, which have been coping with the post-World War II changes – the compulsory transfer of German inhabitants and the process of repopulating the borderland – up to now.

Another problem is the objective deepening of the differences between central and peripheral areas during the transition from centrally planned to market economy, and an application of the regional policy tools in the endeavour to balance some of these inequalities. It is exactly this context in which the question of sustainability of the borderland regions emerges. It is known from the history that, apart from Hitlerian propaganda, economic backwardness of the borderland was the main motive for irredentist tendencies of the majority of Czechoslovak Germans towards the end of the 1930s. Post-war Czechoslovak governments were aware of this fact, and had no intent (with the exception of heavy industries) to fully replace the original inhabitants in terms of quantity. What are the trends and perspectives of the borderland regions' development at present?

Naturally the very concept of the country is going through highly distinctive changes. After World War II the requirement of labour in agriculture has decreased, many farmers left for cities to work in the industry. The accessible countryside was settled by people commuting to towns and cities for work, whilst the remote countryside became a paradise of owners of holiday houses and cottages. Expectations of these new inhabitants of rural areas totally differ from the preferences of the original farmers (Blunden and Curry, 1998). As with an assessment of any settlement structure the question of target groups has to be raised, this development is very important for the assessment of sustainability of the rural settlement.

This paper was elaborated within the project No. 2D06001 of the National research programme II by the Ministry of Education, Youth and Sports of the Czech Republic under the name "Interests of Development in Border Regions (Case Study Orlice)". It was read at the ProRegio Conference organized by the Institute of Regional Information in Brno in 2008. The article is aimed at rural borderland microregions. It is hardly possible to speak about marginality of urban regions in the borderland.

2. Definition of sustainability

The commonly used definition of sustainable life, based on the famous report Our Common Future by the UNO World Commission on Environment and Development reads: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The idea of sustainable life includes an integration of three different aspects: social, economic, and environmental (Huba et al., 2000). Sustainability may be related to biological organizations (for instance a forest), human organizations (for instance a habitation), or human activities (e.g. agriculture). At the beginning of the 21st century even a science on sustainability is created - sustainability science (Clark, Dickson, 2003) focused on the relation of nature and society, and in 2006 the Tokyo University started to publish the Sustainability Science magazine.

Sustainability also has a regional aspect. We may speak about sustainability of regions, towns and cities, country habitations and the like. In most cases we are concerned with what level of sustainability is found in certain territories and regions. In this sense of the word, such countryside, which renders a healthy environment to its inhabitants, and which provides for their economic and social requirements in a manner taking into consideration the potential of local and superior resources, as well as the needs of future generations we could pronounce a sustainable countryside. In doing so, we bear in mind the sustainability of life in the country habitations in question. One of the opinions about these issues is for instance the concept of permaculture (Holmgren, 2006). However it is a question whether this concept is generally sustainable or whether it rather represents one of alternative ways of life.

But the question of sustainability may also be put whether the studied habitations are sustainable as such. Thus ecological sustainability will be understood as an ability of (demographic) survival. Economic sustainability may be defined as a set of functions that may ensure economic functioning of the country in the conditions of market economy. By social sustainability we mean the ability of borderland countryside to fulfil social, cultural, and physical needs of the citizens in an adequate manner.

The reader obviously expects an analysis of environmental sustainability as well. Turnock (2001) highlights that primarily Czech and East German countryside was largely affected not only by emissions degrading soil and forest stands but also by vast opencast mining during the socialist period. This very much holds for the Czech-Saxon borderland. Since the 1990s these issues have been intensely solved, albeit not quite completed. However they do not present a risk in the sense of worsening of the situation, and thus jeopardizing of sustainability. Contrary to that, the Czech-Saxon borderland (from the Czech side) recently becomes a region with a big migration increase of a number of rural habitations.

3. Population sustainability

From the perspective of rural habitations the question of their physical survival is primarily an issue of the demographic development of their population. In the surrounding countries (especially Saxony and Poland – e.g. Knappe, 1998; Eberhardt, 1994; Stasiak, 1992), but also elsewhere (Stockdale, 2004) the peripheral countryside is said to be in mass depopulation. What is the situation in the Czech borderland?

From the different development of numbers of inhabitants in the cities and rural municipalities in the 1991–2001 inter-census period, and from the development of the number of inhabitants in the 2001–2008 period it is possible to infer that in the Czech Republic too relatively intense suburbanization and counter-urbanization procedures are under way, such as those described abroad by e.g. Fielding (1982) or Escridano (2007). Generally this is a decrease of population share living in cities (especially big and medium-sized), and an increase of the share of inhabitants living in the country including some of its centres of the small town type.

