STATE OF GEOMORPHOLOGICAL RESEARCH IN THE YEAR 2016

Book of abstracts

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CONTENT

SURFICIAL STRUCTURES OF ACTIVE FAULTS DETECTED IN CAVES: EXAMPLES FROM SALZACH-ENNSTAL-MARIAZELL-PUCHBERG AND PERIADRIATIC FAULTS (EASTERN ALPS, AUSTRIA)

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Several caves in the Eastern Alps were investigated for indicators of active tectonics or past earthquakes such as displaced gallery sections or deformed flowstone in association to the sinistral ENE-WSW Salzachtal-Ennnstal-Mariazell-Puchberg (SEMP) and WNW-ESE dextral Preiadriatic Fault Systems (PAF). The ENE striking sinistral fault in Hirschgrubenhöhle (Hochschwab, Northern Calcareous Alps) is part of the SEMP and caused shearing of stalagmites, and faulted and striated flowstone. These striations, and offsets of cave walls, prove at least 20 cm of sinistral strike-slip movement. Dating of the faulted flowstone and the younger undeformed layers of flowstone revealed the pre-damage generation at ca. 118 ka BP (end of the Last Interglacial) and the oldest age of post-event layer ca. 9 ka BP (early Holocene). These ages bracket the time of the sinistral faulting which coincides with a growth hiatus of the flowstone during the last glacial period, consistent with the high alpine setting of the cave. These observations, in combination with other data, suggest that the SEMP Fault System accommodates active lateral extrusion of the central Eastern Alps with kinematics similar to the Oligocene and Miocene ones (Plan et al. 2010). A nearby cave (Potentialschacht) records faults with similar features but dating was not successful yet as the analyzed flowstone samples were too old or contained too much detritus. For another cave in Hochschwab (Speikbodenhöhle) preliminary dating of a normal fault indicates an activity between 364 and 51 ka BP. Considering that these caves are at altitudes between 1900 and 2100 m, long hiatuses in flowstone growth due to Pleistocene glaciations are common, because the caves were frozen and no water was available. At the eastern termination of the SEMP fault near the Vienna Basin, in Emmerberghöhle a parallel sinistral fault with 4 cm of offset was investigated. Dating of broken versus unbroken flowstones revealed a fault activity between 77 and 136 ka BP. The best examples of faulted cave galleries and deformed flowstone were found in Wartburghöhle, a part of the Obir Caves in the southernmost part of Austria few kilometers north of the Periadriatic Fault. This fault separates the Eastern Alps from the Southern Alps. Deformed flowstones along a fault with 40 cm offset were dated and show an activity between 7 and 45 ka, while a major breakdown event within a massive flowstone wall could be dated between 9 and 19 ka. Substantial part of the work was done within the framework of a Project of the Austrian Science Fund (FWF) Project No: P25884-N29.

RECENT LANDSLIDE PHASES IN THE CZECH CARPATHIANS: IDENTIFICATION, TRIGGERS AND IMPACTS

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Abundant research on landsliding exists at the present time. We focused on a somewhat omitted part of landslide research – landslide phases – events during which an increased number of individual landslides have been concurrently activated (Špůrek, 1967; Bíl et al., 2014). Landslide phases are important because their occurrence indicates the presence of a triggering event which predominantly involves, in the area of the Carpathians, high rainfall or snow thaw.

Whereas the newest landslide phases (1997, 2006 and 2010) have been sufficiently evidenced (Krejčí et al., 2002; Bíl and Muller, 2008; Pánek et al., 2011), the older ones have not as yet been investigated enough. Identification of those older landslide phases can be accomplished using archive sources, including chronicles of the affected villages and towns or aerial photographs.

Each data source has its own specific drawbacks which will be addressed. Chroniclers had occasionally a different view of the importance of natural processes. Extreme rainfall and even hailstone events have been evidenced irregularly often based on the personality of the chronicler and therefore a distinct change in weather at municipality borders has been recorded. We also interviewed eyewitnesses and persons directly affected by landsliding. Aerial photographs were only of limited use as they were predominantly taken during growing seasons.

Landslide triggers can only be computed from existing precipitation data sets. This limits the extent of our study to the past as the oldest accessible data in this area come from the end of the 19th century.

The reverse approach is also possible, however. Triggering rainfall in all probability occurred when a number of landslides were identified in the historical records.

We have previously identified 6 distinct landslide phases in the central part of the Czech Carpathians (Bíl et al., 2014). The total water content threshold, which shall be released into the soil to trigger shallow landsliding, has also been computed for this area (Bíl et al, in press). Our preliminary results from the southern part of this area indicate that other landslide phases can also be identified there. This is particularly related to events before 1915 because better historical written sources were at disposal there in comparison with the area in the Central Czech Carpathians.

The impacts of the most recent landslide phases and natural disasters in general, and to the transportation infrastructure in particular, were estimated (Bíl et al., 2015). The primary issue when comparing these effects with the older landslide phases is a lack of reliable data. Whereas details about landslide events are at disposal today (e.g., www.rupok.cz), only selected landslides were evidenced earlier. Not even property damage was recorded in municipality chronicles regularly. A different degree of urbanisation and infrastructure also ranks among the limiting factors for direct comparison of the impacts of landsliding. We therefore only estimated the number of affected roads and buildings, related to the degree of development, in order to obtain a rough estimation of the landslide costs.

Keywords: landslides, landslide phases, historical records, archives, Carpathians.

References:

Bíl M, Müller I (2008) The origin of shallow landslides in Moravia (Czech Republic) in the spring of 2006. Geomorphology 99: 246–253.

Bíl M, Krejčí O, Bílová M, Kubeček J, Sedoník J, Krejčí V (2014) A Chronology of Landsliding and its Impacts on the Village of Halenkovice, Outer Western Carpathians. Geography 119(4): 342-363.

Bíl M, Vodák R, Kubeček J, Bílová M, Sedoník J (2015) Evaluating road network damage caused by natural disasters in the Czech Republic between 1997 and 2010. Transportation Research Part A: Policy and Practice 80: 90–103.

Bíl M, Andrášik R, Zahradníček P, Kubeček J, Sedoník J, Štěpánek P (in press) Total water content thresholds for shallow landslides, Outer Western Carpathians. Landslides.

Krejčí O, Baroň I, Bíl M, Hubatka F, Jurová Z, Kirchner K (2002) Slope movements in the Flysch Carpathians of Eastern Czech Rep. Triggered by Extreme Rainfals in 1997: a Case Study. Phys. Chem. Earth 27(36): 1567–1576.

Pánek T, Brázdil R, Klimeš J, Smolková V, Hradecký J, Zahradníček P (2011) Rainfall-induced landslide event of May 2010 in the eastern part of the Czech Republic. Landslides 8: 507–516.

Špůrek M (1967) Historická analýza působení klimatického sesuvného faktoru v Českém masivu. Dissertation thesis. Archive of the Czech Geological Survey – Geofond, Prague.

www.rupok.cz

OLD ROUTES AND THEIR GEOMORPHOLOGICAL EFFECTS

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The communication network in rural areas of the historical Czech Lands predominantly consisted of unpaved paths prior to the 18th century (Hlavačka, 1996). Certain parts of the network transformed gradually into the current roads and are now being used by motor traffic. The majority of the old paths form, however, an abandoned network the remnants of which (abandoned during the Middle Ages or even before) are being discovered today. Similar discoveries have also been made in neighbouring countries (Slivka, 1998; Wißuwa, 1998; Sadowska-Topór, 1999) or other regions (Tsoar andYekutlieli, 1993; Bolles and Folan, 2001; Erickson, 2001; Ur, 2003).

Certain segments of used unpaved paths were, over the course of time, transformed into holloways and consequently also abandoned. The degree of incision of a holloway into the soil was determined by local geological conditions. Paths, which were abandoned due to more difficult transport in holloways, are distinct linear forms and often can be found as a grouping of parallel holloways. This demonstrates that such a route was frequently used or is localized on low-resistant ground.

Laser scanning is an exceptionally powerful tool for old path identification (Sittler and Schellberg, 2006; Bollandsas, et al., 2012). Analyses of the resulting digital elevation models can reveal the distinct pattern of an old path network quite often interacting with other geomorphological phenomena (e.g., landslides, streams) or old human constructions (e.g., fortified settlements). We selected the most promising parts of land within the Czech Republic and had aerial laser scanning ordered there.

We will present several cases where old paths interacted with landslides. These facts can be consequently used for dating purposes of both landslide and the old path section. General erosion impacts, the degree of incision, of the old transportation can also be quantified through analyses of digital elevation models taking into consideration the former and new, incised, surface. We will demonstrate the methodology used for these analyses and the preliminary results.

Keywords: old routes, holloways, landslide, erosion.

References:

Bollandsas O, Risbol O, Ene L, Nesbakken A, Gobakken T, Naesset E (2012) Using airborne small-footprint laser scanner data for detection of cultural remains in forests: an experimental study of the effects of pulse density and DTM smoothing. Journal of Archaeological Science 39(8): 2733–2743.
Bolles D, Folan WJ (2001) An analysis of roads listed in colonial dictionaries and their relevance to pre-Hispanic linear features in the Yucatan peninsula. Ancient Mesoamerica 12: 299–314.
Erickson CL (2001) Pre-columbian roads of the Amazon. Expedition 43(2): 21–30.
Hlavačka M (1996) Cestování v éře dostavníků: všední den na středoevropských cestách. Praha.
Sadowska-Topór J (1999) Starożytne drogi w dolinie rzeki Dzierzgoń w świetle badań archeologicznych, Instytut Archeologii i Etnologii PAN, Warszawa.

Sittler B, Schellberg S (2006) The potential of LIDAR in assessing elements of cultural heritage hiddenunder forest canopies or overgrown by vegetation: possibilities and limits in detecting microrelief structures for archaeological survey. In: Campana S, Forte M (eds.) From Space to Place. 2nd International Conference on Remote Sensing in Archaeology, CNR – National Research Council Roma 4-7 December 2006, BAR Oxford: 117–122.

Slivka M (1998) Rekonštrukcia cestnej siete na Slovensku (Súčasný stav bádania a jeho perspektivy). Archaeologia historica 23: 259–275.

Tsoar H, Yekutlieli Y (1993) Geomorphological identification of ancient roads & paths on loess in the northern Negev. Israel Journal of Earth Sciences 41: 209–216.

Ur JA (2003) CORONA satellite photography and ancient road networks: A Northern Mesopotamian case study. Antiquity 77(295): 102–115.

Wißuwa R (1998) Komunikace v Sasku s ohledem na průsmyky Krušnohoří a Vogtlandu, Archaeologia historica 23/98: 199–219.

SEISMIC GEOMORPHOLOGY AS A TOOL FOR THE GEOLOGICAL AND GEOMORPHOLOGICAL INSIGHT TO BURIED SEDIMENTS

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Seismic geomorphology is a relatively new and modern geoscience approach (Posamentier, 2000, Posamentier-Kola, 2003, Zeng, 2004). The method has its roots in seismic stratigraphy and seismic facies analysis (Vail, et al., 1977, Mitchum et al. 1977) but is based on newer procedures concerned with the extraction of geological and geomorphological information from 3D seismic data. The seismic geomorphology may be consequently defined as the application of seismic interpretation techniques pertaining to the study of ancient, buried landforms and geomorphical surfaces as imaged by 3D seismic data (Posamentier, 2007).

Seismic stratigraphy is primarily focused on the vertical seismic line as opposed to seismic geomorphology which operates with time slice (horizontal seismic line) and horizon, stratal slices (seismic line at proposed position of bedding planes) of 3D seismic data (Chopra-Marfurt, 2007, Zeng et al., 1998). Volume voxel rendering as well as the display of 3D seismic data attributes, like coherence, RMS amplitude, reflection strength and spectral decomposition is used also (Brown, 2011). Seismic geomorphology has therefore an extensive portfolio of approaches for the geological insight to ostensibly invisible spaces.

The seismic geomorphology procedure and principles were used in the interpretation of 3D seismic data from two different localities with different results of seismic geomorphological studies. Tvrdonice (the north part of the Vienna Basin) and Lobodice (the middle part of the Carpathian Foredeep) underground gas storage areas (both in the Czech Republic) are the localities studied. In the Tvrdonice area the Lower Sarmatian clay/claystones and sand/sandstones in about 1250m depth and in the Lobodice area the Lower Badenian basal clastics in about 500m depth were studied. The relatively high amount of underground gas storage wells enables fair well-seismic data ties.

On the vertical seismic lines from the Tvrdonice area, the subtle amplitude anomalies are visible in the lateral restricted way only. However, due to the time slice, the anomaly could be recognized in the extensive manner. The next restriction of this image is the dip of the strata. The top and bottom interface of the area of focus had to be established. The volume voxel rendering allows the display not only of part of the amplitude anomaly but the real lateral and vertical extent as well. This approach serves for the evaluation of the lateral variation and its interpretation also. The amplitude anomaly, after core and well log correlation, could be interpreted as a meandering river depositional environment. The established top and bottom interface enabled the creation of the horizon and stratal (proportional) slices through the anomaly horizon with amplitude strength, RMS amplitude and coherence of the reflexes. That together with spectral decomposition assisted the recognition of many morphological features of the meandering river environment such as point bars, cut bars, floodplains, levees, crevasse splays, oxbow lakes etc.

The seismic facies analysis (Sangree-Widmier, 1977) of the Badenian basal clastics from Lobodice area showed that a moderate to higher amplitude, moderate to lower frequency and quite

moderate to lower coherency is typical for those seismic reflexes. Clinoforms of the reflexes arrangement were recognized with their characteristic morphological parts – topsets, foresets and bottomsets. According to the seismic facies and previous sedimentological studies, the Gilbert-type delta depositional environment could be interpreted. More precise identification of other geomorphological features was unfortunately impossible as opposed to the Tvrdonice area. This was probably caused by the sedimentation process - debris flow - which is not largely seismically identifiable because it does not create significant internal changes in the seismic amplitude and waveform.

The sufficient seismic contrast of sediments is crucial to seismic geomorphology analysis that is clearly evident on the case of studied two localities.

The data was kindly provided by RWE Gas Storage and the software by Schlumberger Limited.

Keywords: seismic geomorphology, Lower Sarmatian, Lower Badenian, Vienna Basin, Carpathian Foredeep, meandering river, Gilbert-type delta.

References:

Brown AR (2011) Interpretation of Three-Dimensional Seismic Data, 7th Edition: AAPG Memoir 42, SEG Investigation in Geophysics, No. 9. AAPG. Tulsa. 646 p.

Chopra S, Marfurt KJ (2007) Seismic attributes for prospect identification and reservoir characterisation. SEG books. Tulsa. 464 p.

Mitchum RM, Vail PR, Thompson S (1977) Seismic stratigraphy and global changes in sealevel, part 2: The depositional sequence as a basic unit for stratigraphic analysis. In: Payton (Ed.), Seismic Stratigraphy: Application to Hydrocarbon Exploration. AAPG-Memoir No. 26, AAPG, Tulsa: 53–62.

Posamentier HW, Davies RJ, Cartwright JA, Wood L (2007) Seismic geomorphology – an overview. In: Davies RJ, Posamentier HW, Wood LJ, Cartwright JA (eds) Seismic Geomorphology: Applications to Hydrocarbon Exploration and Production. Geological Society, London, Special Publications 277: 1–14.

Posamentier HW (2000) Seismic stratigraphy into the next millennium; a focus on 3D seismic data. American Association of Petroleum Geologists Annual Conference, New Orleans, LA, 16-19 April, 2000, A 118.

Posamentier HW, Kolla V (2003) Seismic Geomorphology and Stratigraphy of Depositional Elements in Deep-Water Settings. Journal of Sedimentary Research 73: 367–388.

Sangree JB, Widmier JM (1977) Seismic stratigraphy and global changes in sealevel Part 9: seismic interpretation of clastic depositional facies. In: Payton (Ed.), Seismic Stratigraphy: Application to Hydrocarbon Exploration, AAPG-Memoir No. 26, AAPG, Tulsa, 165–184.

Vail PR, Mitchum RM, Todd RG, Widmer JM, Thompson S, Sangree JB, Bubb JN, Hatfield WG (1977) Seismic stratigraphy and global changes in sea level. In: Payton (Ed.), Seismic Stratigraphy: Application to Hydrocarbon Exploration, AAPG-Memoir No. 26, AAPG, Tulsa, 49–212.

Zeng H, Backus MM, Barrow KT, Tyler N (1998) Stratal slicing, Part I: Realistic 3-D seismic model. Geophysics 63(2): 502–513.

Zeng H (2004): Seismic geomorphology-based facies classification. The Leading Edge 23(7): 644–688.

LANDSLIDES IN THE MORAVSKOSLEZSKÉ BESKYDY MTS. – NEW ISNIGHTS FROM THE LIDAR

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New LiDAR-derived digital elevation model of the Czech Republic (DMR4G) introduces new opportunities for the landslide inventory mapping. We created landslide inventory map of the Moravskoslezské Beskydy Mts. using several hillshade maps which were created with varying parameters of illumination. Performed dataset has 574 landslides in total, their total area is 121,6 km^2 which corresponds to ~18% of the whole study area. Landslides occupy generally higher elevations with mean elevation 738 ±146 m a.s.l. whereas for non-landslide area is 681 ± 158 m a.s.l. Average slope of the landslide area is 20°± 7° (mode 18°) and 18°± 9° (mode 15°) for non-landslide area. Most of the landslide area has aspect in the range SE to SW.

