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# ABSTRACTS – conference papers

## Analysis of the causes of landslide from June 2013 on the D8 highway near Dobkovičky

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**Key words:** landslide; geophysical survey; Dobkovičky; Central Bohemian Uplands.

This presentation summarizes the results of an extensive analysis of the causes of landslides from June 2013, which partially destroyed the construction of the D8 highway near Dobkovičky in Central Bohemian Uplands. The analysis includes field geophysical and hydrogeological survey, geological-geomorphological mapping, 2D and 3D slope stability modelling and remote sensing analysis. In spite of vast inaccurate information from the media, the landslide began to develop in mid-2010. The final acceleration on the night of June 6 to June 7 2013 resulted in a shallow landslide about 500 m long and a width of 200 m. Its volume reached approximately 500,000 m<sup>3</sup>. The landslide originated in an open quarry where precipitations easily infiltrated and increased the groundwater level. At the same time, the middle part of the slope was undercut by the highway construction. Additional overloading in the upper part of the slope by a gravel depot significantly helped the landslide triggering. The results of the analysis have proven that despite the overall landslide susceptibility of the region this landslide was essentially anthropogenic.

## Monitoring the dynamics of a giant landslide on El Hierro, Canary Islands

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**Keywords:** megalandslide; El Hierro; the Canary Isles.

In this paper we investigate the recent behaviour of landslide detachment planes of a giant landslide on El Hierro in the Canary Isles. The San Andrés megalandslide occurred between 176 and 545 Ka BP as a result of either an aborted volcanic flank collapse or a failed slump with a number of discrete movement episodes. We have continuously monitored the behaviour of the megalandslide detachment planes at three sites using mechanical extensometers since 2013. Significant improvements to the instrumental infrastructure were made in early 2016. The extensometric measurements in the gallery are complimented by radon concentration monitoring. This information is then processed using the mathematical tools provided by big data. For our analyses we were able to combine the primary data recorded by the climatic stations and mechanical extensometers with a wide range of independently obtained secondary data (e.g. seismic, magnetic, and tidal). Preliminary results show that the kinematic behaviour of the giant landslide detachments planes is greatly influenced by climatic oscillations and

seismic events. The latter represent the most probable cause of giant landslide reactivation in the future due to their unpredictable nature. In this study we show that big data provides geoscientists with a new set of mathematical tools that can be used to scrutinise data in order to understand the past processes and to predict natural phenomena.

## **Controll and imprint of the deep seated landslides in the Moravskoslezské Beskydy Mts.**

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**Keywords:** landslides, the Moravskoslezské Beskydy Mts.

Deep seated landslides (DSLs) are widespread phenomenon in the Moravskoslezské Beskydy Mountains. They occupy nearly 20 % of the study area. Their spatial distribution is mainly controlled by geology of the study area and the local relief and slope play a secondary role. Most of the DSLs are situated on the back slopes (cataclinal) of the monoclinal ridges, thus their movement is conditioned by sliding on the bedding layers. Portion of the DSLs is situated along key lithological contacts, e.g. sandstones overlying fine-rhythmical flysch. The height of monoclinal ridge and the thickness of coherent sandstone cap seems to be crucial in the evolution of the DSLs. We propose a conceptual model for the evolution of DSLs where coherent sandstone caps overlie weak claystone/siltstone-dominated flysch. We distinguish between “low” and “high” monoclinal ridges. The former is capped by relatively thin sandstones overlying claystone formations and in the other dominates sandstones. The density of DSLs on the cataclinal/dip slopes is similar on both types of monoclinal ridges but major differences exist in the evolution of anaclinal/escarpment slopes. Low monoclinal ridges are highly affected by DSLs, but escarpments of high cuestas are nearly devoid of any DSLs.

## **Identification of landform boundaries in river channel using the Python GIS tool**

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**Keywords:** bank line, lateral shift, GIS, Python.