Naturally it may be assumed that the mentioned processes do not proceed evenly, but are differentiated within the territory of the state (cf. Spencer, 1997). Hypothetically central or peripheral location of the habitations, their size structure, the connections with the labour market but also individual specifics may be manifested. Thus the general counter-urbanization trends do not automatically rule out a possibility of peripheral (and borderland) countryside depopulation.

For the purposes of a borderland assessment 110 microregions of authorized municipal offices attraction zones the territories of which are in contact with the state border have been delimitated. Consequently the 2002–2006 period balances of inhabitants were evaluated. Out of the total number of the borderland microregions hived off this way, 43 microregions have recorded an increase of inhabitant, 67 microregions a decrease of inhabitants. After the data for centres deduction values for non-centre municipalities of the individual microregions were obtained. After this step 66 microregions were found incremental and 42 decrement. It is therefore evident that the demographic development of the borderland microregions countryside is markedly more favourable than the demographic development of the centres of these microregions.

Furthermore, an analysis of borderland municipalities with less than 2 thousand inhabitants has been performed (Vaishar, 2008). Out of the total number of 1,038 of these municipalities 626 (60.3%) have recorded an increase of inhabitants, while in 386 municipalities (37.2%) the population has decreased. This is indicative of an optimistic development of rural settlement in the borderland. It is stated that the population is endangered above all in small municipalities with less than 200 inhabitants. There are 229 such municipalities in the borderland we have delimitated. In 109 small municipalities a positive as well as a negative demographic development has been recorded. Thus it is not possible to speak about small municipalities being jeopardized as a whole; it is rather the fact that with a very low population even a relatively small absolute decrease of inhabitants may mean coming near to the existence limit of a habitation as a municipality.

Thus it turns out that the Czech borderland countryside as a whole is not endangered by depopulation, and it is therefore "environmentally sustainable". Although individual sections of the borderland are differentiated, none of them shows depopulation tendencies as a whole. However it has to be remembered that there may be individual municipalities – and more often their local ends – that may be jeopardized. Especially the western part of the Czech-Austrian borderland and a part of the Czech-Bavarian borderland have a number of very small habitations, where even a disappearance of very few families may lead to an existence imperilment (Kubeš, 1999). The process is also connected with landscape changes (Kubeš, Mičková, 2003). However, such has been the situation in this region for decades.

It also has to be remembered that statistic data relate to the so-called permanent residence. Yet recently the contents of this term undergo a substantial change. Formerly people have predominantly stayed at the place of their permanent residence for most of the time, whereas today this does not have to be the case. A number of mainly young inhabitants of the country stay in cities or even abroad, where they study, work, carry on business, travel etc., without being stabilized there yet; therefore they still have their principal residences in their parental municipalities.

The third note is that the period closely after 2000 has been extremely favourable in terms of population. The process of deferred reproduction was being entered by the strong 1970s age groups, who copied the post-war population explosion, moreover supported by the pro-population measures of the then government. It is highly probable that after 2010 the trends of natural population movement will again become much worse (Kretschmerová, Šimek, 2004). However the relative proportion in relation to cities still appears favourable for the country and any threatening situation leading to liquidation or a major population sinking in a greater number of rural habitations in the borderland cannot be expected.

4. Economic sustainability (and a possible cross-border cooperation)

In this subchapter let us ask a question whether there are important economic functions the country may

Type	Number	%
Population increase by both natural development and migration	288	27.7
Natural increase is higher than decrease by migration	39	3.8
Increase by migration is higher than natural decrease	299	28.8
Population balance is neutral	26	2.5
Decrease by migration is higher than natural increase	121	11.7
Natural decrease is higher than increase by migration	106	10.2
Population decrease by both natural development and migration	159	15.3
Total	**1 038**	**100.0**

Tab. 1: Demographic types of municipalities with less than 2000 inhabitants in the Czech borderland

secure for the society, and at the same time functions that will ensure its further sustainable development. A traditional rural function is agriculture and other activities of the primary sector but these undergo a major transformation in the Central-European circumstances (Věžník, 2002; Věžník, Bartošová, 2004; Bičík, Jančák, 2005). First of all, the share of economically active persons employed in agriculture has very swiftly decreased. In the Czech Republic the share of persons employed in the primary sector has fallen to 4.5% (2001), and it may be assumed it is still on the decrease. Thus from the perspective of employment and population incomes agriculture has not been the main function of the country for a long time.