We examined frequency-area relationship following methods proposed by (Malamud et al., 2004). Fitted inverse gamma function to our inventory has parameters $\rho = 1{,}39$; $a = 0{,}13$ km^2; $s = -0{,}015$ km^2. Scaling exponent of the exponential decay of the probability function $\beta = (\rho+1) = 2{,}39$. It is similar to "general landslide distribution" proposed by (Malamud et al., 2004). Difference is in the position of the maximum of the probability function, which is moved to the higher area values. This may be caused by underestimating of small to medium landslides in our inventory because their evidence was lost by wasting processes. Furthermore, this analysis reveals that the frequency-area relationship is controlled by lithology, which is suggested by different scaling exponents calculated for two landslide sub-sets involving spatially most widespread Godula and Istebna formations.

Using L-function (Pedrazzini et al., 2015) we investigated if the landslides are spatially clustered or dispersed in a given radius. We found that landslides are spatially clustered in the range 800-4000 m and for the radius >5000m landslides are spatially dispersed. All detected landslide clusters tend to occupy geologically feasible areas for slope failures, involving especially long dip slopes and escarpments along key lithological contacts, e.g. sandstones overlying fine-rhythmical flysch. This finding is furthermore confirmed by TOBIA classification of slopes (Meentemeyer and Moody, 2000) revealing relationship between bedding, slopes and landslides. Area classified as dip slope is more frequent in the landslide area than non-landslide area which indicates to structural predisposition of the slip-surface of landslides.

Keywords: landslide inventory, digital elevation model, morphometry, landslide, Moravskoslezské Beskydy Mts.

References:

Malamud BD, Turcotte DL, Guzzetti F, Reichenbach P (2004) Landslide inventories and their statistical properties. Earth Surface Processes and Landforms 29(6): 687–711.

Meentemeyer RK, Moody A (2000) Automated mapping of conformity between topographic and geological surfaces. Computers & Geosciences 26(7): 815–829.

Pedrazzini A, Humair F, Jaboyedoff M, Tonini M. (2015) Characterisation and spatial distribution

of gravitational slope deformation in the Upper Rhone catchment (Western Swiss Alps). Landslides 13(2): 259–277.

WEATHERING AND EROSION OR PHYSICAL FIELDS AND FEEDBACKS: WHAT GIVE SHAPES TO LANDFORMS?

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Weathering and erosion of sandstone produces spectacular landforms such as arches, alcoves, pedestal rocks, rock pillars, honeycombs and tafoni. Large attention in the past was focused on individual weathering processes like salt and frost weathering; rain drops impact, flowing water and aeolian action etc. (Turkington and Paradise 2004). Material damage caused by these processes is readily observable on landform surfaces and in laboratory experiments. Nevertheless, these weathering and erosion processes operate in relatively shallow zone of sandstone and if not coordinated by some external physical field their activity can result only in randomly eroded surface. It was recently demonstrated by physical and numerical modelling, and field observations of locked sands and sandstones that gravity-induced stress controls the weathering and erosion of arches, alcoves, pedestal rocks, rock pillars (Bruthans et al. 2014). Stress field interconnects billions of sand grains into single body - sandstone landform. The shape of stress field is given by initial and boundary conditions, e.g. initial shape of sandstone massive and geometry of discontinuities, like joints and quickly weathering clay and silt horizons. Initial and boundary conditions dictate via the stress field the quasi-stable shape into which the sandstone landform will tend to develop over time. Sufficient condition for arch to form is the subhorizontal discontinuity crossing the sandstone massive, rock shelter forms if such discontinuity undercuts the sandstone massive only partly. Experiments demonstrated that weathering and erosion processes are mere tools connected to gravity-induced stress via negative feedback: As the erosion progresses the stress in remaining part of landform rises, which decreases erosion rate. As a consequence the load-bearing parts of sandstone mass are preserved and ballast portions (mass not carrying any load) are wasted. Spectacular arches and pedestal rocks in various national parks worldwide are result of this interaction. Various weathering and erosion processes will result in similar shape if controlled by same stress field geometry.

Hydraulic field is the other physical field which shapes sandstone landforms. It interconnects water in billions of pores into single body. Similarly like in previous case its boundary conditions controls the water flux and thus also control the zone of destruction by salt and frost weathering (salts are transported to place where water evaporates and there they cause damage, frost weathering will be intense at wetted surfaces). As nicely demonstrated by Huinink et al. (2004) it is the boundary condition of hydraulic field, what dictates whether salt weathering will create tafoni (caverns) or whether it will instead smoothen the surface to perfect plane. Once again, various weathering processes will result in similar shape if controlled by single hydraulic field geometry.

Many other examples can be found. Dendritic pattern of karst cave drainage is similar to dendritic pattern formed by piping. Both processes are controlled by hydraulic field and positive feedback between increase of flow rate and increase in permeability of flow path (Terzaghi and Peck 1948, Bruthans et al. 2012). Also boundary conditions are similar. But the erosion processes differ: dissolution of limestone and entrainment of solid particles by flowing water.

Above mentioned examples show that we often focus too much on readily observable phenomena (weathering and erosion damage) and we are blinded to acknowledge the physical fields which are invisible, but in the same time the only entities able to interconnect and coordinate processes deeply inside the rock environment. Interestingly it is often the boundary and/or initial conditions of the physical field, what gives shapes to landforms. Identifying the physical fields, boundary conditions and kind of operating feedbacks is thus the critical step in full understanding the landform evolution.

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Keywords: weathering, physical field, feedback, erosion, landform.

References:

Bruthans J, Soukup J, Vaculíková J, Filippi M, Schweigstillova J, Mayo AL, Mašín D, Kletetschka G, Řihošek J (2014) Sandstone landforms shaped by negative feedback between stress and erosion. Nature Geoscience 7(8): 597–601.

Bruthans J, Světlík D, Soukup J, Schweigstillová J, Válek J, Sedlackova M, Mayo AL (2012) Fast evolving conduits in clay-bonded sandstone: Characterization, erosion processes and significance for origin of sandstone landforms. Geomorphology 177-178: 178–193.

Huinink HP, Kopinga K (2004) Simulating the growth of tafoni. Earth Surface Processes and Landforms 29: 1225–1233.

Terzaghi K, Peck RB (1948) Soil Mechanics in Engineering Practise. John Wiley and Sons, New York.

Turkington AV, Paradise TR (2005): Sandstone weathering: A century of research and innovation. Geomorphology 67: 229–253.

LANDSLIDE HAZARD IN THE WESTERN BRANCH OF THE EAST AFRICAN RIFT

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The East African Rift System (EARS) is a major intra-continental region of lithospheric extension that shapes Central Africa and is volcanically and seismically active. The region of interest is located in the western branch of the EARS and extents from the North Tanganyika rift zone in the south to the Rwenzori Mountains in the north. It covers mountainous environments shared by DR Congo, Burundi, Rwanda and Uganda. The western branch of the EARS is an area where natural triggering and predisposing factors such as heavy rainfall, tectonic activity and steep topography favour the occurrence of landslides (Maki Mateso and Dewitte, 2014; Jacobs et al., 2015). In addition, sensibility to slope instability is expected to increase in the future in response to increasing demographic pressure, deforestation and land use changes, and projected climate change (Jones et al., 2013; Niang et al., 2014). Landslides are possibly the most important geohazard in terms of recurring impact on the populations, causing fatalities every year and resulting in structural and functional damage to infrastructure and private properties, as well as serious disruptions of the organization of societies (Maki Mateso and Dewitte, 2014; Kervyn et al., 2015; Mertens et al., 2016; Maes et al., accepted; Maes et al., submitted). Until very recently few data was available for the area to estimate the hazard associated with these slope processes. The assessment of landslide hazard implies collecting information on the location of the processes, their types and time of occurrence. It requires data on their predisposing and triggering factors. To achieve these objectives we combine field inventories with multi-scale and multi-sensor remote sensing data from very high to low resolution (Pléiades, Cosmo-SkyMed SAR images, TanDEM-X interferometry, TRMM and GPM). Such data are combined with other earth observations (seismic ground based networks, rain gauge networks, GPS surveying), catalogues, digital soil and lithological maps and state-of-the-art regional climate modelling approaches. Now, through the initiation of several research projects and the setting-up of methodologies for data collection adapted to this data-poor environment, it becomes possible to draw a first regional picture of the situation. Here the current knowledge on landslide hazard in these tropical environments is presented. More than 4,000 landslides have been mapped so far. A specific focus is given on the Rwenzori Mountains (Uganda) (Jacobs et al., 2015, submitted, submitted b), the Rift flanks west of Lake Kivu (DR Congo) (Maki Mateso et al., 2014), and the cities of Bukavu (DR Congo) (Balegamire et al., submitted; Kulimushi Matabaro et al., submitted; Mugaruka Bibentyo et al., submitted) and Bujumbura (Burundi). Results and research perspectives on landslide inventorying, monitoring, and susceptibility and hazard assessment are presented.

Keywords: landslide processes, susceptibility and hazard assessment, remote sensing, ground-based observation, rainfall modelling, tropical Africa

References:

Balegamire C, Michellier C, Muhigwa J-B, Delvaux D, Dewitte O (submitted) Vulnerability of buildings exposed to landslides: a spatio-temporal assessment in Bukavu (DR Congo). Geo-Eco-Trop.

Jacobs L, Dewitte O, Poesen J, Delvaux D, Thiery W, Kervyn M (2015) The Rwenzori Mountains, a landslide-prone region? Landslides 12: 1-18.

Jacobs L, Dewitte O, Poesen J, Maes J, Mertens K, Sekajugo J, Kervyn M (submitted) Landslide characteristics and spatial distribution in the Rwenzori Mountains, Uganda. Journal of African Earth Sciences.

Jacobs L, Maes J, Mertens K, Sekajugo J, Thiery W, van Lipzig N, Poesen J, Kervyn M, Dewitte, O (submitted) Reconstruction of a flash flood event through a multi-hazard approach: focus on the Rwenzori Mountains, Uganda. Natural Hazards.

Jones A, Breuning-Madsen H, Brossard M, Dampha A, Deckers J, Dewitte O, Gallali T, Hallett S, Jones R, Kilasara M, Le Roux P, Micheli E, Montanarella L, Spaargaren O, Thiombiano L, Van Ranst E, Yemefack M, Zougmore R (eds.) (2013) Soil Atlas of Africa. European Commission, Publications Office of the European Union, Luxembourg. 176 p.

Kervyn M, Jacobs L, Maes J, Che V B, de Hontheim A, Dewitte O, Isabirye M, Sekajugo J, Kabeseke C, Poesen J, Vranken L,. Mertens K (2015) Landslides resilience in Equatorial Africa: Moving beyond the problem identification! Belgian Journal of Geography: 1-2015.

Kulimushi Matabaro S, Mugaruka Bibentyo T, Muhindo Sahani W, Michellier C, Dewitte O (submitted) Landslides and elements at risk in the Wesha watershed (Bukavu, DR Congo). Geo-Eco-Trop.

Maes J, Kervyn M, de Hontheim A, Dewitte O, Jacobs L, Mertens K, Vanmaercke M, Vranken L, Poesen J (accepted with revision) Landslide risk reduction strategies: A review of practices and challenges for the tropics. Progress in Physical Geography.

Maes J, Parra C, Poesen J, Kabaseke C, Bwambale B, Mertens K, Jacobs L, Dewitte O, Vranken L, de Hontheim A, Kervyn M (submitted) Disaster governance-beyond-the-state: Evidence from landslide risk management in Uganda. Environmental Science & Policy.

Maki Mateso J-C, Dewitte O (2014) Towards an inventory of landslides and the elements at risk on the Rift flanks West of Lake Kivu (DRC). Geo-Eco-Trop 38: 137–154.

Mertens K, Jacobs L, Maes J, Kabaseke C, Maertens M, Poesen J, Kervyn M and Vranken L (2016) The direct impact of landslides on household income in tropical regions: a case study from the Rwenzori Mountains in Uganda. Science of the Total Environment 550: 1032–1043.

Mugaruka Bibentyo T, Kulimushi Matabaro S, Muhindo Sahani W, Dewitte O (submitted) Anatomy of Nyakavogo landslide (Bukavu, DR Congo): interplay between natural and anthropogenic factors. Geo-Eco-Trop.

Niang I, Ruppel OC, Abdrabo MA, Essel A, Lennard C, Padgham J, Urquhart P (2014): Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros V R, Field CB, Dokken DJ, Mastrandrea MD, Mach KJ, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1199–1265.

RAINFALL THRESHOLDS FOR THE INITIATION OF DEBRIS FLOWS IN THE KRKONOŠE MTS., CZECH REPUBLIC

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Rainfall is a recognized trigger of debris flows - and investigators have long attempted to determine the amount of precipitation needed to trigger slope failures, a problem of scientific and societal interest. Rainfall thresholds can be defined on a physical (process based, conceptual) or empirical (historical, statistical) basis. This poster presents an analysis of rainfall thresholds in two localities in the Krkonoše Mts. Four debris flows originated at Obří důl on the southwest slope of the Čertův rridge. Three debris flows originated on the Černá hora Mt. in June 1974 and June 2013, with extreme rainfall causing regional flooding and debris flows. The rainfall situation that triggered the debris flows was analyzed from 1945 to 2013. The rainfall data were obtained from the rain - gauges of the Czech Hydrometeorological Institute. Three rain gauges were chosen close to Obří důl and five rain gauges were chosen close to the Černá hora Mt. Data of hourly amounts were chosen from the specific period. The antecedent precipitation index (API) for all of the years (1945-2013) for 5, 10, 20 and 30 days in the form of floating values was considered an important calculation. Significant values were only expressed for the years of the flood episodes.

Keywords: Debris flow, Rainfall, Rainfall thresholds, Krkonoše Mts.

References:

Guzetti F, Peruccacci S, Rossi M, Stark CP (2007) Rainfall thresholds for the initiation of landslides in central and southern Europe. Meteorog. Atmos. Phys. 98: 239–267.
Smolíková J, Blahůt J, Vilímek V (2015) Analysis of rainfall preceding debris flows on the Smědavská hora Mt., Jizerské hory Mts., Czech Republic. Landslides 12: 1–14.

GEOPHYSICAL ANALYSIS OF SELECTED BLOCKFIELDS IN THE ŠUMAVA MTS.

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The knowledge of the internal structure of some geomorphic forms is one of preconditions for determination of their origin and evolution. It is not possible to look directly beneath the surface in some (e.g. protected) areas where some distinct surficial geomorphic forms with unclear genesis are located. Geophysical survey is one of the non-invasive methods that can be used for description of the subsurface structure of such forms. We decided to evaluate the suitability of different geophysical analyses to determine the depth, density and internal structure of selected blockfields in the Šumava Mts. We will apply selected geophysical analyses (electrical resistivity tomography, shallow seismic refraction, ground-penetrating radar and dipole electromagnetic profiling) on three blockfields located in the Šumava national park and the Šumava protected landscape area. We presume verification or modification of the existing blockfield classification (based solely on the surficial manifestation) by including the internal structure and deepness of studied blockfields. This research is a part of master thesis.

Keywords: electrical resistivity tomography; shallow seismic refraction; dipole electromagnetic profiling; ground penetrating radar; Czech Republic; Felsenmeer

References:

Mareš S (1990) Úvod do užité geofyziky. 2. přeprac. vyd. SNTL, Praha. 677 p.
Otto JC, Sass O (2006) Comparing geophysical methods for talus slope investigations in the Turtmann valley (Swiss Alps). Geomorphology 76: 257–272.
Schrott L, Sass O (2008) Application of field geophysics in geomorphology: Advances and limitations exemplifield by case studies. Geomorphology 93(1-2): 55–73.
Stacke V (2008) Geomorfologie Slunečné na Šumavě. Bakalářská práce. Plzeň, Západočeská univerzita, Fakulta pedagogická.

SUBSURFACE EROSION IN THE EVOLUTION OF SANDSTONE TABLELANDS, STOŁOWE MTS., POLAND

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Pathways of geomorphic evolution of sedimentary tablelands have been of interest to scientific community since pioneering works by researchers working on the Colorado Plateau (e.g. Gregory, 1917; Bryan, 1929). Over the next decades the concept of parallel escarpment retreat became widely accepted as the dominant pattern of long-term scarpland development (King, 1953; Schmidt, 1989) and a variety of mass wasting processes, including rock falls (Schumm and Chorley, 1964), slumps (Reiche, 1937) and topples (Brunsden et al., 1996) were recognized to be the main processes involved. The key role of water as a factor triggering instability – either acting on the lower scarp slope surface (Koons, 1955) or emerging from the subsurface at cliff lines (Laity and Malin, 1985) – was underlined in the number of studies. However, none of these models of geomorphic evolution has seriously taken mechanical removal of sand particles into account or did it in a very limited way (e.g. Robinson and Williams, 1994). Interestingly, a Polish researcher B. Dumanowski (1961) did realize the importance of mechanical sand removal from caprock in the Stołowe Mountains, but he felt short to provide any observational material for the processes which he called 'suffosion'.

The aim in this study is to examine the importance of mechanical processes within the caprock and to evaluate how this complements the existing scenarios of tableland evolution. More than 14 km of cliff lines bounding mesas and plateaus of the Stołowe Mountains were investigated in order to find geomorphological evidence of sand removal from inside the sandstone mass. Cones and sheets – peculiar forms of sand accumulation at the base of the cliffs – were of special interest. They were mapped and further analysed in the context of diversified morphology of the escarpments. The cones were measured to provide volumetric data on how much sand has been removed from the caprock and deposited below the cliffs. Studies along cliff lines were supplemented by electrical resistivity tomography which made possible to calculate the approximate thickness of widespread sandy covers on the slopes. The ERT survey was conducted within 3 profiles extending from the cliff lines down the slope.