The precise identification of a river landform area by its boundary/line is a basic precondition for the study of its properties in GIS. The most commonly identified boundary in the river channel is the course of its bank line. The GIS approach is presented on the one hand allowing the bank-line vectorization, on the other hand the use of GIS tools for the bank-line shift analysis. The approach consists in five steps as follows: i) vectorization of bank-lines using updating/backdating method based on remote sensing data; ii) splitting of a river channel along centerline into identical segments as to the length; iii) generate a raster layer based on the Euclidean distance of bank-line for each cell in raster in reference time horizon; iv) extract the Euclidean distance values for bank-line position in the consecutive time horizon; v) the application of the zonal statistics GIS tool for all extracted cell belonging to individual segment. The calculation of average, minimal, maximal and median value of lateral bank-shift represent results of the zonal statistics. Steps three, four and five are implemented in Python tool by Python programming language and library ArcPy.

## Geophysical analysis of selected blockfields in the Šumava Mts.

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**Keywords:** Blockfield; electrical resistivity tomography; shallow seismic refraction; dipole electromagnetic profiling; ground penetrating radar.

Blockfields are very significant and attractive landforms. They occur mainly in the protected areas in the Czech Republic. Nature conservation limits number of methods that can be used for geomorphologic survey in these areas. The main goal of this paper is to describe characteristics of blockfields in the Šumava Mts., especially their thickness and density. We presume verification or modification of the existing blockfield classification (based solely on the surficial manifestation). We decided for noninvasive geophysical survey to reach this aim. We used electrical resistivity tomography, shallow seismic refraction, ground penetrating radar and dipole electromagnetic profiling. We also decided to evaluate the suitability of different geophysical analyses to determine characteristics of selected blockfields. The research was carried out in the second zone of the Šumava national park, in the area of Slunečná and Skalka peaks, both located near the Prášíly village. We applied 4 geophysical methods on 150 meters long transversal and 110 meters long longitudinal profile on blockfields in the area of the Slunečná and Skalka peak, respectively. This research is a part of master thesis.

### **The role of landslides in downslope transport of allochthonous sandstone boulders in sedimentary tablelands, Stołowe Mountains (Poland)**

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**Keywords:** landslides, geophysical survey, Stołowe Mountains.

Landslides, usually rotational ones involving caprock, have been recognized in various sedimentary tablelands across the world. Although their contribution to the scarp retreat phenomenon has been underlined a number of times, marginal attention has been paid to their role in downslope transport of caprock-derived boulders. In this study we examine this overlooked problem by means of detailed investigation of middle and lower escarpment slopes of the Stołowe Mountains. The slopes here are mantled with extensive blankets of allochthonous sandstone boulders – often of considerable size – that may be found at huge distances, even 1000 m away, from the caprock outcrops. The fine-grained series in the subcaprock position consist of mudstones, claystones and calcareous sandstones. Field mapping and LiDAR-based geomorphometric analysis revealed the presence of peculiar landform patterns that result from both rotational and translational slides, all limited to the subcaprock complex. The translational slides produced a distinctive tread-and-riser topography, with risers up to 10 m high. Geophysical survey using Electrical Resistivity Tomography (ERT) confirmed landslide origin of the identified landforms and showed the presence of allochthonous, sandstone-derived upper layer that wedges out downslope. The resistivity contrasts at depth of 5–15 m are interpreted as basal boundaries of landslide bodies. The findings are consistent with the concept that sandstone boulders might have rafted on top of slid masses and in this way reached very distant footslope settings. The role of landslides in tablelands should thus also be considered in terms of boulder redistribution.

## Architecture and age of Biebrza river valley floor (NE Poland): case study at Lipowo site

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**Keywords:** river valley, dating.

Study area is located in NE part of Poland in middle Biebrza Basin. Relief of this region formed during Middle Polish (Saalian) Glaciation. The older relief of the basin was transformed during the Late Glacial and Holocene with climate and vegetation changes as controlling factors. Present-day Biebrza is underfit river with vast peat-bogs on its valley floor.

A beginning of peat accumulation in the valley floor was radiocarbon dated at 8490±80 BP (MKL-3275) 7658-7347 cal. BC. At the similar time was cut off Biebrza river channel near a sandy elevation. Cone from the silty sands in the bottom of this abandoned channel was radiocarbon dated at 8330±120 BP (MKL-3277) 7577-7083 cal. BC. Both these occurrences, a rise of ground water level and channel change, could be connected with climatic changes - cool and humid phase at the beginning of Atlantic (8.2 ka BP event). Gytija with water malacofauna was accumulated in oxbow lake during the Early Atlantic. Lake had disappeared about 6170±80 BP (MKL-3276) 5313-4911 cal. BC when started accumulation of peats and developed peat bog here.