The national economic importance of agriculture is also decreasing. Between 1990 and 2006 areas under crops have decreased to 79.1%, out of this with cereals to 94.5%, leguminous crops to 54.2%, potatoes to 29.1%, sugar beet to 45.7%, fodder plants on arable land to 39.0%. Only areas under crop of rape have increased to 321.2% of the year 1990 state. The harvests have also decreased – with cereals to 71.4% (although in this case 1990 has been an exceptionally productive year), with leguminous crops to 57.6%, potatoes to 39.4%, sugar beet to 77.9%, fodder plants on arable land to 37.5%. With rape the yields have risen to 289.0%. In the same period the production of meat went down to 63.4%, the production of milk to 56.1%, egg laying to 67.3%.

By contrast, between 1998 and 2005 throughputs in forestry have increased by 8.5% with a one quarter decrease in the number of employees, although a share of this was due to salvage felling and also a ruthless exploitation of forests by private companies. Nevertheless in the rural borderland circumstances forestry may be economically profitable.

From the angle of land utilization the situation is somewhat different. Agricultural land occupies 4,254 ths. ha, which means 54% of the surface of the state. Its area has decreased by 5.6% since 1990. However, its composition has changed to the detriment of arable land (a decrease to 94.4% of the 1990 situation) and in favour of permanent grasslands (an increase to 117.2%). Forests take another 34% of the area. Thus primary activities ensure a care of 88% of the Czech territory, whilst this share is still bigger in the country. For this reason primary activities cannot be substituted in the country, and will continue to remain the principal activities from the angle of landscape maintenance. To become resigned to these activities and to leave the land derelict would have serious negative economic as well as environmental consequences.

Rural borderland plays an important role in this process. If we take into account that a great part of borderland microregions are situated in locations where an intensive agriculture may hardly be considered, but on the other hand these microregions have protected territories of all categories, the landscape maintenance is a top-priority task of the borderland areas agriculture, and it should be looked upon from this point of view. Moreover there are also conditions for the development of alternative forms of agriculture. Obviously state (and European) support is necessary. Forestry remains an important economic sector of borderland microregions the forest coverage of which usually exceeds nationwide averages.

Most materials mention the development of tourism (Mitchell et al., 2005) with its sub-branches like agrotourism (Béteille, 1996), considerate tourism etc. as a perspective sector. Saxena et al. (2007) highlight that rural tourism is more sustainable than the usual forms of tourism, as exactly this tourism integrates natural, cultural, and economic resources of the region. Almost every borderland region of the Czech Republic offers natural, cultural, or historical attractions for the development of tourism. Protection of nature may function as an attraction factor but at the same time as a factor limiting touristic activities. Simultaneously there is a shortage of infrastructure of a suitable level because of the peripheral character of a great part of the borderland countryside. The cooperation of individual subjects and marketing also show great backlogs.

It is possible to say that tourist traffic in the borderland countryside is not so much a rural tourism but tourism in the country. The owners of the properties very often live in cities or even abroad, the buildings are of a rather urbane character, and the guests are sometimes in fact separated from the real country. Thus a question arises how is tourism of this type beneficial for the country apart from the fact that the guests leave behind a waste in the rural habitations, and this waste has to be disposed of at the expense of the municipalities.

Therefore it is necessary to support such tourist traffic, which would stem from the rural environment. It is very suitable for the holidaymakers to consume local products and service, and thus to leave at least a part of financial means in the borderland countryside. On the other hand it is necessary to put limits on a tourist traffic with consumer character in regions with a recreational overburden, e.g. in the Krkonoše Mountains. At any rate it is clear that borderland rural regions cannot survive on the tourism activities only, as it is moreover subject to a vogue and in our case also dependent on the weather. A marked seasonal character also limits the economic effectiveness of this sector.

Another possible function of the borderland countryside is the development of small-scale industrial and craft manufacturing and services. In the first place these are services directly for the rural inhabitants. Understandably the scope of these services is dependent on the size of the local market. It holds for big rural municipalities that they may maintain a relatively large scope of basic services in the spheres of retail trade, educational system, health service, service for the inhabitants, public catering etc. Small and very small habitations do not enjoy these possibilities, and are reliant on their centres, i.e. in many cases small towns, which have a decisive role in sustainability of the countryside (e.g. Rydz, 2006). These are primarily peripheral small towns (Lampič, Špes, 2007); albeit they do not count among the richest, because of the lack of competition of big and medium-sized cities they are definite centres of their rural hinterland, and have no substitutes in this role. Recently arisen phenomena are distant hypermarkets competing with local retailers.