A total of 141 cones and 77 sheets of various size were mapped along six cliff line sections. The majority of sandy cones is associated with intact rock faces, whereas chaotic sandy sheets are more common within highly disintegrated cliff lines. Nearly all forms are located at the outlet of vertical joints, partly filled with sand grains. Volumetric calculations revealed that the total volume of cones is nearly 977 m^3 and the greatest contribution to the result (89.8%) is provided by cones situated along two cliff lines: Szczeliniec Wielki (444.7 m^3) and Skalniak (432.1 m^3). The ERT results showed that not only is the sandy cover widespread on the escarpment slopes, extending at a distance of a few hundred of meters, but also has a substantial thickness of 1 to 3 m. An approximate volume of sand removed from caprock and stored on slopes amounts to as much as 22 x 10^6 m^3.

The results of our study indicate that in some circumstances sandstone escarpments may follow different evolutionary pathways than commonly applied models assume. Here, groundwater flow and emergence are still crucial, but the exact mechanisms differ from either seepage-induced scarp

retreat or solutional weathering and mass removal accomplished by subsurface flow. In the Stołowe Mountains no zones of increased moisture were found at the base of the cliffs which would be indicative of seepage. It also became obvious that the geomorphic evidence of cliff undermining is rather scarce, with such landforms as alcoves or niches being nearly absent. Instead, sandy cones and sheets occur along the cliff lines indicating active mechanical removal of sand grains from caprock. The process is concentrated along discontinuities in the sandstone caprock which results in progressive joint widening and the development of ruiniform relief at the plateau margins. A formerly intact rock wall becomes a chaos of joint-bounded boulders, that may gradually subside and tilt. In this way the escarpment evolves without the contribution of catastrophic mass movements caused by cliff undermining. New term is proposed to describe the phenomenon – the 'subcutaneous erosion' – which emphasizes the role of subsurface mechanical removal of sand grains. The concept is complementary to recently published findings of Duszyński and Migoń (2015) who inferred gradual rather than catastrophic cliff retreat from a comprehensive analysis of origin of sandstone boulders.

Keywords: Tableland, Sandstone, Scarp retreat, Groundwater geomorphology, Suffosion, Sudetes

References:

Brunsden D, Coombe K, Goudie A-S, Parker A-G (1996) The structural geomorphology of the Isle of Portland, southern England. Proceedings of the Geologists' Association 107 (3): 209–230.

Bryan K (1928) Niches and other cavities in sandstone at Chaco Canyon, New Mexico. Zeitschrift für Geomorphologie 3: 128–140.

Dumanowski B (1961) Zagadnienie rozwoju stoku na przykładzie Gór Stołowych (The problem of slope development on the example of the Stołowe Mountains). Czasopismo Geograficzne 32: 311–324 (in Polish, English summary).

Duszyński F, Migoń P (2015) Boulder aprons indicate long-term gradual and non-catastrophic evolution of cliffed escarpments, Stołowe Mts, Poland. Geomorphology 250: 63–77.

Gregory HE (1917) Geology of the Navajo country: U.S. Geological Survey Professional Paper 93.

King LC (1953) Canons of landscape evolution. Bulletin of the Geological Society of America 64: 721–752.

Koons D (1955) Cliff retreat in the Southwestern United States. American Journal of Science 253: 44–52.

Laity J, Malin MC (1985) Sapping processes and the development of theater headed valley networks on the Colorado Plateau. Geological Society of America, Bulletin 96: 203–217.

Reiche P (1937) The Toreva-block – a distinctive landslide type. Journal of Geology 45: 538–548.

Robinson D-A, Williams RBG (1994) Sandstone weathering and landforms in Britain and Europe. In: Robinson DA, Williams RBG (eds), Rock Weathering and Landform Evolution: 371–389.

Schmidt KH (1989) The significance of scarp retreat for Cenozoic landform evolution on the Colorado Plateau, U.S.A. Earth Surface Processes and Landforms 14: 93–105.

Schumm SA, Chorley RJ (1964) The Fall of Threatening Rock. American Journal of Science 262: 1041–1051.

PLOUGHING BLOCKS IN THE STOŁOWE MTS., POLAND – AS COMMON AS PROPOSED BEFORE?

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The ability of boulders to move slowly down the slope was first observed as early as in the beginning of the 20th century in Scandinavia (Hall et al., 2011), but it were the famous works of L. Tufnell (1969, 1972) a few decades later that have resulted in a wider interest in the phenomenon. Tufnell proposed a term 'ploughing blocks' to describe boulders that move faster than the surrounding sediments and are associated with the occurrence of a furrow behind them and a mound in front. The vast majority of ploughing blocks was found in geographical settings where frost action is common – at mid to high altitudes (e.g. Kotarba, 1976; Gorbunov, 1991) and latitudes (e.g. Ballantyne, 2001). Hence, ploughing blocks are regarded as the most widespread example of periglacial phenomena (Tufnell, 1969).

Amongst areas reported in literature as abounding in ploughing blocks is the sedimentary tableland of the Stołowe Mts., Middle Sudetes. M.Z. Pulinowa (1989) presented one such boulder in detail and asserted that there are many others on the steep escarpment slopes. Ploughing was proposed as an important component of movement of sandstone boulders derived from caprock disintegration across the mid- and lower slope underlain by fine-grained sedimentary formations (marls, mudstones). However, Pulinowa failed to provide specific localities or convincing evidence of their movement.

Our attempt in this study was to verify this claim and to record other examples of block ploughing within the escarpment slopes of the Stołowe Mountains. Hence, we aimed to recognize whether the process is as common in this area as proposed before. Potential mechanisms responsible for boulder movement were also of interest. During field investigation only seven boulders were found, whose morphological features and context indicate their ability to wander slowly down the slope. These boulders are situated in three localities. Two of them were found within the northern slope of the Skalniak plateau, immediately above the road connecting Karłów and Ostra Góra, four of them are scattered on the steep western slope of Rogowa Kopa (including two located now in the riverbed of a stream incised into the slope), and the last one was observed in the bottom of an old road gully in the area of non-existent village of Mały Karłów. Slope inclinations at these localities vary from 2 to 35°. All boulders have the diagnostic feature of wandering/ploughing – a funnel/depression behind them. However, the other typical feature of block movement – mounds in the frontal and lateral part – were found only in case of the boulder in Mały Karłów and the biggest boulder on the Rogowa Kopa slope. The size of the boulders varies and ranges between 2.1 m and 6.6 m for the biggest block on the Rogowa Kopa slope. The length of the funnels is even more varied, from as little as 1.3 m to 31.2 m. Nevertheless, these values fit well to the parameters described by various authors from elsewhere, although the size of two observed boulders exceeds the upper limit of 5.5 m, reported in literature (Finse block in Norway, Reid and Nesje, 1988). In addition, on slopes of Rogowa Kopa boulders occur which do not have funnels behind them, but subtle unvegetated ground swells in front may be recognized. Fox and badger holes are distinct associated features. Reasons of boulder movement include: 1) the presence of

highly deformable ground together with considerable steepness of the Rogowa Kopa slope, 2) action of burrowing animals which undermine the boulders while digging holes and make them unstable, 3) anthropogenic activity that may have resulted in ground vibrations, suggested for the setting above the road Karłów-Ostra Góra. Downslope movement is facilitated by specific, boat-like shape of a boulder (Mały Karłów), aided by root growth.

The general scarcity of evidence for ploughing or other type of boulder displacement, confronted with the abundance of boulders on escarpment slopes in the Stołowe Mountains, reinforces the concept proposed earlier that downslope boulder movement is apparent rather than real (Parzóch et al., 2009; Duszyński and Migoń, 2015; Parzóch and Migoń, 2015) and the actual movement under the present-day environmental conditions is restricted to only a minority of cases.

Keywords: ploughing blocks, sandstone, escarpments.

References:

Ballantyne CK (2001) Measurement and theory of ploughing boulder movement. Permafrost and Periglacial Processes 12: 267–288.

Duszyński F, Migoń P (2015) Boulder aprons indicate long-term gradual and non-catastrophic evolution of cliffed escarpments, Stołowe Mts, Poland. Geomorphology 250: 63–77.

Gorbunov AP (1991) Ploughing blocks of the Tien Shan. Permafrost and Periglacial Processes 2 (3): 237–243.

Hall K, Boelhouwers J, Driscoll K (2001) Some morphometric measurements on ploughing blocks in the McGregor Mountains, Canadian Rockies. Permafrost and Periglacial Processes 12: 219–225.

Kotarba A (1976) Współczesne modelowanie węglanowych stoków wysokogórskich na przykładzie Czerwonych Wierchów w Tatrach Zachodnich. Prace Geograficzne IGiPZ PAN 120: 1–128.

Parzóch K, Migoń P, Latocha A (2009) Geomorfologiczne efekty długotrwałego cofania stoków w rejonie Sawanny Łężyckiej w Górach Stołowych. Przyroda Sudetów 12: 87–98.

Parzóch K, Migoń P (2015). The origin of sandstone boulder trains by escarpment retreat, Stołowe Mountains, SW Poland. Zeitschrift für Geomorphologie 59, Suppl 1: 103–122.

Pulinowa MZ (1989) Rzeźba Gór Stołowych. Wydawnictwo Uniwersytetu Śląskiego w Katowicach 1008.

Reid JR, Nesje A (1988) A giant ploughing block, Finse, southern Norway. Geografiska Annaler 70A (1-2): 27–33.

Tufnell L (1969) The range of periglacial phenomena in Northern England. Biuletyn Peryglacjalny 19: 291–323.

Tufnell L (1972) Ploughing blocks with special reference to North-West England. Biuletyn Peryglacjalny 21: 237–270.

SIMULATION OF BEDLOAD TRANSPORT IN HEADWATER AREA OF THE LUBINA RIVER

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This paper is focused on modeling of bedload transport in mountain headwater streams in the Moravskoslezské Beskydy Mts. Based on field mapping of part of the Lubina River (length: 1014 m.; catchment area 1.06 km2; average slope: 0.06 m.m-1) data for simulations of bedload transport were prepared for modeling of discharge Q2 and Q20 (the latter according to the flood discharge in May 2010). Several combinations of equations and calibration parameters values were used. Values of flow velocity, flow discharge, bedload discharge and accumulated bedload transport were simulated at 17 channel cross-sections. In total, 247-466 m3 (630-1188 tons) of bedload were transported during Q20 flood in study part of Lubina River according to the model. During Q2 discharge the model supposed almost zero bedload discharge except the upper part of study area (0.73-2 m3.hod-1). Settings of calibration parameter has the highest impact on resulted values; the choice of transport equations does not lead to significant differences in modelled values. Validation was not executed due to the absence of directly measured data of bedload transport; only comparison to amount of transported material in the nearby watercourse (the Velký Škaredý Stream) was possible. The model TOMSED represents a good solution for simulation of bedload transport in mountain headwater streams due to relatively accurate results when compared to other models.

Keywords: TOMSED, bedload transport, mountain headwater stream, hydrological modelling, Moravskoslezské Beskydy Mts

MOBILITY AND PARAMETERS OF INSTREAM WOOD IN STEEP HEADWATERS: A CASE STUDY OF THE MAZÁK STREAM, MORAVSKOSLEZSKÉ BESKYDY MTS.

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Instream wood represents natural component of fluvial systems, influencing fluvial geomorphologic processes. Besides the well-known significance of large wood (LW), also small woody pieces (SW; for our purpose defined as pieces with dimensions at least 0.5 m length and 0.1 m diameter or 1.0 m length and 0.05 m diameter), play an important role in steep narrow headwaters (e.g., Gomi et al., 2003). However, a significant decline of instream wood by increasing watershed area was documented in flysch Western Carpathians due to the removal of logs from channels by local people (Galia and Hradecký, 2014).

We inventoried instream wood in the 0.4 km long Mazák headwater channel in the protected area of the Mazácký Gruník natural monument, Moravskoslezské Beskydy Mts. The studied channel ($2<W<4.5$ m; $0.20<S<0.40$ m/m) was confined by very steep adjacent hillslopes ($0.6<S<1.1$ m/m). The total number of inventoried instream wood was 90 LWs and 199 SWs. Almost all investigated pieces were European beeches (*Fagus sylvatica* L.) and only two pieces were Norway spruces (*Picea abies* (L.) Karst.). We assessed the parameters of wood dimensions, orientation, decay status (four classes), stability (unattached/in contact with hillslopes/attached by bed sediments or other wood), % of influenced channel width by a wood, the geomorphic function of a wood (step, wood jam) and % of length of a wood in channel. In addition, dendrogeomorphic dating of 36 LWs and 17 SWs was performed to obtain residence time of instream wood and to provide some insights into its mobility.

The results demonstrated a local increase in the number of LWs in channel-reaches confined by the steepest adjacent hillslopes (especially at 0.15-0.20 km). Increasing downstream amount of SW most likely reflected wood transport dynamics in the stream, and the later deposition of SWs on the lowest channel gradients. Also LWs and SWs in the downstream channel-reaches were more decayed than wood presented in the upper reaches. The orientation of instream wood was connected with its length and stability, when LWs longer than 5 m were usually attached to adjacent hillslopes. Pieces longer than 2 m, which were unattached or were somehow stabilised in the channel bed, had often orientation of 0° or 337°. LWs were mostly unattached in the upstream channel-reaches, while often stabilized by adjacent hillslopes in the middle part. At 0.05-0.10 km, we documented also many logs stabilised by bed sediments. By contrast, SWs were mostly unattached in the entire studied stream. We observed higher % of influenced channel width by SWs than LWs. Also, SWs were usually entirely located in the channel, which was significantly different when compared to LWs. Nine small steps (step height ~0.5 m) were created by instream wood; six of them were formed by SWs. We did not observed any larger woody jams in studied channel. Dendrogeomorphic cross dating documented that older LWs and SWs, with pieces from the 1960s and 1970s, were typical for the downstream channel-reaches. On the other hand, almost all instream wood was dated from the 1990s and 2000s in the uppermost part of evaluated stream. This

observation is in agreement with our hypothesis of a higher intensity of transport processes in the upper parts.

Keywords: instream wood, headwater stream, wood mobility, Moravskoslezské Beskydy Mts.

References:

Galia T, Hradecký J (2014) Morphological patterns of headwater streams based in flysch bedrock: Examples from the Outer Western Carpathians. Catena 119: 174–183.

Gomi T, Sidle RC, Woodsmith RD, Bryant MD (2003) Characteristics of channel steps and reach morphology in headwater streams, southeast Alaska. Geomorphology 51: 225–242

GRAIN-SIZE ANALYSIS OF BED SEDIMENTS OF THE TORRENTIAL KNĚHYNĚ STREAM

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The study deals with relationships between bed sediments of the Kněhyně Torrent and local geometric parameters in selected cross-sections. Downstream grain-size trends are also described. Wolman (1954) methodology was used for the grain-size analysis at 10 locations of 3.9 km long studied longitudinal profile. Additional geomorphic mapping provided information about spatial distribution of sediment sources (i.e., bank failures, gullies and landslides). The grain-size percentiles (D16, D50, D84) were calculated, which were later used as a key factor to identify a change of sediment calibre. In general, these changes of bed grain sizes were caused by anthropogenic impacts, namely by a check dam construction, and a river restoration of downstream part of the studied channel, and by activity of channel-hillslope processes (gullies development, landslides). The results indicated a significant dependence between the parameters of local channel geometry (i.e., bankfull width and channel slope) and bed grain-size. We found out that the anthropogenic factors had a larger effect on resulted bed grain-sizes than natural character of sediment supply.

Keywords: mountain stream, grain-size analysis, bed sediments, Wolman method, the Kněhyně Torrent, Moravskoslezské Beskydy Mts

References:

Wolman MG (1954) A method of sampling coarse river-bed material. Transactions American Geophysical Union 35(6): 951–956.

RFID OBJECT TRACKING, UAV GRANULOMETRY AND TIME-LAPSE TLS AS NEW ATTITUDES IN FLUVIAL GEOMORPHOLOGY: FIRST EXPERIENCE FROM ŠUMAVA MTS.

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Fluvial geomorphological and hydrological research in the upper catchment of the Vydra R. in the Šumava Mts. is a long term interest of our research team, and has been carried within the scope of several consequent projects. In recent years, newly developed, and/or improved techniques allowed to employ innovative attitudes and methods, which can potentially bring qualitatively and quantitatively new information on the fluvial systems function, development and dynamics.

The in-stream object tracking is based on RFID (Radio frequency identification) microchips, which are attached to individual sediment clasts and planted into the river channel. The position of each tagged clast is recorded using a GNSS-RTK positioning device. After certain period (or a flood event), the clasts are detected using a custom made reader, and the new position of each clast is recorded. This method represents a unique experiment, allowing observing very closely the real process of downchannel transport in natural conditions, calculating velocities and forces involved, and quantifying the total bedload transport.

In recent years, among the technologies for acquiring sound data on fluvial processes is the Unmanned Aerial System (UAS) photogrammetry. However, the combination of low-flying, easy-to-control carriers with high resolution cameras brings more possibilities than orthophotogrammetry. Emerging techniques thus include SFM (structure from motion) terrain modelling, time-lapse monitoring, and, in combination with specialized DIA (digital image analysis) software, also the UAV granulometry. This means that the photographed coarse sediment surface is analysed for the individual clast size, and processed. Compared to ground based DIA granulometry, larger areas can be quickly covered, and whole sedimentary bodies analysed, which allows obtaining extra information, such as 2D changes in gradation or angularity.