Results of studies at Lipowo and other sites in Biebrza valley floor indicates some periods of climatic changes and an increase of activity of morphogenetic processes. The oldest phase of cool and humid climate was dated at beginning of Atlantic (growth of peat bogs in valley floor, river channel cut off). Next humid period indicated subfossil trees fallen in the valley bottom in the end of the Atlantic. The youngest humid period and beginning of peat accumulation on Subboreal colluvia (delluvia) occurred about 3200-3100 BP (Krasnoborki site). Climate fluctuations correlate very well with phases distinguished in Centraleuropean river valleys (Kalicki 2006).

Part of the research was carried out in cooperation with the project: „Preservation of wetland habitats in the upper Biebrza Valley” LIFE11/NAT/PL/422.

## ERT on water: a new approach in lake sediment research

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**Keywords:** fluvial sediment dynamics, sonar, ERT, Mladotice lake, bathymetry.

Estimating of the lake infill sediment volume is a common, albeit difficult task in paleogeographical and limnological studies. So far, it relied on combination of hypsometric measurements with sampling or

probing. This is however complicated and requires specialized drilling machinery and equipment capable of working from the water surface.

The situation is easier in the case of newly dammed lakes (by landslide, for example), where the detailed maps or DEMs of the pre-damming situation exist. However, in the case of our study of Mladotice lake, the detailed maps do not exist, as the lake developed after a landslide in May 1872. The contemporary maps were not precise and detailed enough to allow reliable, accurate valley bottom reconstruction.

In this study, we combined geophysical profiling using electric resistivity tomography with bathymetric measurements. Nine ERT and bathymetric profiles were measured across the lake. The profiles were designed to cover evenly whole area of the lake, which allows interpolation of the sediment thickness for the whole lake. The ERT cables were mounted on flotation pads, linked together with a strong cord, so that the electrodes could be fixed to a stable position by tightening of the cord. The electrode stepping was 2 m.

The ERT data were of good quality, with few points missing. The processing was performed in Res2DInv software by Geotomo. The results revealed usability of the method for pre-lake landscape reconstruction, and following shallow lake sediment volume estimate.

### **Anthropogenical changes of water reservoirs in Suchednów in the light of cartographical and geophysical investigation**

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**Keywords:** geophysical methods, water reservoir.

Research area is located in middle Poland in northern part of Holy Cross Mountains region. In Suchedniów since the Middle Ages was functioned at least three forges, which were built at dams and ponds in Kamionka river. Archival maps show near one of these forges different reservoirs in last centuries. When at the beginning of the twentieth century forges was destroy, the nearby pound become dry. This area was unused by man to the age of 70, of the twentieth century. In present day was build in 1974 new reservoir in this area. There was built the city park in location of the old pound. In this area was made geophysical analyzes. These analyzes showed the presence of anomalies which indicate the remnants of the old reservoir.

Since a short time geophysical prospection become one of the most useful methods in geographical research. Geophysical recognition of anthropogenical places makes possible non-invasion testing of the sites. During research we used GPR method which was based on the Mala ProEX unit with the shielded antenna of 500 MHz. It allowed to view underground structure to catch the line of the water reservoirs. However on the echograms is a lot of anomalies which can be interpreted as the human activity. Comparing geophysical survey to cartographical evidence we can observe major changes in the natural environmental caused by those activity in the last three centuries.

## Polygenetic relief of Wizna basin (NE Poland) - new results

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**Keywords:** relief, sediment, dating, Biebrza Basin, Poland.

In relief of the north-eastern part of Poland, Biebrza Basin is a macrodepression with complex structure. The evolution of this form included several stages of transformation during the last two Pleistocene glaciations and two interglacial periods – Eemian and Holocene. The origin and age of Biebrza Basin was associated with erosional processes or ice-melting connected with Saalian ice sheet or Vistulian – Świecie stadial before LGM. Wizna Basin is most southern basin of Biebrza Basin. Many forms related with ice-melting (e.g moraine monadnocks, sandar-kemes plain, keme terraces and kemes) and composed with highly textural and structural diverse fluvio-glacial and glacial deposits occur within it. Those monadnocks (erosional remnants) rise above the peat-bog in the valley bottom. In the valley bottom could be distinguished two segments: first one - wide (2/3 width of the bottom) without traces of fluvial activity and the second one – narrow, fluvial.