However the country may also be a location of some kinds of production and services for a wider territory. Traditional manufacturing facilities of this kind are basic processing of primary manufacture products – food products, wood etc. or extraction of local raw materials. Some plants of the former subsidiary enterprises of unified farmers´ cooperatives remain from the past.

In relation to the real prices of land also other factors of localization of manufacturing and non-manufacturing industries come into question presently. These are activities requiring relatively large areas, whilst expecting more likely one-off visits by customers, e.g. outlets selling construction materials, furniture, used cars and the like. In these cases, the important things are an abundance of free space and a good access by road. Thus, it can be expected they only concern a smaller part of borderland municipalities. Restructuring of regions after mining activities is a special issue. Mining has impacted not only large industrial centres but also a relatively wide rural hinterland. The question is, how the originally rural areas can function after the end of mining. Improvement of the environmental situation is a positive side of the coin (Ladysz, 2006).

Other possibilities are emerging in relation to demographic changes. The Czech population inexorably ages, and this process will be intensified in the future. Countryside with its quiet environment is an ideal location for social service establishments like boarding houses for senior citizens, old people's homes, hospices and the like. This may be completed with the development of service for senior citizens in the spheres of health and rehabilitative care, culture, retail shops etc. An advantage to these activities is that they are partly paid by the state and thus relatively secured, as well as the fact they at least partially offer job opportunities in non-manufacturing branches.

A possibility of doing a highly qualified work from home through modern media of information transfer, primarily the Internet is sometimes discussed. Modern communication technologies certainly make the access to information and contacts among people easier. It does not seem possible, however, to replace face-to-face contacts by electronics. In addition many companies are reluctant to let information out into the digital world, outside of their internal controlled space. Therefore we do not assume that an on-line work from home could currently be a principal conceptual solution for peripheral rural areas, although it may happen in individual cases.

Obviously a significant activity in the country is dwelling – in economic terminology council housing. In relation to the current counter-urbanization trends, this function becomes a priority in many places. The factors in favour of country living are primarily dwelling in one's own house on one's own land, and a feeling of a greater personal safety of the family members. The proclaimed factors are closeness to nature and a contact with the rural way of life but these are usually put into effect only as far as individual moving of inhabitants to the country is concerned; as a rule they do not function in concentrated suburbs. The disadvantages of this way of life are transport and energy demands, and an inadequate infrastructure, especially social, of the country in relation to the habits of "city" inhabitants.

In the Czech circumstances the so-called second dwelling is a chapter of its own (Fialová, 2001). It seems that especially owners of holiday homes have saved a part of rural residential properties that would otherwise uncontrollably deteriorate. With a good management it is possible to make use of experience, qualification and contacts of the owners of second houses also for the development of a municipality. The coexistence of owners of second houses with the local community remains to be a task for sociological research. This is because the original inhabitants and the owners of holiday homes may differ from the angles of age, social, and educational structure, and may thus have differing interests and motivations. Their balancing – if it is successful – may hypothetically bring a great benefit especially to peripheral municipalities.

Last but not least, the protection of nature and landscape are entering the scene. A great part of the Czech borderland countryside is under some kind of a large-area protection. There are national parks and protected landscape areas, biosphere reserves, and even a creation of landscape architecture protected by UNESCO as a part of the world heritage. On the one hand this protection adds to the attraction and promotion of the borderland, but on the other hand it puts limits on some economic activities. Finding of a suitable balance between protection and utilization is a major issue. Neither extreme protection nor unlimited economic utilization is sustainable.

Is the borderland countryside of today economically sustainable then? It seems there is a wide spectrum of possible functions, which make country habitations eligible for an economic survival, although this does not have to hold for completely all rural habitations. Therefore the question of economic sustainability has to be examined separately for each case and each period. It also manifests itself that sustainability depends on the ability of important subjects to maintain the balance among various interests, and to use rather the positive sides of conflicting interests than to accentuate negative outlooks.

The sense of the cross-border collaboration is an open issue. Although much effort is observed in this direction (e.g. Jeřábek, 2002), it seems that the development of the collaboration is insufficient (Dokoupil, 2001). In many cases, the collaboration is understood as a tool for gaining financial resources from EU or as a tool for the self-representation of borderland regions exponents. Moreover, some psychological, historical, language or currency barriers remain.