Terrestrial LiDAR scanner (TLS), a state-of-the-art geodetic method, allows the measurement of the object spatial position with sub-millimetre accuracy, which makes this technique unique for a precise evaluation of temporal changes in the river channel and floodplain. Using terrestrial LiDAR scanning, a detailed 3D model of floodplain, gravel bodies, channel banks can be constructed. If the scanning is repeated (time-lapse), comparison of the DEMs allows very precise quantification of volumetric changes.

Fusion of these techniques enables to quantify accurately the spatial and volumetric characteristics of the floodplain and channel, measure the velocity and volume of the sediment transport, to identify threshold values of forces and events, triggering the fluvial processes, and together with climatic and hydrologic parameters observation also to simulate the effects of changing boundary conditions of fluvial processes by climate change, landscape changes, channel modifications. The first results from our study area in Šumava Mts. have already proved the synergic power of these new methods combination.

MORPHOLOGY AND GEOLOGY OF WIERNA RIVER VALLEY BETWEEN RUDA GÓRNA - KOPANINY

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The study area is located in the south - western edge of the Holy Cross Mountains. Wierna River (Łososina River) is a left-side tributary of the White Nida with a length of 35.6 km. Catchment of this area is 314 km^2 and includes: Suchedniów plateau, Łopuszno Hills and Przedborsko – Małogoskie Range. Wierna River creates a breakthrough between Chęciny Range and Przedborsko – Małogoskie Range. The bottom of the Wierna River is terraced. The high terraces are built by sandy deposits of a braided river. The bottom of the valley is made up of a few of different aged insertions of Late Glacial and Holocene. Late glacial insert associated with macromeanders which are located in the coastal parts of the valley floor. However the Holocene insert can be distinguished within the bottom of the valley. Those oxbow are smaller and most of them are located in the west side of the river valley. That shows the direction of lateral migration of the Wierna River in this section. Also in the east side of the valley are located few Pleistocene macromeanders. In this area anthropogenic changes are minor and most of the riverbed is still natural. The Holocene and Pleistocene meanders are clearly visible in the area.

Keywords: morphology, Wierna river valley, macromeanders, Late Glacial.

FACIAL DIFFERENTIATION OF ALLUVIA IN CZARNA KONECKA RIVER VALLEY DOWNSTREAM OF STĄPORKÓW (POLISH UPLANDS)

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Study section of the Czarna Konecka river valley is located dowstream of Stąporków on Polish Uplands. There is the Mesozoic margin of Holy Cross Mountains with Jurassic (Lias) sandstone (Żarnów series) in basement.

Within the valley can be divided high terrace (approx. 6 m) composed of sandy channel sediments of braided river (profile Czarna 5). Middle terrace (4.0-4.5 m above the river level) is erosion-accumulative in the east (profile Czarna 2) and accumulative in the west (profile Czarna 3) of study area. It has also been formed by braided river. Lower terrace (approx. 3 m) was already shaped by the meandering river. Along the river extend relatively narrow strips floodplain higher (2.0-2.5 m) and lower (0.5-1.0 m). Alluvia these two levels show a clear facial differentiation typical meandering river sediments. Lateral channel migration has created a meandering hill (profile Czarna 3) and a few Holocene cut-fill alluvial bodies. There are numerous subfossil tree trunks in both the channel sediments (profile Czarna 3) and abandoned channel fill (profile Czarna 4 and 1). One of this subfossil tree was ^{14}C dated at 1700±40 BP (MKL 2862) cal. 240-420 AD. It was fallen in the Late Roman period and it has accumulated on the limit between channel deposits and sandy bars in the first stage of abandonem channel filling. The fillings oxbow lakes (profiles Czarna 4 and 1) indicate distinct variation of sedimentation types, referring to changes in the frequency of flooding in the Holocene. One of this type change was ^{14}C dated at 630±60 BP (MKL 2861) cal. 1270-1420 AD when peats were covered with levee deposits (intercalations of sands and silts). It could be connected with a Medieval increase anthropogenic changes of drainage basin and valley floor but also with clustering of catastrophic events during the Little Ice Age.

The data collected during Archaeological Map of Poland (Polish Archaeological Record) from the study section are few, only 4 points (traces of settlements) from the Stone Age. Two of them are located on the high terrace. The next two are already on the low terrace, which confirms indirectly probably its Lateglacial age. On this terrace (site 7) developed Early Medieval and Medieval settlement, which indicates that the area was overflood in this period. However anthropogenic changes could triggered changes of sedimentation type on flood plain. Archaeological data indicate that the settlement entered the valley floor (flood plain) only in modern times.

In last centuries, the valley has been transformed anthropogenically as document cartographic and historical data. This led to the occurrence of catastrophic event in 20th century, eg. flood after break the dam and accumulation very coarse alluvium with artefacts downstream of drained lake. Present-day, the morphology of the river bed and the valley strongly influences the activity of beavers.

Keywords: Holocene, alluvia facies, Czarna Konecka river, alluvial bodies.

UPPER BIEBRZA BASIN – PROBLEMS OF GEOLOGICAL, GEOMORPHOLOGICAL AND GEOARCHAEOLOGICAL MAPPINGS

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Study area is located in NE part of Poland in upper Biebrza basin. Relief of this region formed during Middle Polish Glaciation –Wartha Glaciation. However during the next ice-sheet advance until the Pomeranian phase of last glaciation (Val'chik 1992: 15,5-15,0 ka BP; Kozarski 1995: 16.2 ka BP) outflow from the dam lakes Naroch-Wilia and Skidel and river waters of the upper Neman river followed Łososna river valley, its tributary Tatarka river breakthrough Pripilin-Nurki gap section to Biebrza and Narew river valleys (Val'chik 1992, Żurek 1994). Therefore the upper Biebrza is underfit river with vast peat-bogs on its valley floor. The Pleistocene relief of the valley was transformed in small degree during the Late Glacial and Holocene. Controling factors of the evolution were climate and vegetation changes. This type of lanscape was settled by Prehistoric people since the Palaeolithic. Subneolithic cultures, the last hunter-gatherer community in the borderland of East and West Europe, are among the least recognized issues of Polish prehistory. Their way of life, inextricably linked and driven by environmental considerations. Among other things, determined the cyclical nature of the selection and location of settlements. They preferred a small, dry hills situated directly within the valley floor. Geological, geomorphological and geoarchaeological studies were conducted near the Krasnoborki site in western part of upper Biebrza river valley. "Dune-like" elevation is located here on the bottom of the marginal valley (pradolina) near its northern slope. Distance between this form and present-day river is about 650 m. Two archaeological outcrops were located on elevation slope (trench 1) and valley bottom (trench 2). Few flint artefacts with lithic technology of the Late Mesolithic Janisławice culture and assemblage of burned bones (human?) over the wooden structure (depth about 60 cm below surface) were located between peat and sands in trench 1. Wood from this structure was ^{14}C dated at 4190±50 BP cal. 2899-2626 BC (MKL 2854). The trench 1 indicate traces of some phases of soil erosion and formation of delluvial covers, which interfinger with the surrounding peats. At the same time tree stumps preserved in peats at trench 2 indicate a drier periods, when the trees could encroach on a peat-bog in the valley bottom. However rising the level of groundwater in the end of the Atlantic has led to death and fallen of trees at 5060±60 BP (MKL 2856).

Due to structure and texture of sediments elevation is not a dune but erosional remnant of sandy-gravel fluvioglacial deposits. This form was settled in one phase (homogenous flint artefacts in one geological strata) by Subneolithic gatherers of Niemen culture. Layer of artefacts are Late Neolithic occupation horizons because people of this culture, without intensive and stable settlement, didn't formed typical cultural level. Late Mesolithic lithic technology outlived until Late Neolithic (1st half of 3rd millenium BC) Niemen culture. Lack of pottery could be connected with small area of excavation or function of this settlement (hunting or fishing). Cremated bones (human?) concentration could be the first traces of cremation funeral feast of Subneolithic gatherers. So far they have not found any grave of Niemen culture. Tree stumps preserved in peats (trench 2) indicate

humid period in the end of the Atlantic, when the trees couldn't growth on a peat-bog in the valley bottom. Traces of the Subboreal soil erosion and colluvial (delluvial) covers formation occurred on the slope elevation (trench 1). Second humid period and beginning of peat accumulation on Subboreal colluvia (delluvia) occured about 3200-3100 BP. Climate fluctuations correlate very well with phases distinguished in Centraleuropean river valleys (Kalicki 2006). The research was carried out in cooperation with the project: „Preservation of wetland habitats in the upper Biebrza Valley" LIFE11/NAT/PL/422.

Keywords: geoarchaeological studies, upper Biebrza Valley, Subneolithic gatherers.

References:

Kalicki T (2006) Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich. Prace Geograficzne IGiPZ PAN 204, 348 p.

Kalicki T, Wawrusiewicz A, Frączek M, Przepióra P, Kusztal P, Nowak M (2015) Geoarchaeological studies of the Subneolithic site at Krasnoborki (upper Biebrza river valley, NE Poland) In. Nohalova H, Káňa V, Březina J (eds.) Sbornik abstrakt 21. Kvarter, 27.11.2014, Brno, 25.

Kalicki T, Wawrusiewicz A, Frączek M, Przepióra P, Kusztal P, Nowak M (2016) Late Glacial and early Holocene environmental context of Subneolithic settlement in the Upper Biebrza Basin, 12 Konference Environmentalni Archeologie „Před neolitem…", 7-9.02.2016, Praga, Czechy: 29.

Kozarski S (1995) Deglacjacja północno-zachodniej Polski: warunki środowiska i transformacja geosystemu (~20KA→10KA BP). Dokumentacja Geograficzna 1.

Musiał A (1992) Studium rzeźby glacjalnej północnego Podlasia. Rozprawy Uniwersytetu Warszawskiego 403 p.

Val'chik MA (1992) Razvitie dolinno-rechnoy seti Belorussii i Pribaltiki v sviazi s degradaciey valdayskogo lednikovogo pokrova. In: Shirokov LM (ed.) Gidrographicheskaya set' Belorussii i regulirovanie rechnogo stoka. Universitetskoye. Minsk: 310 p.

Żurek S (1994) Geomorphology of the Biebrza valley. In Okruszko H, Wassen MJ (eds.) Towards protection and sustainable use of the Biebrza Wetlands: Exchange and integration of research results for the benefit of a Polish-Dutch Joint Research Plan, Utrecht: 15–47.

THE DEVELOPMENT OF UPPER KAMIENNA RIVER VALLEY IN LATE GLACIAL AND HOLOCENE

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Research area is located in surrounding of Marcinków, several kilometres downstream of Skarżysko-Kamienna. It lies on the upper course of Kamienna river (about 150 km of length), one of the primarily river which draining the Holy Cross Mountains region. River catchment reaches 2007,9 km^2 and has a characteristic longitudinal shape (Suligowski et al. 2009). Mentioned region is connected with Mesozoic margin, within which distinguished a Lower Triassic rocks of Suchedniowski Plateau and a Lower Jurassic rocks of Iłżeckie Foreland (Kondracki 2009). Some identified Quaternary deposits originated from Oder glaciations, as complex of fluvioglacial sands and gravels. Sandy-gravel alluvia of braided river created two levels of the Pleistocene terraces. An aeolian processes has been recognized by dunes and layer of windblown sand covering buried soils on the terrace. An increase of these activities could have a climatic reason in the Late Glacial or has been connected with human impact in the Holocene (Barwicka, Kalicki 2012, 2013).

The characteristic feature of the Holocene flood plain of Marcinków surroundings is significantly complicated structure caused by the presence of several alluvial bodies from different ages. This section was formed by process of lateral migration of meandering river (Barwicka, Kalicki 2012, 2013). The increase of fluvial activity with bank erosion and probably also human activity in the Roman time are the main reasons of formation of layers of subfossil trees in channel deposits. Black oaks from Marcinków III site, was dated at 2020±40 BP. Dendrochronological method made it possible to determine the age of other black oak on 186-45 BC (Marcinków IV – K7 profile). In profiles K4 and K5 (Marcinków II site) with palaeochannel fills (peats) has observed typical finning upward sequence. This tendency is also visible in K2 profiles. Barwicki and Kalicki (2012, 2013) identified and dated buried soil (730±90 BP) along the river channel, from Marcinków I site. It is results of increase of vertical accretion caused by floods events in the Little Ice Age and human impact in last centuries. The further micromorphological analysis will allow for a better recognition of formation of that buried soil layer.

An beginning of anthropopressure on that research area has been connected with the mining of hematite ores lied within the Archeaological Reserve „Rydno" in the Paleolithic, and also mining and processing of chocolate flint. In the Roman time an ancient metallurgy on the Holy Cross region could have a strongly influence on deforestration in Kamienna river valley. Nowadays the significant anthropogenic impact is reflected by hydrotechnical buildings that change the morphology of river channel and conditions of erosion, accumulation and transport processes. The example of mentioned building are water-mills from 19th or beginning of 20th century located along Kamienna river which caused to development of mill streams.

Keywords: Kamienna River Valley, Pleistocene terraces, flood plain, alluvial bodies.

References:

Barwicka A, Kalicki T (2012) Development of the Kamienna river flood plain near Marcinków [in:] Geomorphic processes and geoarchaeology. From Landscape archaeology to archaeotourism. Extended abstracts. Moscow-Smolensk 20-24.08.2012, 40-41.

Barwicka A, Kalicki T (2013) Development of Kamienna river flood plain in Rydno Archaeological Reserve (Holy Cross Mountains, Poland) [in:] 9. Konference environmentalni archeologie KEA 2013, Sbornik abstraktu (eds. A. Bernardova, J. Benes), 28-30.01.2013, Czeskie Budziejowice, 13.

Kondracki J (2009) Geografia regionalna Polski. Wydawnictwo Naukowe PWN, Warszawa.

Suligowski R, Kupczyk E, Kasprzyk A, Koślacz R (2009) Woda w środowisku przyrodniczym i jej zagospodarowanie w województwie świętokrzyskim. Instytut Geografii Uniwersytetu Humanistyczno-Przyrodniczego Jana Kochanowskiego w Kielcach, Kielce.

GROWTH RESPONSES OF COMMON SPRUCE ON LANDSLIDE EVENT GIROVÁ 2010

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Dendrogeomorphic methods are frequently used in landslide analyses. Although methods of landslide dating based on tree rings are well developed, they still indicated many questions. The aim of this study was to evaluate the frequently used theoretical scheme based on the event–response relationship. Seventy-four individuals of Norway spruce (*Picea abies* (L.) Karst.) exhibiting visible external disturbance, were sampled on the Girová landslide (the largest historical flow-like landslide in the Czech Republic). This landslide reactivated in May 2010, and post-landslide tree growth responses were studied in detail. These growth responses were compared with the intensity and occurrence of visible external tree disturbance: tilted stems, damaged root systems, and decapitation. Twenty-nine trees (39.2 %) died within one to four years following the 2010 landslide movement. The trees that died following the landslide movement were significantly younger and displayed significantly greater stem tilting than the live trees. Abrupt growth suppression was a more-frequent response among the dead trees, whereas growth release dominated among the live trees. Only two trees (2.7 %) created no reaction wood in response to the landslide movement. Forty-four percent of the trees started to produce reaction wood structure after a delay, which generally spanned one year. Eccentric growth was significant since the first years following the landslide movement, and some was evident in the tree rings of the landslide year. Missing rings were observed only on the upper sides of the stems, and no false tree rings were observed.

Keywords: Landslide; Dendrogeomorphology; Growth response; Compression wood.

MORPHOLOGY CLASSIFICATION OF AVALANCHE PATHS AND THEIR ACTIVITY IN THE EASTERN HIGH SUDETES

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Snow avalanches are one of the most dynamic processes in the mountain environment with important impact on morphology of upper parts of valleys and vegetation. In the eastern part of the High Sudetes (i.e. the Hrubý Jeseník Mts. and the Králický Sněžník) there were already described over 20 avalanche paths (Kříž, 1995). Many of them are inactive and are overgrown by forest. There are only 5 not overgrown avalanche areas in the eastern High Sudetes. The evidence about avalanche activity is almost unknown because of lack of written or other sources. To encrypt information about avalanche activity and its dynamics, dendrogeomorphological analysis and detailed geomorphological mapping (both terrain and remote sensing) were chosen. All avalanche paths in the Hrubý Jeseník and Králický Sněžník Mts. are located in east- to south- oriented hollows, where huge snow accumulations occur during the winter. The slope of their starting zones exceeds 30 degrees and the average slope of all paths exceeds 20 degrees in all avalanche areas. The width of the paths varies between 20 and 150 meters and the length between 150 and 660 meters. There are two groups of avalanche paths on the basis of length, width and slope. The first group represents shorter, wider and steeper paths of the Vysokoholský ridge. The paths of the second group (the Sněžná kotlina and the Morava Hollow) are relatively narrower and longer than the paths of the first group. These paths are also surrounded by canopy forest, as they are suitable for dendrogeomorphological analysis.

Hence, these two avalanche paths were analysed by dendrogeomorphological approach and geomorphological analysis to find out their activity and its relation to avalanche path morphology. The Sněžná kotlina path is located on the eastern slope of the Červená hora Mt. and the Morava hollow on the southern slope of the Králický Sněžník Mt.

Samples for dendrogeomorphological analysis were taken from 50 living trees and 11 death logs in the Sněžná kotlina path and 27 living trees and 8 dead logs in the Morava Hollow. *Picea abies* was sampled tree. The semi-quantitative approach (sensu Kogelnig-Mayer et al., 2011) was used to determine potential avalanche years.

Detailed geomorphological mapping of studied paths was visualized in the GIS environment on the basis of terrain exploration and GPS measurements of selected landforms and LiDAR Digital Elevation Model. Also historical aerial photographs were compared to find out potential avalanche disturbances in vegetation cover.