In the first segment the relief of biogenic deposits bottom indicate the occurrence of palaeolake filled with gyttja deposits. The surface under the peats was transformed by aeolian processes at the end of last glaciation and the Younger Dryas cooling resulted, in probably, that the complex of parabolic dunes (Grzędy site) was still active at the end of the Late Glacial and Early Holocene. After the climate warming in the Preboreal starts the accumulation of peats (10 135±90 BP (MKL 3129) 10143-9396 cal. BC) but with short-time an increase of aeolian processes activity in the beginning of the Atlantic (8320±80 BP (MKL 3274) 7542-7141 cal. BC). It could be coincided with global cooling and more open vegetation on sand dunes or impact of the Mesolithic cultures.

Within the fluvial segment are preserved macromeanders whose cut off was 14C dated at 11 780±100 BP (MKL 3130) 11 851-11 461 cal. BC (Włochówka site) and at 9900±90 BP (MKL 3135) 9762-9231 cal. BC (Ruś site). They represent two generations of large, Late Glacial meanders: older probably from Bölling and younger, probably from Alleröd. Less meandering pattern of the older generation shows, that they was transitional system from braided to meandering river, similar like in Warta and Moza valleys (Vandenberghé i in. 1994). Small palaeomeander Grądy Woniecko 2 undercuts dune with archaeological site Grądy Woniecko and it was cut off before 3800±60 BP (MKL 3127) 2461-2043 cal. BC. Within aeolian sediments could be distinguished several members separated by buried soils. Phases of aeolian activity have a high conformity with the general phases dune formation for Poland and phases of activity and stabilization of the nearby dune field in Narew and Biebrza watershed.

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# Age and structure of morphological levels of Czarna Konecka river valley between Janów and Wąsosz Stara Wieś (Polish Uplands)

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**Keywords:** morphological levels, fluvial deposits, Czarna Konecka river valley, Polish Uplands.

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

Within the valley can be divided some morphological levels of different age and structure (Kalicki et al. 2016). Vistulian (?) erosion-accumulative high terrace (approx. 7.5-7.0 m above river level) composed of sandy channel sediments of braided river (profile Czarna 5). Fluvioglacial sands in erosional socle of this terrace, TL dated at  $144,2 \pm 21,6$  ka (KIE-909), is covered by tills. Vistulian (?) middle terrace (5.0-4.5 m a.r.l.) is erosion-accumulative (profile Czarna 2). It has also been formed by braided river. Linnoglacial deposits with cryoturbation in erosional socle were TL dated at  $209,3 \pm 31,4$  ka (KIE-918). Lateglacial low terrace (approx. 4.5-3.0 m a.r.l.) was already shaped by the meandering river. Sandy alluvia of this terrace (profile Czarna 3) was TL dated at  $11,9 \pm 1,8$  ka (KIE-906) and  $11,3 \pm 1,7$  ka (KIE-907). Along the river extend relatively narrow strips floodplain high (3.0-2.0 m a.r.l.) and low (1.0 m a.r.l.). 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. Two of them were dated on Early  $7350 \pm 90$  BP cal. 6411-6052 BC (MKL 3029) and Late Atlantic  $5570 \pm 50$  BP cal. 4497-4337 BC (MKL 2983).

There are numerous subfossil tree trunks (oaks and pines) in both the channel sediments (profile Czarna 3) and abandoned channel fill (profile Czarna 4 and 1). The subfossil trees from these last two profiles were <sup>14</sup>C dated at  $2610 \pm 40$  BP (MKL-2984) cal. 849-750 BC and  $1700 \pm 40$  BP (MKL 2862) cal. 240-420 AD, respectively. There were fallen in the beginning of Subatlantic and in the Late Roman period and were accumulated on the limit between channel deposits and sandy bars in the first stage of abandoned channel filling. The oxbow lakes fills (profiles Czarna 4 and 1) indicate distinct variation of sedimentation types, referring to changes in the frequency of flooding in the Holocene. These type changes were <sup>14</sup>C dated in Czarna 4 profile at  $2470 \pm 60$  BP cal. 772-413 BC (MKL 3031) and  $1410 \pm 70$  BP cal. 567-672 AD (MKL-3030) - beginning and end of peaty silts accumulation, respectively and in Czarna 1 profile at  $630 \pm 60$  BP cal. 1270-1420 AD (MKL 2861) when peats were covered with levee deposits (intercalations of sands and silts). The last date could be connected with the Medieval increase anthropogenic changes of drainage basin and valley floor but also with clustering of catastrophic events during the Little Ice Age (Kalicki et al. 2016).