5. Social sustainability

Let us ask the question what are the social prerequisites of sustainability of the country, how are these secured by the rural municipalities, and what is the outlook for the future. An important criterion is the educational structure of inhabitants; in our circumstances this replaces other indicators, for example income groups of the population to which there are no data available.

Research (Vaishar, Zapletalová, Dvořák, 2008) have shown that in all 110 borderland microregions under study the share of persons older than 15 years with post-GCE education was lower than the nationwide average. The situation was even worse with rural microregions, especially those having the smallest cities as centres.

Understandably this situation has a number of consequences. From the most general angle it is the overall cultural standard of the rural borderland inhabitants in the widest sense of the word. In specific cases this concerns a more conservative thinking, a lower initiative, a low potential to process visions, concepts and programmes, with which it would be possible to apply for various grants, and finally the issue of acquiring an adequate number of persons

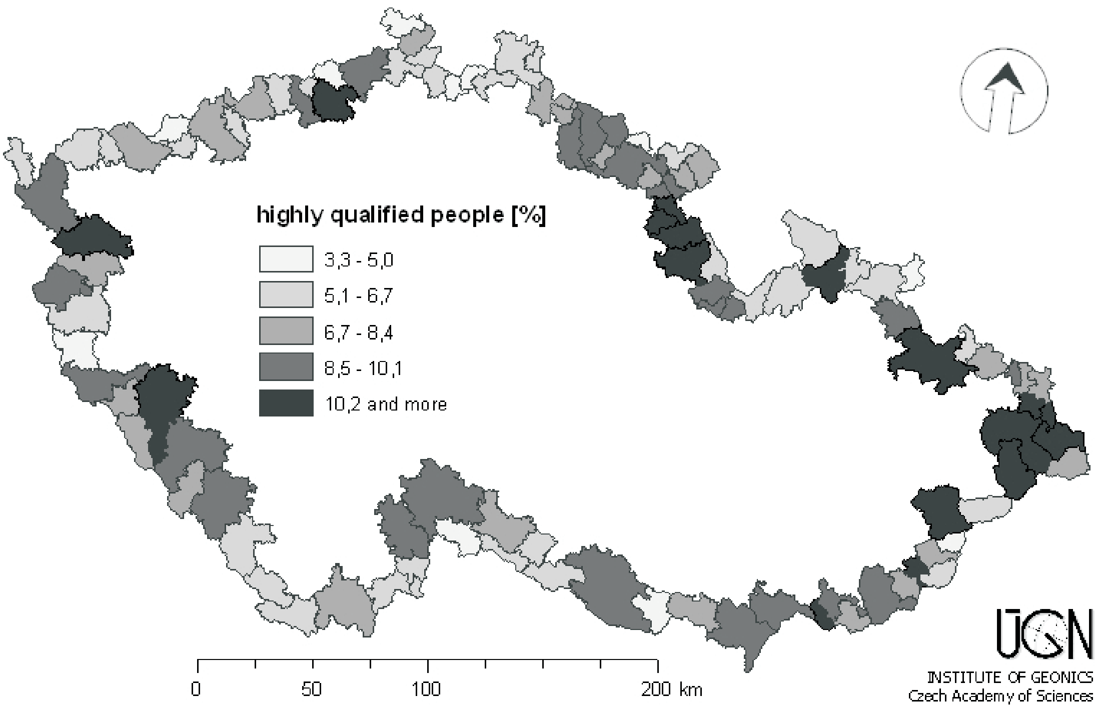

Fig. 3: The share of the borderland microregions' inhabitants with higher than secondary education (2001). The nationwide average was 12.5%

capable of getting involved in the self-administration bodies, especially of the smallest municipalities. In the borderland a lowered ability to communicate in the language of the neighbouring nation (except for Slovakia), to understand and tolerate the neighbours' attitudes, the ability to explain one's attitudes also plays its role.

Moreover, in a great part of cases the above aspect correlates with the consequences of the post-war exchange of population. The generations who came to the borderland after 1945 have not considered their new places homes. They regarded their municipalities as temporary stations, have not acquired the certainty of owners or administrators of properties; they had a distrustful relation to the former proprietors – the compulsorily transferred Germans. It has to be stated, that the relation to a locality has not been supported by the state either, with its collectivization, communization, and attempts to liquidate not only the higher stratum, but also the middle class in the borderland. The claims raised by the former Czech Germans in contradiction to the post-war European reality were far from helping to stabilize the situation. Only the more recent generations of the borderland population that start to feel at home in these regions.