The results show that morphology and activity of avalanche paths are completely different. The Sněžná kotlina path is much more active than the Morava hollow The difference in avalanche activity between two studied paths is supported by their morphology.

The analysis helped to clarify information about avalanche activity in studied avalanche paths and confirmed strong relationship between avalanche activity and path morphology. It can be helpful for potential creation of avalanche cadastre or another detailed avalanche studies in mid-mountains.

The study was supported by the Grant Agency of Charles University in Prague (project GAUK 1072116) and the terrain research was enabled by the Protected Landscape Area Jeseníky.

Keywords: snow avalanches, avalanche paths, morphometry, dendrogeomorphology, Eastern High Sudetes

References:

Kogelnig-Mayer B, Stoffel M, Schneuwly-Bollschweiler M, Hübl J, Rudolf-Miklau F (2011) Possibilities and Limitations of Dendrogeomorphic Time-Series Reconstructions on Sites Influenced by Debris Flows and Frequent Snow Avalanche Activity. Arctic, Antarctic and Alpine Research 4.

Kříž V (1995) Laviny Hrubého Jeseníku, Králického Sněžniku a Moravskoslezských Beskyd. Sborník přírodovědecké fakulty Ostravské univerzity - Geografie, geologie 149/3.

COMPARISON OF CHEMICAL WEATHERING MICROTEXTURES OF SAMPLES FROM MORAVIAN GATE AND HIGH TATRAS

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Weathering and diagenesis causes on quartz grains various microtextures, which reflect the age, diagenetic history and environmental condition. This paper deals with main microtextural, which distinguish saalian glaciofluvial quartz grains from Moravian Gate and würm glaciofluvial squartz grain from High Tatras.

Six samples (300 quartz grains) from three sand-quarries in Moravian Gate and six samples (300 quartz grains) from glaciofluvial outcrop in High Tatras were studied under electron microscope and results were statistically analysed with F-test to define the main microtextures which distinguish the samples from two glacial stages.

Saalian samples from Moravian Gate were characterized by rounded shape, low relief, straight steps, V-shaped pits, dish-shaped pits, straight grooves, adhering particles and solution features. Würm samples from High Tatras were characterized by sub-rounded shape, medium relief, straight grooves, fracture features, parallel grooves, edge abrasion, meandering ridges, adhering particles and solution features. On quartz grains, which were reshaped by older saalian glaciation, occur less glacial microtextures, whichare overlaid with microtextures of subsequent transport. On surfaces of würm quartz grains sampled from outcrops in High Tatras occur the relicts of glacial action. Based on the statistical analysis, quartz grains from saalian and würm stage are significantly distinguished by sub-angular and rounded shape, parallel grooves, edge abrasion, V-shaped and dish-shaped pits, grinding features and irregular chemical relief.

The study was funded by the Grant Agency of Charles University (GAUK 1314214).

Keywords: glaciofluvial sediment, exoscopy, weathering.

ESTIMATING EFFECT OF SMALL STREAM MORPHOLOGY RESTORATION ON FLOOD WAVE ATTENUATION BY 2D HYDRAULIC MODEL

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Stream restoration projects are often presented as a part of flood protection management. In practice are restoration realised often on small streams for hundreds meters long sections. How much are these projects effective in flood risk reduction can be estimated by mathematical hydraulic models without actual realization. This approach was applied on Jasénka stream located at Czech Republic for 1, 5 km long section of channel. The effect of current state of channel morphology on potential flood waves was compared to proposed variants of new channel morphologies. New variants of morphology were proposed with preserving original trace but with lower capacity and with new meandering trace. By method of unit hydrogram were estimated potential flood waves with probability of reocurece 5, 20 and 100 years. For current and proposed morphologies were established two dimensional hydraulic models in software HEC-RAS. Then were simulated all designed flood waves. The results showed that the effect of the proposed modifications to the flood waves attenuation from the current state is evident just for 5yr flood wave where restored morphology cased delay of peak flow. For flood waves with higher flows the effect is not significant compared to current state.

Keywords: flood risk, HEC-RAS, hydraulic model, restoration, stream morphology.

GEOMORPHOLOGY OF CHOSEN CREVICE-TYPE CAVES IN THE OUTER WESTERN CARPATHIANS

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We investigated three crevice-type caves, which are formed by gravitational forces in flysch rocks of the Outer Western Carpathians, in order to determine particular movements, which led to the cave corridors formation. The Mraznica cave is located in the Moravskoslezské Beskydy Mts. (Istebna Formation), the Smrdutá cave is located in the Hostýnské vrchy highland (Rusava Member of Zlín Formation) and the Naděje cave is located in the Vizovické vrchy highland (Luhačovice Member of Zlín Formation). All studied sites are strongly affected by the deep-seated gravitational slope deformations. We used methods based on structural geological measurements and geological profiling, namely bedding planes position comparison. Data were visualized in the Stereonet software. According to results, we revealed various mechanisms responsible for the development of the caves. The resulting morphology of each cave was affected by several types of gravitational movements. The Mraznica and the Naděje caves were formed by lateral spreading and both back and horizontal rotations movements. For both caves, the subsidence of huge inner rock blocks is observed, probably as a result of the overall slope relaxation. Some of the joint sets are probably of nongravitational origin and were formed before the slope movement occurred. The Smrdutá cave is formed by toppling process as well as by horizontal rotation.

Keywords: Crevice-type caves, Deep-seated gravitational slope deformations, Mraznica cave, Naděje cave, Outer Western Carpathians, Pseudokarst, Smrdutá cave.

References:

Lenart J (2015) Morphological patterns of crevice-type caves in sedimentary rocks of the Outer Western Carpathians (Czech Republic). Journal of Cave and Karst Studies 77(3): 165–176.
Lenart J, Pánek T, Dušek R (2014) Genesis, types and evolution of crevice-type caves in the Flysch Belt of the Western Carpathians (Czech republic). Geomorphology 204: 459–476.
Margielewski W, Urban J (2003) Crevice-type caves as initial forms of rock landslide development in the Flysch Carpathians. Geomorphology 54: 325–338.

ANALYSIS OF THE INFLUENCE OF TECTONICS ON THE VALLEY NETWORK EVOLUTION BASED ON THE SRTM DEM AND THE RELATIONSHIP OF AUTOMATICALLY EXTRACTED LINEAMENTS AND THE TECTONIC FAULTS, JEMMA RIVER BASIN, ETHIOPIA

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The Ethiopian Highland is good example of high plateau landscape formed by combination of tectonic uplift and episodic volcanism (Kazmin, 1975; Pik et al., 2003; Gani et al., 2009). Deeply incised gorges indicate active fluvial erosion which leads to instabilities of over-steepened slopes. In this study we focus on Jemma River basin which is a left tributary of Abay - Blue Nile to assess the influence of neotectonics on the evolution of its river and valley network. Tectonic lineaments, shape of valley networks, direction of river courses and intensity of fluvial erosion were compared in six *subregions* which were delineate beforehand by means of morphometric analysis. The influence of tectonics on the valley network is low in the older deep and wide canyons and in the and on the high plateau covered with Tertiary lava flows while younger upper part of the canyons it is high. Furthermore, the coincidence of the valley network with the tectonic lineaments differs in the *subregions*. The fluvial erosion along the main tectonic zones (NE-SW) direction made the way for backward erosion possible to reach far distant areas in E for the fluvial erosion. This tectonic zone also separates older areas in the W from the youngest landscape evolution *subregions* in the E, next to the Rift Valley. We studied the functions that can automatically extract lineaments in programs ArcGIS 10.1 and PCI Geomatica. The values of input parameters and their influence of the final shape and number of lineaments. A map of automated extracted lineaments was created and compared with 1) the tectonic faults by Geology Survey of Ethiopia (1996); and 2) the lineaments based on visual interpretation of by the author. The comparation of lineaments by automated visualization in GIS and visual interpretation of lineaments by the author proves that both sets of lineaments are in the same azimuth (NE-SW) - the same direction as the orientation of the rift. But it the mapping of lineaments by automated visualization in GIS identifies a larger number of shorter lineaments than lineaments by visual interpretation.

Keywords: valley network, lineaments, faults, azimuth, Jemma River basin, Ethiopian Highlands.

References:

Gani ND, Abdelsalam MG, Gera S, Gani MR (2009) Stratigraphic and structural evolution of the Blue Nile Basin, Northweastern Ethiopian Plateau. Geologic Journal 44: 30–56.

Kazmin V (1975) Geological Map of Ethiopia. Geological Survey of Ethiopia, Adrie Ababa, Ethiopia.

Mangesha T, Chernet T, Haro W (1996) Geological Map Of Ethiopia (1: 250,000). Geological Survey of Ethiopia: Addis Ababa, Ethiopia.

Pik R, Marty B, Carignan J, Lavé J (2003) Stability of the Upper Nile drainage network (Ethiopia) deduces from (U/Th)/He thermochronometry: implications for uplift and erosion of the Afar plume dome. Planetary Science Letters 215: 73 – 88.

HUMAN ACTIVITIES IN THE CZARNA KONECKA RIVER VALLEY BETWEEN JANÓW AND WĄSOSZ STARĄ WIEŚ

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The study area includes part of the Czarna Konecka river valley between the Janów and Wąsosz Stara Wieś. It is located within the northern margin of the Holy Cross Mountains, the area of the left bank of the Vistula river basin, 40 km north of Kielce.

Documented traces of human activity date back to the Paleolithic to the present. They are represented by archaeological finds, sedimentological and geomorphological records, cartographic and historical data and visible transformation of the area.

Medieval anthropogenic activities indicated in the geological structure of the floodplain. Found artifacts from past centuries attest to the functioning of the industry within the valley. Archival information documenting the catastrophic event caused by the damage of the dam reservoir. Present-day activities include the development of settlement pattern on the higher terrace, deforestation, hydrological and hydrotechnical changes, and interference with the natural discharge of the river.

Keywords: Czarna Konecka river valley, anthropogenic changes, last centuries.

GENESIS AND EVOLUTION OF THE MATĚJOVICKÁ CAVE IN THE AMALÍNSKÁ VRCHOVINA HIGHLAND IN OSOBLAŽSKO REGION

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The Matějovická cave is small underground cavity in the north-eastern portion of Czechia, near town Osoblaha. The cavity is formed in the western steep slope, 20-30 m above the bottom of the Hrozová valley. It is formed in the Cenoman sandstones with the subhorizontal layering and transversal subvertical joints (SSV-JJZ, SZ-JV). The system of several short corridors and two bigger chambers is 25 m long and might be also used as underground sand pit. The corridors are terminated by the phreatic-like channels. The ceiling is formed by the lower bedding planes, the bottom is filled by debris and sand. Two main chambers are disrupted by several transversal joints, which are gravitationally widened and filled with sand. The entrance chamber is disrupted by distinct weak jointed zone with petrographical attributes different from the surrounding rock. We identified the Liesegang rings within this structure. The differences in cement are detectable between the samples from the cavity and from the superficial environment. The samples from the cavity contain contact kaolinite cement, whereas sample from the superficial environment contains calcareous and clayey contact or overgrowth cement. The investigated cavity should be considered to be pseudokarst cave, which was discovered during the historical mining works. The cave was formed by the erosion of incoherent sandstones by the underground water permeating into the massif along the joints and rock layers since the incision of the river Hrozová during the alpine orogenesis started. The resulting corridors and chambers were anthropogenically modified. The jointed massif is affected by gravitational movements. Recently, the cave is fossilized and the active development is limited to the inflow of melting water and rainwater.

Keywords: Cretaceous sandstones, Matějovická cave, Speleogenesis.

References:

Král V (1957) O některých pseudokrasových zjevech na Jesenicku. Přírodovědecký sborník Ostravského kraje XVIII (2): 271–276. Slezský studijní ústav, Opava.

Schweigstillová J, Bruthans J, Falteisek L, Válek J (2013) Rychlá tvorba skalních kůr na povrchu hruboskalského pískovce: mikroskopický popis, tahová pevnost, odolnost vůči erozi, vznik a význam pro pískovcový reliéf. Zpr. geol. Výzk. v Roce 2012: 228–234.

Soukup J, Bruthans J, Světlík D, Schweigstillová J, Smutek D (2013) Sebeorganizovaný systém otevřených puklin vzniklých prouděním podzemní vody v kvádrovém pískovci v lomu Střeleč. Zpr. geol. Výzk. v Roce 2012: 296–304.

Vítek J (1978) Typy pseudokrasových jeskyní v ČSR. Československý kras 30: 17–28.

Zapletal L, Kubalec B (1959) Geografie okresu Krnov. Odbor pro školství a kulturu rady ONV v Krnově, Krnov.

RELIEF AND SETTLEMENT PATTERN IN THE NIDA RIVER VALLEY NEAR WIŚLICA

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Wiślica is located in southern part of Nida Basin (Polish Uplands) in the Nida river valley, tributary of upper Vistula river. The geomorphological regionalization this area belongs to Wiślica Funnel, depression located between two elevations Wodzisław Hummock and Pińczów Hummock. It is a tectonic Solec trough, where the Cretaceous marls are covered with Miocene (Tortonian) rocks. In relief, the most important is the role of gypsum folded anticline and syncline in the course of the NW-SE. Karstic phenomena developed on gypsum. On the anticline lines were formed inversion karst basins occupied by swamps and bogs lying directly on the Cretaceous marls. On the syncline lines formed sink holes, dry karst valleys (eg. Skorocice) etc. Active karst phenomena also led to the changes of direction of hydrographic pattern. A number of geological and geomorphologic data indicates the existence young subsidence movements in the area of Wiślica Funnel.

The ice sheet of the San I glaciation reached the foreground of the Sudetenland and the Valley of the Lower San surpassing the belt uplands Central Polish and covering an area of research. Tills, which are the remains of this period reaches thickness of 5 to 30 meters. Glaciation San II was the last of the glacial ice sheet in southern Poland reached the northern slopes of the Carpathians and mites and the Sudetenland. The material left behind by the glacier reaches a thickness of several, or a dozen meters. During the glaciations of the Oder in the Silesian Upland, Malopolska Upland and in our study area was sedimentation of loess.

One gypsum fold, Wiślica anticline, forms the eastern limit of the subsequent Nida river valley on the study section. Contemporary Wiślica town is located on it and this gypsum hill was settled since Neolithic. Western slope of the valley is rectilinear and steeper than eastern one. Both slopes of the valley was densely settled in the Neolithic. Flat valley bottom has a width of 1-3 km. Within its monoclinal gypsum elevations and gypsum tumuli occur, which create small overflood islands rising directly above the valley floor. They constituted a favorable environment for settlement. There are several cut-fill alluvial bodies in the valley bottom of the different age referring to changes of river pattern during the Late Glacial and Holocene. Alluvia are clearly facial differentiated. According to the Archaeological Map of Poland data only a single Neolithic sites occur on the floodplain (4 sites) and on the border between the plain and upper terrace (3 sites).

Keywords: Neolithic, settlement pattern, Nida Basin.

References:

Flis J (1954) Kras gipsowy Niecki Nidziańskiej. Prace Geograficzne, PAN 1: 7–73.
Gilewska S (1972) Wyżyny Śląsko-Małopolskie. In: Klimaszewski M (ed.) Geomorfologia Polski, Tom 1: Polska Południowa. Góry i wyżyny. Państwowe Wydawnictwo Naukowe, Warszawa.
Kalicki T (2006) Zapis zmian klimatu oraz działalności człowieka i ich rola w holoceńskiej ewolucji dolin środkowoeuropejskich, Prace Geograficzne 204.
Kondracki J (1978) Geografia regionalna Polski, PWN, Warszawa.

Lindner L (1977) Wietrzenie peryglacjalne na Wyżynie Małopolskiej.
Malicki A (1947) Zabytki przyrody nieożywionej na obszarach gipsowych dorzecza. Nidy. Chrońmy Przyrodę Ojczystą, 3: 31–38.

MAPPING GEOMORPHOLOGICAL DIVERSITY OF A LARGE TOR GROUP, STAROŚCIŃSKIE SKAŁY, WEST SUDETES

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Starościńskie Skały tor group is located in the northern part of the Rudawy Janowickie range, situated within the Karkonosze-Izera granite massif. In the West Sudetes a typical granite landscape consists of domed elevations (bornhardts) (Migoń 1993) and smaller tors (Jahn 1962, 1972), which rise above ridge and slope surfaces. Another type of residual landform is represented by the elevation of Starościńskie Skały which is characterized by hierarchical structure composed of several granite tors situated on a dome-like pedestal. This tor group is 180 m long and up to 85 m wide and due to its size and complexity deserves the name of a "rock city" – the only one if this kind in the Polish part of the Karkonosze-Izera massif.

Field geomorphological mapping of the Starościńskie Skały tor group was carried out with the support of detailed contour map generated from a digital terrain model (DTM) of 1 × 1 m resolution, derived from a point cloud obtained from airborne laser scanning (ALS). Mapping provided information on morphological diversity of Starościńskie Skały, which includes landforms of various size, from high tors of different shapes (e.g. ridges, towers) through pinnacles, platforms, open clefts and tunnels, to microforms such as rillenkarren and weathering pits. The results of this research were presented on the detailed geomorphological map where 30 symbols were used to show the diversity of forms and cover deposits on the adjacent slopes.

The Starościńskie Skały group consists of two distinct parts which differ in morphology and stage of degradation. The north-western part includes a rather narrow ridge and a tall tower tor, surrounded by block fields and rock debris slopes, whereas the more complex south-eastern area is composed of a series of elongated residuals which extend parallel to each other and are separated by wide corridors or narrow clefts. In this part of the rock city pseudobedding is conspicuous. Downslope, the hilltop rock labyrinth grades into steep cliffs up to 15 m high and curved, convex bare rock surfaces.