The data of Archaeological Map of Poland show only 4 points (traces of settlements) from the Stone Age located on the high and low terraces. On the low terrace developed the Early Medieval and Medieval settlements, which indicates that the area was overflowed in this period. However anthropogenic changes could triggered changes of sedimentation type on flood plain. Archaeological and historical 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.

# Spatial distribution of postglacial DSGSDs in Tatra Mountains (Western Carpathians) influenced by long-term exhumation

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**Keywords:** sackung, Tatra Mountains.

We present an inventory of sackung-type DSGSDs for the Tatra Mountains (Western Carpathians). From west to east, there is a sharp morphometric contrast in the study area: while Western Tatras are lower, with gentler slopes, Eastern Tatras rise higher (reaching 2654 m a.s.l.) and are characterized by steeper slopes. Tatra Mts. were remodelled by repeated glaciations during the Pleistocene. After deglaciation, Tatra Mts. experienced formation of numerous DSGSDs, probably induced by glacial debuitressing, or climatic changes.

Mapped sackung-type DSGSDs in the study area follow a clear pattern: only 26 sackung features were mapped in the Eastern Tatras characterized by a more pronounced local relief and more extensive glacial cover during LGM. The majority of sackungen however (453 features), is located in the Western Tatras. This clear difference is striking, given that similar lithologies are present in both parts.

Time lag between deglaciation and sackung initiation, revealed by published <sup>10</sup>Be ages, shows either (very long) pre-failure endurance, or it indicates leading role of triggering factors other than stress-release after glacier retreat. Spatial distribution of DSGSDs is tracing a SE-ward younging trend in published AFT ages, suggesting a possible influence of long-term exhumation rates on the predisposition of DSGSDs. Due to earlier exhumation, slopes of the Western Tatras experienced more gradual weakening, as compared to the younger uplifted rocks of the Eastern Tatras. The spatial distribution of DSGSDs in the Tatra Mts. suggests that long-term exhumation might play a vital role in the spatial distribution of slope deformation, potentially exceeding the effect of glacial debuitressing.

## The geochemical features of flood plain deposits of kamienna river (holy cross mountain, poland) – first results

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**Keywords:** geochemistry, flood plain, organic carbon, pH, carbonates, heavy metals.

The record of environment changes caused by natural and anthropogenic factors are the subject of environmental research. One of branch of science dealing with this issue is geochemistry. It is a science that investigated the time and spatial distribution of elements and its isotopes in Earth's geospheres and atmosphere, and also elements cycle in the nature. Alluvia are a specific source of information about many kind of human influence on environment. It usually leads to enrichment in heavy metals and another elements of deposits.

Studied section is located near Marcinków village, on the upper course of Kamienna river. It lies within Mesozoic margin of Holy Cross Mountains and its valley forms a border between two mesoregions,

Suchedniów Plateau and Iłża Foreland. The structure of the Holocene flood plain is very complicated because the presence of several alluvial bodies of different ages.

An investigated alluvia characterized by different amount of organic matter, very acid or acid reaction and very few concentration of carbonates. The low value of pH is connected with geological structure of this area, because it is built in the most degree by Lower Triassic stones, rich in iron ore. The high concentration of organic matter usually reduces the value of pH, and carbonates are leached away from acid deposits.

The geochemical analysis of macro- and trace elements by XRF spectrometry is in preparation. Its concentration is connected with natural changes in the environment and human activity.

### **Typology of patterned ground in the Czech Republic**

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**Keywords:** patterned ground, morphology, palaeogeography, Central Europe.