A major social issue, indicative of problems in the sustainability sphere, is usually considered to be the high unemployment. The analyses performed have shown that the unemployment in the borderland regions is a rather a function of an economic transformation than a peripheral location. It is true that in 62 borderland microregions the situations is worse than the nationwide average (8.6% in September 2009). In 28 microregions the situation is better than the average, and in 19 microregions the unemployment rate moves within a half percentage point around the nationwide average.

The highest unemployment rates, however, are experienced in the borderland regions, which underwent the conversion of heavy industry, i.e. mostly the urbanized microregions in the Ostrava area (especially in the Karviná district) and in the north-western Bohemia (a strip from Kraslice to Varnsdorf). Some other microregions (the areas from Hanušovice to Osoblaha or Uherský Brod to Hodonín) fall into this subdivision as well. Conversely in some parts of borderland the situation in the labour market is markedly better than the average in the CR (e.g. in the parts from Jindřichův Hradec to České Velenice or Police nad Metují to Jablonné nad Orlicí).

The typical problem of sustainability with a vast social impact is closing down of country schools. There were 275 basic schools closed down in the Czech Republic between the 2005/2006 and 2006/2007 school years. Although this number certainly includes some city schools as well, it may be expected that many of these cases have happened in the rural areas, where the numbers of children of school age have decreased below an acceptable level. The situation is by no means made lighter by the fact that the numbers of children are fluctuating. A close-down of a country school in not an issue of commuting to a city or a bigger village; this has both technical and economic solutions available. The main problem is that in small municipalities the last cultural institutions (probably apart from municipal libraries) irretrievably disappear together with the school. A municipality without a school declines a class lower in the hierarchy of municipalities. An existence of a school may be a criterion when inhabitants are making their decisions about staying or leaving (Trnková, 2009). Closing down of schools may be considered a part of marginalization of the affected rural municipalities (Kučerová, Kučera, 2009).

This is also related to the development (or decline) of the social life of rural municipalities. After 1990 the role of some organizations of a political character under the guise of a uniform ideology has declined or markedly diminished. It is a question to what extent the municipalities succeeded in making for this deficit through the development of a voluntary activity that would be of importance for the entire municipality or its greater part. This side of municipal life is sometimes underestimated in favour of building a technical infrastructure, although it is of the same, if not greater importance. It is the club life that makes a community of the inhabitants of a municipality; otherwise they are a set of individuals. This is especially important in the face of suburbanization and counter-urbanization trends that bring inhabitants, who are not rooted there, to the country.

It may be assumed it is the social sphere where the main issue of rural borderland sustainability rests. The main social problem of the post-socialist countryside is often considered to be the shortage of job opportunities (e.g. Herslund, 2008). In our opinion, however, it is much more the issues of culture in the wide sense of the word, social life, interpersonal contacts, a share in administration and the like.

6. Discussion and conclusion

Is the borderland countryside sustainable then? We would like to state it is despite all the events it has undergone. However for the individual municipalities of these regions it is not implied. The future development too certainly remains a question.

It is true that in the years following the turn of the millennium the borderland countryside has recorded a markedly positive demographic development. It has to be noted, however, that the process of deferred reproduction was entered by the strong 1970s age groups at that time; moreover the reproduction power of the strong post-war years was supported by the massive pro-population measures of the then state government. Will the rural borderland maintain the positive demographic trends even in the period when this wave becomes depleted?

On the one hand for the period to follow it is possible to expect impaired conditions of natural reproduction, as the fertility development has become somewhat better but the Czech Republic still remains among the states occurring deep below the level of simple reproduction. In 2008 the overall fertility amounted to 1.497. On the other hand it may be assumed that suburbanization and counter-urbanization trends will still continue. Although certain depletion may be presumed even in this sphere, it is not likely to occur in the nearest future.

Remoteness of the country must not always imply its marginality in the sense of economic backwardness. For example Ciok et al. (2008) call attention to the German-Polish borderland as being conversely a line of development making use of intraregional diversities. In the circumstances of the Czech Republic such role may probably be played by the Czech-Bavarian frontier. Also in the other sections of borderland there are microegions (e.g. Vejprty, Javorník areas), where the centres of the neighbouring countries are markedly better accessible than the Czech centres. After the accession to the Schengen Area the Czech crown is the only real barrier preventing a full development of economic cooperation, and a possible replacement of peripheral character on the Czech side by cooperation with the neighbours. From this angle a speedy switch to EUR is in the interest of the rural borderland.