A characteristic feature of this tor group is the presence of varied microrelief, which indicates protracted subaerial evolution and prolonged surface stability. However, one of these minor features – flared slopes – are interpreted as evidence of subsurface chemical weathering of the Starościńskie Skały tor group in the first stage of their development, before stripping of regolith exposed granite surfaces to further subaerial weathering.

To investigate structural control on tor morphology fracture patterns were measured at 5 sites. The main factor influencing the morphology of the Starościńskie Skały is a complex system of joints (sheeting and orthogonal joints) and it is the differences between them in the various parts of the hill that correspond to the morphological duality of the rock city. Two major joint sets have WNW-ESE and NNW-SSE direction and control both the outline of the entire rock city, its subdivision into smaller compartments, as well as the shape of individual residual landforms within the group. Differences in joint density bear on varying degrees of degradation of the two parts of the tor group, with more jointed variants being more susceptible to breakdown into angular fragments, typical for the north-western part.

Starościńskie Skały are an example of an exceptional granitic landform in the region, which partially resembles a domed bornhardt crowned by a diversified tor group with varied microforms. Plenty of rock forms allowed for provision of the first detailed geomorphological map of a tor group in the West Sudetes – an activity which will be continued on other large tor groups in the region, in various lithologies, ultimately leading to the proposal of a key to detailed geomorphological mapping of rock residuals.

Keywords: granite geomorphology, tors, rock city, joint, West Sudetes.

References:

Jahn A (1962) Geneza skałek granitowych. Czasopismo Geograficzne 33: 19–44.

Jahn A (1974) Granite tors in the Sudeten Mountains. In: Brown EH, Waters ES (eds.). Progress in Geomorphology. Inst. Brit. Geogr., Spec. Publ. 7: 53–61.

Migoń P (1993) Kopułowe wzgórza granitowe w Kotlinie Jeleniogórskiej. Czasopismo Geograficzne 64: 3-23.

FLUVIAL SEDIMENT TRANSPORT IN A PROGLACIAL ALPINE RIVER

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Glaciers in the European Alps are retreating since the end of the Little Ice Age around 1850. Where the glaciers shrink, they leave unconsolidated sediment stores (moraines, till, glacifluvial deposits). These sediment stores are highly vulnerable for being subsequently eroded and are thus a key variable (source) in the fluvial sediment budget of proglacial areas. The fluvial system in proglacial areas is more or less continuously fed with (fine) sediment by glacial melt water (glacial milk) during the ablation period and infrequently (e.g. during rainstorm events) supplied with sediment by landslides, debris flows, rock fall or fluvial transport from the slopes. A part of the sediment input is temporary stored in intermitted sinks, such as the river bed, bars or braid plains. These storages can be reworked and then become sources for fluvial sediment transport mainly during floods. These sediment transporting processes are highly variable in both, the temporal and spatial scale. Following this high variability, knowledge of sediment fluxes and the interrelated geomorphological processes in proglacial areas, based on field-data was found to be lacking. Therefore, a research project has been set up in the Kaunertal valley, Austrian Alps. The presented part of this joint project is focussed on the quantification of recent fluvial sediment dynamics in the proglacial Fagge River below the glacier Gepatschferner. The glacier is located in the Eastern European Alps at the south end of the Kaunertal valley covering an area of 15.7 km² (2012) and is drained by the Fagge River. During the years 2012 to 2015 the Gepatschferner has shown an accelerated glacial retreat leading to the exposure of unconsolidated sediments as well as bedrock areas.

The main aim of the presented part of the joint project is the investigation of the fluvial sediment transport rates in the proglacial Fagge River in the Kaunertal valley. Sediment output of the glacial meltwater stream was measured during the ablation periods at a gauging station installed in front of the glacier outlet. Water level was recorded every 15 minutes and discharge measurements were made at different stages. Using the derived stage-discharge relationships, a hydrograph was computed for each ablation season. Suspended sediment concentration (SSC) of several hundred water samples and bedload transport using a portable Helley-Smith sampler were measured. The solid sediment output was then estimated using the discharge data as well as SSC and bedload data.

Keywords: proglacial, sediment dynamics, fluvial sediment transport, river load.

SPATIAL ANALYSIS OF THE LANDSLIDE RISK IN THE CAMEROON VOLCANIC LINE (CVL)

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Landslides are recognized as important geomorphologic process due to the role they play in the development of hill slopes in mountainous regions, and to related socio-economic consequences.They are many causes of landslides and their distribution varies with the changing conditioning factors.Slope stability depends on a number of causative factors and the knowledge of these variables can help to predict the type of landslide expected in the future.In this study, past landslide activity and the triggering factors,will be used to access, mass mouvement hazards along the Cameroon Volcanic Line (CVL). Spatial aspects will be studied in terms of landslide susceptibility maps that are important for development planning and disaster management.The current synthesis of landslide susceptibility map at regional scale is based on litterature review to inventory passed mass mouvement impacts, on the detection of landslides feactures from Google Earth imagery, combined with spatial analysis using Geographical Information Systems (GIS) and remote sensing.One of the most critical stages in landslide susceptibility mapping is the selection of landslide pre-conditioning, conditioning and triggering factors and weighting of the selected causative factors in accordance to their influence on slope stability. Google Earth helps for delineating past (but recent) and present landslide activity whereas GIS is suitable when deriving static factors (slope aspect and surface curvature) and time-dependant factors (annual precipitation and changing groundwater table level) that are needed to produce landslide susceptibility maps.Landslide susceptibility mapping is based on the assumption that future landslides will occur under similar circumstances as past and present mass movements.Different methods, including the weight of evidence methods, are used for landslide susceptibility mapping along the Cameroon Volcanic line, as the area is known to be highly susceptible to landslides occurrences.

Key words: Mass movements, Landslide susceptibility, Spatial analysis, Cameroon Volcanic Line (CVL), GIS/Google Earth.

VOLUME AND SIGNIFICANCE OF VINEYARD TERRACING, AS AN ANTHROPO-GEOMORPHOLOGICAL PROCESS IN TOKAJ-HEGYALJA WINE REGION, HUNGARY

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Dry constructed stone built terrace retaining walls are characteristic landscape elements in historic wine regions of Europe (Balassa, 1991; Lasanta et al., 2001; Petit et al., 2012). Since the cultivation of these terraced slopes is mostly very expensive and labor-intensive they were abandoned in large extension during the last century (Bicik et al., 2001; Lesschen et al., 2008; Lieskovský et al., 2013). On abandoned vineyards trees and shrubs overgrow the walls, which failure and collapse without further management and corrections. Collapse of terraces and walls means not only loss of cultural heritage and destruction of soil archives, but has also environmental consequences as inducing increase of erosion, and nutrient fluxes and cause slope failures (Stanchi et al, 2013; Tarolli et al, 2014).

We investigated dry built stone terrace walls on abandoned vineyards on Tokaj Wine Region, which is one of the most famous vine-producing region of Hungary, and a World Heritage site as cultural landscape as well. Terraced slopes were identified over a 590 ha area, equivalent to 11.3% of the present-day area of vineyards in the Tokaj-Hegyalja wine region. 574.9 ha (97.7% of the terraced area) were found on hillsides steeper than 17% (Fig 2), which is in accordance with the usual soil conservation aim, where terracing is recommended on slopes steeper than 12%. In terms of elevation, terraces occurred between 150 and 500 m a.s.l. (Fig 4), where the intervals of 250.1-300 m (226.2ha), 300.1-350 m (156.7 ha) and 200.1-250 m a.s.l. (122.6 ha) were found to be the most notable.

Based on the substructure of the walls four types of lithological constitution could be specified (Novák and Incze, 2014). In the first case walls are built on loess or redeposited loess material. In the second type lithological discontinuities could be observed, in which colluvic material settling over weathered volcanic rocks lays directly below the wall. In the third case the walls were built directly on rock outcrops. The fourth type's construction is initiated by digging a ditch at lower part of the parcels, and stones emerging due to cultivation were removed and putted in the ditch, since they fill the ditch and raised in form of a wall.

The types mentioned above were distinguished based on the lithological constitution, since according to the method of construction and the architectural characteristics (height, width, slope, etc.) was not found significant correlation. However, we would like to carry out the classification based on architectural criteria as well. The types described above show a strong correlation with soil characteristics and lithological facility of parcels (Novák et al., 2014). Several types can occur within a short section of retaining walls, they vary with each other following the micro-scale variability in geology, topography and lithology within the area.

The further management and protection of this heritage is currently legislatively unclear. In the absence of legal protection e.g. nature conservation areas, there are no any guarantees for persistence of walls, and implied natural and cultural values.

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Keywords: terraced slopes, dry built retaining walls, abandoned vineyards, Tokaj, World Heritage landscape

References:

Balassa I (1991) Tokaj-Hegyalja szőlője és bora (Vineyards and wine of Tokaj-Hegyalja). Tokaj-Hegyaljai ÁG. Borkombinát, Tokaj, 752 p. (in Hungarian).

Bicik I, Jelecek L, Stepanek V (2001) Land-use changes and their social driving forces in Czechia in the 19th and the 20th centuries. Land Use Policy 18: 65–73

Lasanta T, Arnaez J, Oserin M, Ortigosa LM (2001) Marginal lands and erosion in terraced fields in the Mediterranean mountains. Mountain Research and Development 21: 69–76.

Lesschen JP, Cammeraat LH, Nieman T (2008) Erosion and terrace failure due to agricultural land abandonment in a semi-arid environment. Earth Surf. Process. Landforms 33: 1574–1584.

Lieskovský J, Kanka R, Bezák P, Stefunková D, Petrovic F, Dobrovodská M (2013) Driving forces behind vineyard abandonment in Slovakia following the move to a market-oriented economy. Land Use Land Use Policy 32: 356– 365

Novák TJ, Incze J (2014) Retaining walls of abandoned vineyard terraces on Tokaj Nagy Hill, 4D. Journal of Landscape Architecture and Garden Art 35: 20–35.

Novák TJ, Incze J, Spohn M, Glina B, Giani L (2014) Soil and vegetation transformation in abandoned vineyards of the Tokaj Nagy-Hill. Catena 123: 88–89.

Petit C, Konold W, Höchtl F (2012) Historic terraced vineyards: impressive witnesses of vernacular architecture. Landscape History 33(1): 16-22.

Stanchi S, Godone D, Belmonte S, Freppaz M, Galliani C, Zanini E (2013) Land suitability map for mountain viticulture: a case study in Aosta Valley (NW Italy). Journal of Maps, 367–372.

Tarolli P, Preti F, Romano N (2014) Terraced landscapes: From an old best practice to a potential hazard for soil degradation due to land abandonment. Anthropocene, 10–25.

SEDIMENT FLUX CONDITIONS IN THE ČERNÁ OPAVA RIVER BASIN - AN ANALYSIS OF THE (DIS)CONECTIVITY OF THE FLUVIAL SYSTEM

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This contribution concerns with sediment flux conditions and its disruptions in the Černá Opava River basin. Furthermore, attention is paid to the analysis of the (dis)connectivity of the fluvial system and the delivery of sediments into the streams and downstream fining of the bedload sediment. The Černá Opava River Basin represents one of the examples of connective middle-mountain river basins in the Czech Republic. Almost 60 % of the valley network is connective (Brierley 2006), which means very close contact between slopes and channels (slope-channel coupling phenomenon; Wistuba 2014). The author also focuses on defining the potential source areas of sediment-delivery, which were checked by the field survey. Studied river basin is strongly connected in terms of sediment delivery into the channels, however there is not show hungry water effect, despite of the numerous natural and anthropogenic barriers in channels. One of the goal is to identify the areas of erosion and sediment accumulation for the selected streams. The attention is also paid to defining blockages in the sediment transport in the form of buffers, barriers and blankets. Although Černá Opava River basin is located in the Protected Landscape Area Jeseníky (PLA Jeseníky), sediment transport is disrupted due to the human impact in the channel and close river landscape. There are two main types - historical remains (flumes to the saw mills or iron mills) in the upper reaches. Recent channel regulations in the urban area of Vrbno city (flood control measures after flood in 1997, straightening the river, concreted parts of the channel). Part of the thesis deals with anthropogenic interventions in the channel and extracting of sediments. During the field mapping, sediment grain size analysis was carried out at selected locations and it is assessed whether a refinement of the bottom material is present. Generally bed load sediment downstream fining was observed and clarified with an attention on local disturbances in this trend. Further maps, source areas of sediment delivery, blockages are created accompanied with illustrative documentation photographs. This contribution provides a summary view about existing findings on this river basin research since 2012.

Keywords: sediment flux, connectivity, barriers, bed load, grain size, geomorphological mapping, Černá Opava River.

References:

Brierley G, Fryirs K, Jain V (2006) Landscape connectivity: the geographic basis of geomorphic applications. Area 38(2): 165-174.

Ondráčková L (2015) Sediment flux conditions in the Černá Opava River basin – an analysis of the (dis)connectivity of the fluvial system. Master thesis. Department of Geography. Faculty of Science. Masaryk University, Brno, 103 p.

Wistuba M (2014) Slope-Channel Coupling as a Factor in the Evolution of Mountains. The Western Carpathians and Sudetes. PhD Thesis. Springer International Publishing, 234 p.

SACKUNG RESPONSE TO RETREAT OF QUATERNARY GLACIERS AND REGIONAL CLIMATE CHANGES IN THE CARPATHIANS

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Sackung represents common mode of deep-seated rock-slope failures in alpine landscapes, but its relation to glacier retreat and climatic changes remains highly enigmatic. Based on the terrestrial cosmogenic nuclide (TCN) dating of 18 sackung scarps, we reconstructed post-glacial chronology of sackungen in the Tatra Mts (Slovakia), the highest part of Carpathians. Onset of sackungen completely post-date the regional LGM determined to ~26-20 k.y. ago. Scarps yield ages between ~17 and 4 k.y., revealing substantial lag (more than ~3-3.5 k.y.) in respect to dated glacier withdrawal. We show that sackungen emerged predominantly during warmer and more humid periods with majority of dates coinciding with Bølling–Allerød chronozone, early Holocene and especially the termination of Holocene Climatic Optimum. This is for the first time when mountain-scale sackung activity is presented in the context of major paleoclimatic changes. Our chronological data furthermore suggest, that sackung activity was concentrated only up to few millennia after the onset of deep-seated slope movements with absence of the Late Holocene activity.

Keywords: sackung, rock-slope failure, paraglaciation, climate change, Quaternary, Carpathians, Tatra Mts.

USE OF SCHMIDT HAMMER TEST FOR DETERMINATION OF RELATIVE CHRONOLOGY OF GLACIAL WITHDRAWAL IN THE ROHÁČSKÁ DOLINA VALLEY IN THE WESTERN TATRA MOUNTAINS

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Geomorphological research in the Roháčská dolina Valley is accomplished in order to find out the relation between the glacier withdrawal and onset of deep-seated gravitational slope deformations. Many studies suggest (e.g. Bovis 1990, Blair 1994, Hippolyte et al. 2009, Coquin 2015) relation between steepening by glacial erosion, debuttressing, stress release and onset of deep-seated gravitational slope deformations.

Research focusing on relative dating by Schmidt hammer was performed in order to find out the relative age of the glacial landforms and to establish their relative chronology in the Roháčská dolina Valley.

The glacial landforms (moraine ridges) and relict rock glaciers in the study area were mapped in the field. Representative landforms were chosen for relative dating by Schmidt hammer. Six blocks per landform were tested. The results were evaluated and the relative chronology was accomplished. According to the results three different glacial phases were determined. The results were compared with relative chronology established in Bystrá and Žiarska dolina Valleys, Western Tatra Mts. (Kłapyta, 2013) and absolute chronology in Velká and Malá Studená dolina Valleys in the High Tatra Mts. (Engel et al., 2015).

Keywords: geomorphological mapping, glacial landforms, glacial withdrawal, relative dating, Schmidt hammer.

References:

Bovis MJ (1990) Rock-slope deformation at Affliction Creek, southern Coast Mountains, British Columbia. Canadian Journal of Earth Sciences 27: 243–254.

Blair RW (1994) Moraine and valley wall collapse due to rapid deglaciation in Mount Cook National Park, New Zealand. Mountain Research and Development 14: 347–358.

Coquin J, Mercier D, Bourgeois O, Cossart E, Decaulne A (2015) Gravitational spreading of mountain ridges coeval with Late Weichselian deglaciation: impact on glacial landscapes in Tröllaskagi northern Iceland. Quaternary Science Reviews 107: 197–213.

Engel Z., Mentlík P, Braucher R, Minár J, Léanni L (2015) Geomorphological evidence and 10Be exposure ages for the Glacial Maximum and deglaciation of the Velká and Malá Studená dolina Valleys in the High Tatra Mountains, Central Europe. Quaternary Science Reviews 124: 106–123.

Hippolyte JC, Bourlés D, Braucher R, Carcaillet J, Léanni L, Arnold M, Aumaitre G (2009) Cosmogenic 10Be dating of a sackung and its faulted rock glaciers, in the Alps of Savoy (France). Geomorphology 108: 312–320.
Kłapyta P (2013). Application of Schmidt hammer relative age dating to Late Pleistocene moraines and rock glaciers in the Western Tatra Mountains, Slovakia. Catena 111: 104–121.