Patterned ground is a wide group of periglacial landforms, which has more or less symmetrical surficial shape, such as circle, polygon, net, stripe etc. A substantial part of patterned ground (e.g. ice-wedges, large sorted polygons) is associated with the permafrost environment and forms within the active layer, which underlines its palaeogeographic significance. Patterned ground can serve as proxy indicator of specific cold climate conditions. Most of patterned-ground types (i.e. ice-wedge casts in lowland areas; sorted polygons, sorted nets, sorted and non-sorted stripes in upland areas) in the Czech Republic are recently non-active. Sorted circles and earth hummocks at the highest parts of the High Sudetes are the only active patterned ground. Ice-wedge casts in the Czech Republic were found and described only due to accidental discoveries during construction and mining operations. Most of them were buried or quarried. Currently, we build a database of spatial distribution of ice-wedge casts. The origin of ice-wedge casts was tentatively attributed to the LGM.

Now we aim to determine the age of patterned ground in both lowland and upland areas and to create innovative palaeogeographic reconstruction of the Quaternary landscape history based on patterned-ground evidence.

This investigation is financially supported by the Czech Science Foundation, project number 17-21612S.

### **Influence of neotectonics on land surface evolution in the upper part of the Blue Nile Basin (Ethiopia): findings from a DEM**

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**Keywords:** landscape evolution, neotectonics, river piracy, lineaments, DEM, Main Ethiopian Rift, Ethiopian Highlands.

The morphometric analysis of lineaments, valleys and signs of erosion taken from DEM made it possible to make several new hypotheses. Relative age of morpholineaments of particular directions was estimated from the character of topographic profiles and from the abundance of the first order streams in given direction quantified as a Stream Order Length Ratio (SOLR). Overall, the most abundant NE-SW and NNE-SSW lines reflect a change of extension from the NW-SE to the WNW-ESE direction during the Pliocene, in relation to the creation and development of the Main Ethiopian Rift (MER). This is confirmed by the more developed character and lesser erosion activity of the NE-SW oriented valleys contrary to the deeper narrower NNE-SSW valleys characterised by downward and backward erosion in the second direction. E-W extension characteristic for MER and western Afar during the Quaternary has the most pronounced morphological manifestations confined to the borders of the MER and markedly maximal SOLR values indicate the very short-time effect of the stress field on the development of the landscape. Similar SOLR values are found in an E-W direction that could be a result of the Quaternary activity of E-trending transverse faults. The directions of the Pre-Neogene rift structures to the NW-SE and WNW-ESE are compatible with the oldest elements of the current landscape, i.e. with the relict fragments of the valley network in the upper Blue Nile Basin, which could have been drained across current shoulders of the MER to the S and E before the Late Miocene.

**The timberline as result of the interactions among forest, abiotic environment and human activity.  
Case study of the Babia Góra massif (1725), Western Carpathian Mountains**

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**Keywords:** timberline, the Babia Góra massif.

The timberline is one of the clearest and most easily discernible boundaries in nature (Troll 1973). Among the existing conceptual models clarifying the complex nature of the relationship between the timberline and the environment and human impact, the fullest seems to be the one presented by K. Holtmeier (2009). The quoted author comprehensively characterizes the timberline, taking into account its course, appearance and ecological characteristics. The aim of the work is to quantitatively assess the factors influencing the course of timberline and its changes over the last ca. 400 years in the Babia Góra massif (1725 m a.s.l.), the highest flysch ridge in the Western Carpathians, which is formed as an asymmetric ridge of kuesta type. Forests mainly in the upper montane zone have preserved their natural character in many areas. Old spruce tree growths are a particular advantage of the Babia Góra Mt., being there on the predominant section of the altitude zone of the timberline. In the rest of this zone, spruce forests have been under a direct or indirect influence of changes resulting from grazing with its 400-year history and forestry taking place about 100 years ago. The 60 m difference between the average altitude of the timberline on the northern (1335 m a.s.l.) and the southern slope (1395 m a.s.l.) on the Babia Góra Mt. can be explained with climatic conditions of these areas. The average gradient of the slope within the timberline ecotone on the southern slope of the massif is by 100 smaller, and the amount of solar energy delivered during the growing season is 40% higher (960 kWh/m<sup>2</sup>) than on the northern slope. The higher position of the timberline on the windward southern slope is favored by the dominant winds from S-W sector, thinner snow cover and earlier melting due to the lower precipitation on the slope and also due to the winnowing of snow onto the steep northern slope of the ridge. On the southern slope of the ridge there are no larger snow avalanches. Soils in this part of the massif are richer in nutrients which due to the small inclination of the slope are flushed on a smaller scale. Because it is on the southern slope of the massif that timberline has been significantly lowered due to the old grazing, it can be expected that in the future the timberline can achieve even higher position than at present. Lower position of the timberline on the northern slope of the massif is also due to frequent falling winds of foehn type, much thicker snow cover and its longer existence. In many places the most important role

play in this matter frequent and long snow avalanches, and in local scale landslides and debris flows and also edaphic conditions. The work has been conducted as part of the research project of the Polish National Science Centre N N306070540.