But this hope only holds for a smaller part of the rural borderland as the prevailing length of the Czech borderland consists of natural barriers. Experience show that these barriers put limits to a possible cooperation not only in physical, but also psychological sense. Certain hopes were placed on Euroregions that today cover the entire Czech borderland (Peková, Zapletalová, 2005). Nevertheless, the hitherto experience show that, rather than a support of a cross-border cooperation, self-government authorities see Euroregions as possibilities to acquire financial subsidies for their own development. It has also been found out that if cooperation occurs, it is primarily cooperation between institutions and authorities of the Euroregion centres, which are sometimes considerably distant from the border. It is not the rural borderland that plays the main role in these relations. One of the outcomes is opening of a number of new border crossings of a local importance, often only for pedestrians or cyclists. But this is also important as it is not possible to speak about cooperation without functioning roads.

Yet we presume that social sustainability will be decisive. The major role in it is played by the level of education. However it is not possible to proceed through a mechanical increasing of the rural borderland inhabitants' qualification. Most of university graduates would probably leave these municipalities. It should rather be a system of lifelong education that would enhance the overall level of cultural development of the borderland countryside.

Fig. 5: An example of cross-border contacts: a German Railways train at the railway station in Vejprty

Primarily the peripheral country including borderland is undoubtedly very dependent on small towns that represent settlement centres. The future of peripheral countryside is related to the sustainability of small towns, their job opportunities, services, and social system. Because of a poor accessibility of bigger and more distant centres the role of small towns in a great part of the borderland cannot be substituted.

The entire issue also has a political dimension. The greater part of the European Union budget goes into the support of agriculture. To a certain degree it puts sustainability into a relation to multifunctional development of agriculture. However this European trend conflicts with neoliberal tendencies (Potter, Tilzey, 2007). At any rate we would like to stress out that our attention is focused on the sustainable development of the country as a multifunctional area, not just on the sustainability of agricultural production.

On all accounts, the suggested issues are worth of systematic monitoring, both in terms of rural development or in respect of borderland study. It is necessary to take into account that the Czech borderland is differentiated (Chromý, 2000) according to its natural conditions, historical development and geographical position in the consolidating Europe. As the borderland itself is a subject of at least a bilateral interest, international cooperation will be very appropriate the conditions for which become increasingly more favourable.

Fig. 6: Pavlov under the Pavlovské vrchy Hills is a symbol of Czech-Austrian contacts; the shared wine culture may contribute to cooperation in this area (Photo: A. Vaishar)

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INVESTMENTS IN EDUCATION DEVELOPMENT

NEW RURAL SPACES: CONFLICTS, OPPORTUNITIES AND CHALLENGES

Stanislav MARTINÁT, Bohumil FRANTÁL, Pavel KLAPKA, Petr KLUSÁČEK

The Institute of Geonics, Academy of Sciences of the Czech Republic, Department of Environmental Geography has been assigned a project named "*Improvement of professional skills and abilities of geographers from the Institute of Geonics, Academy of Sciences of the Czech Republic*" (CZ.1.07/2.3.00/09.0234), funded by the European Social Fund and from the state budget of the Czech Republic. Within this project, a series of invited lectures will be organized in 2010. The lectures will focus on the topic of "*New rural spaces: conflicts, opportunities and challenges*". Research in rural geography is one of main topics concerned with the current human geographical issues. The whole series is divided into three sub-topics that are closely linked:

1. Renewable energy development in rural areas
2. Multifunctional farming and rural development
3. Rural tourism

Short annotations of each sub-topic can be found bellow.

Renewable energy development in rural areas

A plan to increase the share of energy production gained from renewable sources has been declared and ratified in most of European countries. The use of so-called clean energy (wind, solar, biomass etc.) has become a global challenge that raises social controversies on a local and regional level though. Projects of wind parks, photovoltaic plants, biomass or biogas plants are objects of interest for developers, a potential source of investments for the concerned municipalities (often from peripheral rural areas), a new way of land use and development for farmers. On the other hand, in the eyes of their opponents they violate the local landscape character and degrade the agriculture land. In this respect, the problem of the implementation of new technology projects has become kind of a hammer in political frays in the context of spatial planning, regional development and land use policy. It could seem that the dispersal of these new technologies should be conditioned exclusively by suitable climatic, physical-geographical and environmental conditions of the concerned localities. However, the research and practice reveal that "soft factors" including political-institutional and social factors, risk perception, positive motivation for the adoption of innovations and social acceptance by all key stakeholders (developers, residents, local government, regional authorities, conservationists etc.) are crucial aspects in the implementation of the projects. A wide space offers itself for investigation in human geography, sociology and other related disciplines.