PUBLIC PERCEPTION OF CHANNELISED AND CLOSE-TO-NATURE STREAMS

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Rivers are part of human society since prehistoric ages, however in the last century the point of view has changed. In the last century rivers were channelized, narrowed and became artificial. The quality of river water decreased by industry and agriculture. Nowadays, the view has changed and by European Union, Water Framework Directive, it is compulsory to achieve good river quality for each one. The key process for this change is: river restoration, including renaturalisation. A much debated question is whether these changes are appreciated by society. The purpose of this contribution is to review recent research and examines the relationship between rivers and public perception (close-to-nature and channelized streams). The hypothesis was set: are close-to-nature rivers perceived as more aesthetic than channelized ones? Data were collected by using online survey with the set of photographs of close-to-nature and channelized rivers. Obtained data were used for statistical analyses between tested groups of photographs and respondents. The results of this contribution show that close-to-nature streams are perceived as more aesthetical than channelized ones. The present research explores, for the first time, public perception of the rivers in Moravian-Silesian region and its findings can contribute to wider research of perception of the rivers.

Keywords: public perception, aesthetic perception of rivers, river restoration, internet survey.

THE EFFECTS OF LARGE LOG JAMS ON LONGITUDINAL SEDIMENT CONNECTIVITY – EXAMPLES FROM TWO SMALL STREAMS IN AUSTRIA AND GERMANY

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Large wood (LW) significantly influences riverine ecosystems by providing various ecological and morphological functions. Recent research on LW in streams has focused on habitat diversity and abundance, e.g. highlighting its effects on e.g. channel planform development, channel bed formation, flow regimes and storage of organic matter and sediment. However, only few information on the influence of large log jams on sediment trapping and sediment connectivity is yet available. The presented project tries to diminish this research gap. First results will be presented from two small streams in Austria (Bohemian Massif) and Germany (Wetterstein Mountain Range).

To investigate the effects of large log jams on sediment trapping and sediment connectivity, the spatial distribution and characterization of LW (>1 m in length and >10 cm in diameter) in channels is examined by field mapping and dGPS measurements. Channel hydraulic parameters are determined by field measurements of channel long profiles and cross sections. To quantify the direct effects of LW on discharge and bed load transport the flow velocity and bed load up- and downstream of LW is measured using an Ott-Nautilus and a portable Helley-Smith bed load sampler during different water stages. Sediment storage associated with large log jams are quantified in the field and spatio-temporally monitored using dGPS measurements.

First results indicate that large log jams generally induce in-channel sediment storage disconnecting downstream sediment transport. However, quantity, specific location, stability and type of sediment storage is observed to be highly dependent on log jam location, size and trapping efficiency.

Keywords: large wood, sediment storage, sediment transport, fluvial systems, riverine habitats.

DOING A TRANSDISCIPLINARY RESEARCH ON HISTORICAL NATURAL HAZARDS – STUMBLING BETWEEN WINNERS AND LOSERS OF RESEARCH POLICY AND PRACTICE

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Policy makers and research agencies of the last few decades are more often then ever in the past claiming that environmental changes and multiple transitions faced by society call for a complex perspective. The possible contribution to strategies resolving the issues such as poverty, religious conflicts or natural hazards is seen in strongly integrated approaches, such as transdisciplinarity (*sensu* Jantsch 1972), rather than merely paralleling the research foci common to different disciplines. Through this paper, I would like to raise a discussion on barriers that a researcher may drive at during his or her attempt for transdisciplinarity. In particular, I use the example of the research on historical natural (mainly geomorphologic) hazards to explore the perspectives and valuation that various disciplines have in terms of their epistemologies, assumptions and perceived validity of results.

Natural hazards cause immense social and economic impacts deserving a global agreement on research and policy. In spite of attempts for such integrative approach (e.g., Tobin and Montz 1997), a brief look into the scholarly publishing shows the research practice to be a double-track one. On one hand, geomorphologists and other geoscientists pursue the issue of causal mechanisms of hazards and are trying to define the threshold of triggers using historical and present-day data. On the other hand, social scientists aim their effort at understanding the complexity of variations in impacts caused by natural hazards. Certainly (and naturally), the situation stems from differing epistemological stances and traditions of the disciplines, which accentuate individual segments of the general model of risk (i.e. segment of hazard in geomorphology, and the vulnerability one in social sciences). At the same time, the situation emerges from recognition of experiences with and refinement of particular methods that various disciplines developed to study 'their' problems. But, what will happen, when a single research problem itself calls for an integration of empirical data and explanatory models that are common to different disciplines?

According to a theory, a transdisciplinarity denotes a research approach that has common assumptions, thus integrating various disciplinary perspectives in a unified manner of the research practice. In a study on historical natural (geomorphologic) hazards, such perspectives will be necessarily represented by historiography (analysing written sources and iconography) and geomorphology. However, while historiography has significantly moved toward constructivist paradigm at least since 1960s (Iggers 1975) and considers historical sources as socially constructed (in radical view meaning that they may depict 'virtual' events and people), the realistic and positivist stance still prevails in geomorphology (Baker 1996; Richards 1990) despite current notion that strong explanatory concepts may not necessarily result in greater ontological depth (Rhoads 1994). Interestingly, science-based researchers frequently tried to distrust post-modern social research for its lack of scientific rigour (cf. Bauer 1994). It must be noted, however, that considering any data as social construct does not necessarily imply the lack of critical analyses or theory-laden research, which are common attributes of certain part of the current historiography. On

the other hand, historiographical criticism of non-critical analyses of historical data by other disciplines was perhaps too often guided by radical relativism.

To illustrate the issue in a narrative way, I draw from more than fifteen reviews that I received during the last few years, while aiming at and publishing about reconstruction of historical natural hazards in geoscientific and physical geographical journals. While not questioning the professionalism of reviewers, I rather highlight a certain confusion that reviewers must have faced when trying to preserve the rigour in tackling with empirical data, and, at the same time, intuitively understanding that present-day perspective of historical sources must be constrained by conventional mental models. As a result, some reviews pointed to a fuzziness of historical data interpretation, but they also implicitly required the most precise figures and other data to be shown derived from historical sources. As one cannot accept both of these comments, such cognitive (in this case epistemological) dissonance must be resolved by prioritizing. In this case – as well as in many studies dealing with historical hazard databases, and in realism paradigm in geomorphology (Richards 1990) – a priority stems from a conviction that focus on inherent content of the data and a separation of observer from what is being observed may help in searching for 'real' phenomena (true guiding principles and laws).

The complete situation reminds us classical studies of integrated Ph.D. projects, research projects and publishing strategies in landscape ecology (e.g. Tress et al. 2007), noting that although there is public proclamation on benefiting from integrative approaches, those pursuing integrative research faced serious problems in receiving, completing and publishing their projects. Thus, potential 'winners' who comply with proclaimed research agenda, fall short to become 'losers' of the research practice. To conclude, the case of research on historical natural hazards shows the demand for deeper discussions on epistemology within the geomorphological community to be able to tackle fundamental issues of environmental change that we face. A promising perspective in my opinion may be gained from overcoming the dichotomy of realistic stance and constructivist (relativist) by discussing and adopting the critical realistic paradigm (Sayer 2000).

Keywords: natural hazards, transdisciplinarity, epistemology.

References:

Baker VR (1996) The Pragmatic Roots of American Quaternary Geology and Geomorphology. Geomorphology 16: 197–215.

Bauer BO (1994) Geomorphology, Geography, and Science. In: Rhoads BL, Thorn CE (eds.) The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology. John Wiley & Sons Ltd., New York, 381–414.

Jantsch E (1972) Towards Interdisciplinarity and Transdisciplinarity in Education and Innovation. In: Apostel L, Berger G, Briggs A, Michaud G (eds.) Interdisciplinarity: problems of teaching and research in universities. CERI OECD, Paris, 97–101.

Iggers G (1975) New Directions of European Historiography. Wesleyan UP, Middletown.

Rhoads BL (1994) On being a 'real' geomorphologist. Earth Surface Processes and Landforms 19: 269–272.

Richards KS (1990) '"Real" geomorphology', Earth Surface Processes and Landforms 15: 195–197.

Tobin GA, Montz BE (1997) Natural Hazards: Explanation and Integration. The Guilford Press, New York – London.

Tress G, Tress B, Fry G (2007) Analysis of the barriers to integration in landscape research projects. Land Use Policy 24(2): 374–385.
Sayer A (2000) Realism and social science. Sage, London.

PLIOCENE – QUATERNARY FLUVIAL SEDIMENTS IN SW MORAVIA: PRIMARY PALEOGEOGRAPHIC INTERPRETATION

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The systematic survey of Pliocene – Quaternary changes of river network and valley character has been carried out in most of regions in the Czech Republic, representing quite favourite research topic. From this point of view, the Bohemian Massif / Carpathian Foredeep boundary area (dominating firm crystalline rocks / poor molasse-type sediments) in SW Moravia has been yet inadequately investigated. Very numerous remnants of clastic fluvial sediments of (paleo)streams in different locations, many times detected with help of airborne laser scanning data, indicate there specific development of river systems combining typical features of both adjacent master geological units and unique phenomena, however, thus deserving more attention in connection with closer recognition of various related landscape phenomena.

The first significant process was multi-stage change of the valley pattern from wider shallow upper (nowadays hanging) landforms to rapidly deepening river cuts – a widespread feature of the Earth's Crust in the Early Pleistocene, currently usually ascribed to greatly different magnitude of Quaternary climatic fluctuations and interrelated rate of surface denudation directly influencing the Crust vertical behavior before and after this transition event (e.g. Tyráček 2001, Bridgland, Westaway 2008). More extensive fluvial covers vs. smaller terrace accumulations mainly evolved in these diverse environments, completed also with various alluvial fan deposits. The second closely linked process included very frequent changes of stream / valley courses, concerning all of the major regional rivers and their surroundings, located in both mentioned major morphological domains. The cases occuring within firm-rocks terrains, especially crystalline lithologies, are quite common. Both mentioned phenomena point to considerable recent landscape dynamics of the study area.

Keywords: paleogeography, river network, valley pattern, fluvial sediments, fluvial landforms, Pliocene – Quaternary, Bohemian Massif / Carpathians boundary region.

References:

Bridgland D, Westway, R (2008) Climatically controlled river terrace staircases: A worldwide Quaternary phenomenon. Geomorphology 98: 285–315.

Tyráček J (2001) Upper Cenozoic fluvial history in the Bohemian Massif. Quaternary International 79: 37–53.

THE INFLUENCE OF DEM RESOLUTION AND CONTOUR INTERVAL ON THE RESULTS OF SEMI-AUTOMATIC CALCULATION OF STREAM LENGTH-GRADIENT INDEX

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Elements of fluvial system are particularly often analyzed as apart of morphotectonic studies owing to their low "topographic inertia", i.e. relatively quick response to tectonic disturbances (Burbank, Anderson, 2011). Stream length-gradient index (SL) introduced by Hack (1973) is a measure frequently applied in these studies, conducted in various geodynamic settings (Troiani, Della Seta, 2008; Font et al., 2010). The use this parameter in longitudinal stream profile analysis is aimed at identification of channel segments abnormally steep in respect to the adjacent ones, for which active tectonics is one of the possible causes.

For a given segment of a river SL index is calculated according to the equation: $SL= (\Delta H/\Delta L)L$ in which, ΔH is a change in elevation, ΔL is a horizontal length of the segment and L is a length from the midpoint of the segment under consideration upstream to the highest point of the channel. This formula should be applied for relatively short stream segments, for which a constant channel slope may be assumed.

The SL index is usually computed in two different manners, i.e with different constant variable introduced into the equation – constant ΔH or constant ΔL. In the former the difference in elevation between the upper and the lower points of the reach may range from 6 m (García-Tortosa et al., 2008) to 20 m (Peters, van Balen, 2007; Tsodoulos et al., 2008), in the latter their fixed length may vary from 100 m (Stěpančíková et al., 2008) to 250 m (Pedrera et al., 2009).

The aim of this study is to compare the results of SL index calculation using these two approaches. Different variants of constant ΔH (2, 6, 12 m) as well as different variants of fixed stream length (50, 100, 200 m) are implemented in order to assess how changes in input variables influence the final results. The computations are carried out on DEMs of different spatial resolution (1x1, 5x5 and 10x10 m) in order to examine their sensitivity and ability to register tectonic signals. The area selected for the study includes the northern part of the Bystrzyckie and Orlickie Mountains block in the Middle Sudetes, which has been subject to differential uplift in the Neogene and possibly Quaternary.

Keywords: stream length-gradient index, DEM resolution, slope channel, stream profile analysis.

References:

Burbank DW, Anderson RS (2011) Tectonic Geomorphology (2nd ed.). Wiley-Blackwell.

Font M, Amorese D, Lagarde JL (2010) DEM and GIS analysis of the stream gradient index to evaluate effects of tectonics: The Normandy intraplate area (NW France). Geomorphology 119: 172–180.

García-Tortosa FJ, Alfaro P, Galindo-Zaldívar J, Gibert L, López-Garrido AC, Sanz de Galdeano C, Ureña M (2008) Geomorphologic evidence of the active Baza Fault (Betic Cordillera, South Spain). Geomorphology 97: 374–391.

Hack JT (1973) Stream-profile analysis and stream-gradient index. U. S. Geological Survey Journal of Research 1: 421–429.

Pedrera A, Pérez-Peña JV, Galindo-Zaldívar J, Azañón JM, Azor A (2009) Testing the sensitivity of geomorphic indices in areas of low-rate active folding (eastern Betic Cordillera, Spain). Geomorphology 105: 218–231.

Peters G, van Balen RT (2007) Tectonic geomorphology of the northern Upper Rhine Graben, Germany. Global and Planetary Change 58: 310–334.

Štěpančíková P, Stemberk J, Vilímek V, Košťák B (2008) Neotectonic development of drainage network in the East Sudeten and monitoring of recent displacements on tectonic structures (Czech Republic). Geomorphology 102: 68–80.

Troiani F, Dell Seta M (2008) The use of the Stream-Gradient index in morphotectonic analysis of small catchments: A case study from Central Italy. Geomorphology 102: 159–168.

Tsodoulos IM, Koukouvelas IK, Pavlides S (2008) Tectonic geomorphology of the easternmost extension of the Gulf of Corinth (Beotia, Central Greece). Tectonophysics 453: 211–232.

RECONSTRUCTION OF TEMPORAL CHANGES OF THE ODRA RIVER CHANNEL PLANFORM IN THE POODŘÍ PROTECTED LANDSCAPE AREA

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River courses exhibit dynamic equilibrium, adjusting themselves continuously in time and space to fluctuations in discharge and sediments (Schumm 1979). Consequently, it results in lateral and vertical mobility of channels. During the last 200 years rivers in Czech Republic were intensively affected by man impact with result of channel pattern transformations. The main aim of this research is focused to the Odra River channel in 25.0 to 52.0 river km in the Poodří Protected Landscape Area. The Odra River channel in the studied locality is typically meandering river. River floodplain close to the study reach of river channel was intensively affected by human, especially by construction of fish ponds and reservoirs. Channel segment is not significantly regulated or stabilised with except for some short reaches. The research was based on analysis of channel development with using of old maps, aerial photographs and digital terrain model assessment. Namely (i) the Second Military Mapping from the years 1836-1852 at a scale of 1:28 800, (ii) the Third Military Mapping from the 1920s to 1930s at a scale of 1:75 000, (iii) aerial photographs from 1950s and (iv) Digital Terrain Model of the Czech Republic - 4th generation (DMR 4G) were used for this analysis. For study reach were assessed parameters of channel planform as: meander radius, (ii) meander belt width, (iii) sinuosity of meanders and (iv) channel index (Leopold et al. 1964, Mueller 1968). Analysed parameters show that meander radius has decreased trend from first half of the 19th century to the 1920s-1930s and increased trend from the 1920s-1930s to present. Number of meanders oscillates from 108 in 1836-1852 to 76 in present. Analysis of channel index which is quantify how much is channel meandering shows similar situation however from 1950s to present is visible stagnation of the thalweg length ratio of the straight length. So assessment of meander belt is showing increase of width from upstream to downstream but in the last several decades in the downstream part is distinctive effect of man impact in sense of channel training structures construction (e.g. bank stabilisation, channel straightening or shortening). The results showing still preserved channel pattern of meandering in the study reach however river training structures affected of natural processes of lateral erosion in some reaches, especially in the downstream part.

Keywords: channel index, sinuosity, meander belt, meander radius, Odra River, Poodří Protected Landscape Area

References:

Leopold LB, Wolman MG, Miller JP (1964) Fluvial processes in geomorphology. Dover Publication Inc., New York. 522 p.

Mueller JE (1968) An introduction to the hydraulic and the topographic sinuosity indexes. Annals of the Association of American Geographers 58: 371–385.

Schumm SA (1979) Geomorphic tresholds: the concept and its applications. Transaction of the Institute of the British Geographers (NS) 4: 485–515.

THE EFFECTIVENESS OF DENDROGEOMORPHIC METHODS FOR RECONSTRUCTION OF PAST SPATIO-TEMPORAL LANDSLIDE BEHAVIOUR

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Dendrogeomorphic methods are actually frequently used approaches for past spatio-temporal landslide behaviour reconstruction. But their real accuracy was not evaluated yet. This study try to evaluate the effectiveness and accuracy of these tree-ring based methods by comparison with real data about landslide behaviour based on the field monitoring. In total 876 increment cores were extracted from 219 *P. sylvestris* to reconstruction past spatio-temporal activity of the Ľubietová landslide (1977). Landslide events recurrence interval recorded within tree ring series of each tree were spatially interpolated. These data were compared with the long-term field monitoring based on the measuring changes of stabilized geodetic points positions. In general, tree ring based spatio-temporal landslide reconstruction reveals higher landslide activity than the monitoring based one (partially in the lower part of the landslide). On the other hand higher activity was recorded by monitoring in the northern part of the upper half of the landslide. About 30 % of studied landslide area reveals highly similar normalized values based on both approaches. The highest agreement between results (more than 80 %) is in the areas with mean cumulative surface displacement around 200 mm (monitoring based results) and mean events recurrence 14.5 years (tree ring based results). The potential sources of uncertainties which should be taken into consideration during next dendrogeomorphic research are: irregular spatial position and the spatial density of trees; the physiology of tree species; the inertia of tree growth response within tree ring sequences; the type of studied landslide.

Keywords: landslide, dendrogeomorphology, monitoring, the Ľubietová landslide.

EFFECT OF GRADE-CONTROL STRUCTURES AT VARIOUS STAGES OF THEIR DESTRUCTION ON BED SEDIMENTS AND LOCAL CHANNEL PARAMETERS

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Grade-control structures (GSCs) represent the typical management of torrential streams, preventing massive bed erosion and bedload transport. The original and present geometric and sedimentary parameters of 18 GCSs at various stages of their destruction since the 1970s were evaluated to determine the relationship between the former and present-day components of the managed Mohelnice River (the western Carpathians, Czech Republic). The latest changes in the GCS geometry, related scour holes, and bed surface grain size of sedimentary wedges were caused by the 2010 flood event of 20–50 R.I. discharge. No relationship exists between the bed surface grain sizes and the present water drop or the present equilibrium channel slope of the sedimentary wedge. A significant downstream coarsening of the largest grain size percentile represented by D_{95} is detected through the sequence of GCSs. Also, statistically insignificant trends in downstream coarsening were observed for D_{16}, D_{50}, and D_{84} grain sizes. However, the investigated sequence is still passable for grain diameters up to 200mm during high-magnitude floods similar to the 2010 event, as documented by the development of a confluent gravel bar downstream of the sequence. Bedload transport simulations provide the highest bedload transport rates for the initial stage of the uppermost studied channel reach without the presence of GCSs (30,000 kg.min^{-1} for 50 R.I. discharge). Grade-control structures reconstruction in the 1970s significantly decreased transport rates (> 2000 kg.min^{-1} for 50 R.I. discharge). Owing to the erosion of GCS crests and an increase in related equilibrium channel slope, damage on GCSs can lead to an increase in bedload transport intensity (13,000 kg min^{-1} for 50 R.I. discharge). Significant linear relationships exist among the present parameters of the scour holes (length of scour hole, maximum scour depth, and horizontal distance between the point of maximum depth and the GCS crest). A statistical significant power relationship exists between the parameters of maximum scour hole depth and the present drop height, showing adjustments of maximum scours to the present stage of GCSs and the last flood event.

Keywords: grade-control structure, channel geometry, grain size, gravel-bed stream, Mohelnice River, Moravskoslezské Beskydy Mts.

VALLEY EVOLUTION OF THE BIALA LĄDECKA DRAINAGE NETWORK DURING LATE CENOZOIC, LOWER SILESIA, POLAND

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Biala Lądecka (Biala Kłodzka) river is located in Lower Silesia (Poland) and its valley separates Góry Złote Mts. (Rychlebské hory Mts.) on the northeast from Góry Bialskie Mts. on the southwest. During last year we dealt with geomorphology research in Biala Lądecka river basin, which has a noticeably asymmetrical river basin, probably due to Quaternary tectonic activity of the Sudetic Marginal Fault. According to old research provided in this area by L. Finckh and G. Götzinger (1931), W. Walczak (1954) and A. Ivan (1966), Biala Lądecka river used to flow across the Góry Złote Mts. directly to Oderská nížina Lowland during Pliocene; currently it flows to Nysa Kłodzka Basin. Our research was focused on analysis of all available cartographic materials (geological and topographic maps), available literature and own detail geomorphological mapping of selected landforms. Spatial distribution of these landforms such as gullies, erosion trenches, dellens, alluvial plains, alluvial fans, springs, swamps, river terraces, could potentially indicate recent tectonic activity in the studied area. Moreover, stream network parameters (based on DEM data) such as changes in erosion intensity indicated in longitudinal and cross-section profiles, slope gradient and morphometric indexes, e.g. Stream Length (SL) index (Hack 1973), for Biala Ladecka river basin were analyzed. On selected places geophysical research was also performed to discover rests of sediments of the Biala Lądecka paleoriver.

The results will also complete the research focused on tectonics in the adjacent areas, e.g. paleoseismologic studies on the SMF (Štěpančíková et al. 2010, 2011), monitoring using dilatometric gauges TM71 installed on the SMF (Stemberk et al. 2010), etc. Some of preliminary results will be presented.

Keywords: Biala Lądecka river, active tectonics, Góry Bialskie, Góry Złote Mts. (Rychlebské hory Mts.), Sudetic Marginal Fault, Bohemian Massif, Lower Silesia, morphometric indexes, DEM analysis.

References:

Finckh L, Götzinger G (1931) Erläuterungen zur geologischen Karte des Richensteiner Gebirges, des Neselkoppenkammes und des Neisse-Vorlandes. Wien, 108 p.
Hack JT (1973) Stream-profile analysis and stream-gradient index. U.S. Geological Survey Journal of Research 1: 421–429.
Ivan A (1966) Geomorfologické poměry severozápadní části Rychlebských hor. Kandidátská práce, GÚ ČSAV, Brno, 120p.

Stemberk J, Košťák B, Cacoń S (2010) A tectonic pressure pulse and increased geodynamic activity recorded from the long-term monitoring of faults in Europe. Tectonophysics 487: 1–12.
Štěpančíková P, Hók J, Nývlt D, Dohnal J, Sýkorová I, Stemberk J (2010) Active tectonics research using trenching technique on the south-eastern section of the Sudetic Marginal Fault (NE Bohemian Massif, central, Europe). Tectonophysics 485: 269–282.
Štěpančíková P, Dohnal J, Pánek T, Łoj M, Smolková V, Šilhán K (2011) The application of electrical resistivity tomography and gravimetric survey as useful tools in an active tectonics study of the Sudetic Marginal Fault (Bohemian Massif, central Europe). Journal of Applied Geophysics 74: 69–80.
Walczak W (1954) Pradolina Nysy i plejstoceńskie zmiany hydrograficzne na przedpolu Sudetów wschodnic. Polska Akademia Nauk, Instytut geografii, Warzawa, 52 p.

PALEOSEISMIC CASE STUDIES IN BOHEMIAN MASSIF SHOWING THE APPLICABILITY OF COMPLEX GEOPHYSICAL SURVEYING

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During last decade, several faults in Bohemian Massif that were re-activated during Quaternary were studied. We present three case studies from various geological environments where extensive 2-D and 3-D geophysical survey preceded and accompanied paleoseismic trenching survey, thus the results of geophysics could be correlated with the lithology exposed in the trenches. The methods included (i) direct current (DC) geoelectrical surveying, i.e. electric resistivity tomography (ERT) and micro-scale resistivity profiling (mRP); (ii) electromagnetic (EM) surveying, i.e. ground penetrating radar (GPR) and *dipole electromagnetic* profiling (DEMP); and (iii) shallow seismic refraction (SSR) and seismic tomography (ST).

First trenching site is Bílá Voda, situated in the north-eastern part of the Bohemian Massif where morphologically pronounced NW- trending Sudetic Marginal fault controls the mountain front of the Sudeten mountains at the length of 140 km. Due to distinct physical rock properties on the both sides of the fault, remarkable horizontal gradient in electric resistivity clearly showed the fault position and identified more resistive crystalline bedrock juxtaposed to conductive Miocene clayey sands covered by a veneer of alluvial fan deposits. Also limit of the alluvial fan deposits and its thickness was identified, which helped in interpretation of paleoseismic survey such as sense of the movements.

The second site Brodek, situated in the Upper Morava basin, a Late Cenozoic tectonically active region located at the contact of Bohemian Massif and the Western Carpathians' orogenic front, on the Holešov fault, which controls the SE basin margin. Both 2-D and 3-D geophysical measurements clearly distinguished between two different sedimentary units and, thus, indicated the position of the studied fault.

The third site, Kopanina exposed Mariánské Lázně fault controlling the Cenozoic Cheb-Domažlice graben in the western Bohemian Massif. Trenching survey revealing Holocene activity was combined with 2-D ERT, 3-D GPR and 3-D conductometry (DEMP) in order to extent the fault properties to the depth and laterally and traced the faults as well as displaced sedimentary bodies.
The case studies showed the usefulness and suitability of an individual method depending on different geological conditions.

Keywords: paleoseismology, active faults, geophysical surveying, electric resistivity tomography, ground penetrating radar, dipole electromagnetic *profiling, shallow seismic refraction, Bohemian Massif.*

STRUCTURAL AND TECTONIC CONTROL OF THE SANDSTONE MESA DEVELOPMENT AS REVEALED BY ERT MEASUREMENTS AND TM-71 CRACK-GAUGE (OSTAŠ AND HEJDA MTS., CZECH REPUBLIC)

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Two table mountains, Ostaš and Hejda, together with rock ridge Kočičí skály ("Cat Rocks") including a small plateau with an apt name Rovný ("Flat") in its northern part, were investigated in terms of structural and tectonic conditions. The area belongs to the Broumovská vrchovina uplands, the part of the Sudety subprovince – Orlická oblast (region) of the Czech highlands (north-eastern part of the Czech Republic). In is the easternmost part of the Bohemian Cretaceous Basin (Czech massif). The top parts of all studied mountains are formed by the Cretaceous quartz sandstones of Teplice formation – the facie of thick-bedded block sandstones, which is underlain by the rhythmically interbedded Cretaceous layers of marls (marlstones) with limestones. Geophysical surveying, performed in 2014 and 2015, revealed the thickness of block sandstones, which form the platforms (table mountains), and confirmed the hypotheses of the tectonic control of their development. DC resistivity imaging (electrical resistivity tomography, ERT) revealed different thicknesses of the block sandstones of individual mesas, ranging from 20 to 50 m. However, the difference between maximum altitudes of each mesa reaches nearly 100 m. Because mere thickness of sandstones did not sufficiently explain this altitude variance, another explanation had to be found. Vertical movements controlled by tectonics seemed to be a possible answer. This theory was supported by detection of several vertical, low-resistivity structures limiting the marginal parts of the sandstone platforms. Therefore, another ERT profiles were performed across the valleys among individual studied parts. Fault zones of considerable width (~ 50 to 100 m) were discovered. It could indicate a probable landscape development – a disintegration of an original platform into individual blocks and their gradual vertical movements along detected faults (the Police fault zone intersected by a different nearly perpendicular fault system). The survey also confirmed the origin of the Zlomová rokle ("Fault gully"). The gully seems to be really predisposed by one of the branches of the Police fault system (which confirm the original theory of its origin). Moreover, the morphology of the top platforms (namely local depression forms) corresponds with ERT results and suggests a vertical subsidence (sackung) of rock blocks, on both Ostaš and Hejda mesas. It is very likely a result of deep-seated creep of the block sandstones along the underlying plastic marlstones and limestones. Block movements were further confirmed by precise dilatometric measurements (using TM-71 optical-mechanical crack gauges), namely on Hejda site. Dilatometric measurements describe a dynamics of the sandstone mesas development as follows: (i) separate rock towers on the very margins of the platforms does not show current movements – margins thus seem to be stable, at least in short-term period; (ii) measurements inside the rock massif in the central parts of the Hejda mesa confirm vertical block movements that is in agreements with our findings from the ERT

imaging. The ERT surveying revealed or confirmed: (a) different thicknesses of the block sandstones within individual blocks (platforms) as wells as its local disruptions; (b) the hypotheses of the breaking of the original sandstone platform along the complex fault system. It seems that long-term development of the Ostaš and Hejda mesas, as well as Kočičí skály rock ridge, is predisposed and further controlled by tectonics. The research was performed thanks to the financial support of the projects CzechGeo LM2010008 and GAUK862213.

Keywords: block sandstone, mesa, tectonic predisposition, fault zone, electrical resistivity tomography, TM-71 crack gauge.

THE CHANGING ABILITY OF NORWAY SPRUCE TO RECORD HYDRO-GEOMORPHIC PROCESSES BASED ON THE AGE AND DIAMETER OF THE TREE STEM – A DENDROGEOMORPHIC APPROACH

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Dendrogeomorphic reconstructions of debris flows, debris floods and floods are widely used in territories with incomplete chronologies and potential future hazards. More sophisticated methodical approaches for the determining of event years were established in recent few years (Stoffel et al., 2010; Stoffel and Corona, 2014). The varied age structure of the forest (from juvenile to several hundred years' old trees) provides an ideal study site for debris flow/flood chronologies. However, what if the younger/thinner trees are not affected by the moving material, older trees with thicker bark resist the impact of boulders, and the trees in their prime life are not such sensitive to burial? There is a common agreement that trees, across their lifespan, have changing sensitivity to geomorphic processes even with regard to different types and/or intensity of growth disturbances, but the lack of quantitative data has prevented confirmation of such premises. Therefore, we investigate age-dependent and diameter-dependent tree sensitivity of Norway spruce (Picea abies (L.) Karst.) – a very common species used in dendrogeomorphic reconstructions. We tested 462 individuals in the apical part of the Hrubý Jeseník Mts. where there is widespread occurrence of debris flows and debris floods. The tree sensitivity analysis was performed based on the position of growth disturbances within the increment cores of trees. P. abies shows very high tree sensitivity in the first two decades of the tree lifespan. With increasing age and diameter, trees are less sensitive recorders of debris flows/floods. Moreover, the intensity of growth disturbances significantly decreases with tree age and stem diameter. Mature trees (51–120 years) record the geomorphic events mainly through abrupt growth changes (suppression and release) and tangential rows of traumatic resin ducts. In contrast, scars, the onset of reaction wood and traumatic resin ducts are dominant growth disturbances in young, thin trees (11–30 years; diameter 0–15 cm). Different occurrences of particular growth disturbances as well as the different age- and diameter-dependent sensitivities emphasize the need for the inclusion of new variable that will take into account the amount of sensitive trees for each year, which is subjected to dendrogeomorphic reconstruction. After that, adequate mixture of sampled tree (i.e. mixture of age/diameter classes), which is necessary for the completeness of debris flow/flood chronologies, could be balanced regarding their sensitivity.

Keywords: dendrogeomorphology, hydro-geomorphic processes, tree sensitivity, Norway spruce, age effect, diameter effect.

References:

Stoffel M, Bollschweiler M, Butler DR, Luckman BH (2010) Tree Rings and Natural Hazards: A state of the art. Springer, Dordrecht, Heidelberg, London, New York.

Stoffel M, Corona C (2014) Dendroecological dating of geomorphic disturbance in trees. Tree-Ring Research 70: 3–20.

GEOMORPHOLOGICAL AND GEOLOGICAL CONDITIONS OF A PREHISTORIC SETTLEMENT IN THE AREA OF CZARNA STASZOWSKA ESTUARY SECTION (POLISH UPLANDS)

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The study area includes of the Czarna Staszowska valley, between Staszów and Połaniec, and adjacent parts of plateaus. The most part of the study area is located in the Połaniecka Basin and remanider in Vistula Lowland. The Czarna Staszowska valley takes here extended cirque shape, which probably is conditioned by the deeper substrate tectonics. The bottom of the valley is situated at an altitude of 160 to 185 m a.s.l. and the general slope is towards the SE. The surface of the plateau rises up to a 190-200 m a.s.l. In places, between the bottom of the valley and plateau, preserved fragments of terraces, or under slope denudation flattening. To the east of the Czarna Staszowska valley, there are also parabolic dunes on the plateau.

In the ground arrears Sarmatian deposits (Krakowiec Clays), covered with low thickness Quaternary sediments – preglacial sand and gravel, fluvial series; glacial, fluvioglacial and remnant of South-Polish Complex; fluvial sands, aeolian and loess like sediments of Middle-Polish and North-Polish Complexes; fluvial sands, alluvial soils, and peats of Holocene (Makowska 1976).

Czarna Staszowska flows into the Vistula in the Połaniec area. A few kilometers before it takes the waters of the Wschodnia river, a tributary of almost equivalent size. Thus reinforced, cuts a clear edge separating Połaniecka Basin and the Vistula Lowland.

Valley of the Czarna Staszowska and Wschodnia, combined with the Vistula Valley create areas with convenient access to the water. In the bottom of the valleys, there are many oxbow lakes to this day. At the end of the Late Glacial and beginning of Holocene it could be much more. It is also assumed that if there were a effusions and sources that owe their existence could arrears Sarmatian clays in the substrate.

The variety of the landforms and the southern exposure of this area posed favorable conditions for the existence of prehistoric man. The first traces (artefacts) are from the Late Paleolithic (Massalski 1991). Groups of people prefer the edges of the plateau and upper parts of the slopes of the valleys. The settlement in this area was continued in the Mesolithic Age. In the Neolithic Age to these areas, they arrived agricultural and breeding Danubian tribes. There has been increased use of the valley floors.

At all stages of the settlement development of people groups there is a link of settlements with the geographical environment.

The largest amount of data about prehistoric cultures comes from the region of Połaniec.

Key words: geomorphology, prehistoric settlement, Czarna Staszowska river, Polish Uplands.

References:

Makowska D (1976) Kształtowanie się rzeźby w dorzeczu dolnej Czarnej w plejstocenie. Rozprawa doktorska, mps. WGiSR Uniw. Warszawskiego.

Massalski A (1991) Kraina Świętokrzyska. In: Kaczanowski L, Massalski A, Olszewski D, Szczepański J (eds.) Pamiętnik świętokrzyski. Studia z dziejów kultury chrześcijańskiej. KTN Kielce.

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