Multifunctional farming and rural development

Rural space has recently experienced important structural changes. While the countryside was primarily linked to farming with emphasis on agricultural production some years ago, the attitude to rural space is much more diversified nowadays. Production as a main paradigm of agricultural activities has been reshaped in line with the multifunctional strategy for farming. Social, environmental and cultural aspects are distinctly taken into account. Depopulation of rural areas, their ageing, unemployment and deteriorating educational structure are typical features of most present rural areas. Peripheral rural areas in particular are highly endangered by such a development. Farms as the natural cores of entrepreneurial activities in rural areas are facing challenges – needs for increasing alternative sources of income from both services and tourism or for qualitatively enhanced production methods – organic farming. These attitudes to rural areas make their development less dependant on the crowded market with conventional products of farming and thus more stable. All the above mentioned facts create a basis for well-balanced development of rural areas and make the map of rural economy much diversified and calling for research. Geographical analyses of the spatial distribution of this phenomena help to understand the wide context of changes while foreign experience helps to identify bottlenecks.

Rural tourism

Tourism and recreation in rural areas have certain specific features as compared with other dominant forms of tourism such as in mountainous areas, towns or by a seaside. The intensity of rural tourism is considerably lower while the offer of activities is quite distinct although their scale is rather smaller than in the "strong" forms of tourism and recreation. Rural tourism can be considered one of sustainable approaches to the landscape and local population. It should have a multiple effect, not only bringing economic benefits to tourist agencies but also positively influencing the landscape character. It should respect local cultures and identities, playing at the same time an educational role for the participants, improving the economic situation of local people, which can diversify income sources in case they make their living on agriculture. Rural tourism as such is closely linked with organic farming, local planning and landscape protection. Rural tourism can be one of ways to stimulate local and regional development in less favoured areas.

Geographers interested in recent rural geographical research are encouraged to participate. For further details (list of lecturers, topics, abstracts, dates of lectures etc.), see www.geonika.cz. All lectures will be announced in advance at web pages of the Insitute of Geonics (Department of Environmental Geography). The lectures will take place at the conference room of the Department of Environmental Geography, Institute of Geonics AS CR, v. v. i. in Brno, Drobného 28. Coordinators are: Stanislav Martinát (*martinat@geonika.cz*), Bohumil Frantál (*frantal@geonika.cz*), Pavel Klapka (*klapka@geonika.cz*) and Petr Klusáček (*klusacek@geonika.cz*).

Project: *Improvement of professional skills and abilities of geographers of Institute of Geonics, Academy of Sciences of the Czech Republic*

Registration number: *CZ.1.07/2.3.00/09.0234*

Recipient of funding: *Institute of Geonics, Academy of Sciences of the Czech Republic, Department of Geography*

This project is co-financed by the European Social Fund and state budget of the Czech Republic

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All scientific papers are subject to a peer review process, with two anonymous independent reviewers (one of whom preferably would be from outside the Czech Republic) appointed by the Editorial Board. The criteria for the review process include the following: an evaluation of the topicality and originality of the research problem; level of theoretical and methodological understanding of the problem; the methods used; the relevance of sources and references to the literature; and contribution to the development of the scientific area under study.

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Fig. 1: A borderland landscape in the Králická brázda Furrow. The Králíky town in the centre (Photo: A. Vaishar)

Fig. 2: The landscape of the Rychlebské hory Mts. in the Czech-Polish borderland (Photo: A. Vaishar)

Illustrations related to the paper by A. Vaishar and J. Zapletalová

Fig. 2: Partly destroyed dam of water reservoir after heavy rains in the upper part of the Olešenský potok brook watershed by Hlohov, Czech Republic (Photo: V. Vilímek)

Fig. 7: Lower part of the earth flow originated in March 29th, 2006, site "Za Díly" 1 km to the NE from the Vsetín town, the Vsetínské vrchy Hills, the Outer Western Carpathians, Czech Republic (Photo: K. Kirchner)

Illustrations related to the paper by V. Vilímek