## **Occurrence of remnants of glacial forms in the Polish Beskidy Mountains – myths or reality?**

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Utterly different opinions concerning the occurrence of glacial forms in the Polish part of the Western Beskidy Mountains have been given for over 150 years. According to A. Rehman (1865, 1895), deep rocky corries on the northern slope of Babia Góra Mt. are the result of large landslides. In 1913 L. Sawicki published his work entitled “Glacial landscapes of the Western Beskid Mts.”, where he indicates that erosional and accumulation forms of glacial relief occur on Babia Góra Mt. (1725 m a.s.l.) and Pilsko Mt. (1557 m a.s.l.) and some traces of such relief may have preserved on the highest parts of the Beskid Śląski Mts. Inasmuch only corries and moraine ramparts occur on Pilsko Mt., Sawicki reckons that the glaciated area on Babia Góra Mt. had been much larger which resulted in formation of numerous moraine ramparts. Conceptions of Hanslik and Matzura/Macura published before 1950 concerning the Beskid Śląski Mts. and also works of some authors of the 1930s concerning Babia Góra Mt. refer to Sawicki’s ideas. The work of K. and T. Ziętaras (1958) entitled “About the supposedly glacial relief of Babia Góra Mt.” has changed for many years the outlook of geographers about the occurrence of glacial forms not only in this massif but in the whole Western Beskidy Mts. These forms were interpreted as the result of landslide movements (with reference to Rehman) and only some parts of rocky slopes on the northern slope of Babia Góra Mt. were explained in works of some geomorphologists as the results of former glacial erosion. For the last 25 years more and more attention has been paid to glacial or nival origin of some niches and ramparts on the northern slopes of Babia Góra Mt. and Pilsko Mt. Geomorphological mapping and analysis of data from aerial laser scanning of Babia Góra and Pilsko enabled the Author to look critically on the origin of the landforms which had been differently interpreted in the past. It was revealed that on the northern slope of Babia Góra Mt. there are variously preserved glacial undercuts indicating the occurrence of three corries and several nival niches. Accumulation forms are less visible as they were remodelled by landslides, however distinct ramparts of lateral moraines are visible below the largest corrie. Glacial and nival forms do not occur on the southern slope of this massif. The origin of ramparts on the northern slope of Pilsko Mt. may be explained as a nival one or as the result of large solifluction movements of the rock-mantle. Glacial undercuts do not occur in this massif. Searching for possible traces of glacial or nival erosional forms in the Polish Beskidy Mts. apart of Babia Góra and Pilsko, it was assumed that the snow-line in this area in the last glacial period might have lowered to about 1000 m a.s.l. The attempts of discovering traces of such relief in the altitude range 1000-1360 m a.s.l. were unsuccessful with one exception – Barania Góra Mt. (1220 m a.s.l.) in the Beskid Śląski Mts, where a distinct niche at the altitude 1100-1200 m a.s.l. was assumed as a nival form. In identification of erosional glacial forms, the rule of west wind domination was taken into account as well as morphometric analysis of mountain ridges. This was the base to determine the limit of snow alimentation areas, possibilities to blow the snow to the east, and possibilities of snow accumulation in deep preglacial forms exposed to the north. Only some fragments of the northern slope of Babia Góra Mt., which underwent considerable glacial transformation, meet these conditions.

## **Predisposition and genesis of crevice type caves in the Labský důl valley in the Giant Mts.**

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**Keywords:** cave, the Labský důl Valley.

This research presents new findings concerning the predisposition and genesis of two pseudokarst caves in the Labský důl valley in the Giant Mountains (Czechia). The Krakonošova klenotnice cave extends to 102 m and is regarded as a combined talus-crevice-type cave by many authors. The Lomená cave reaches 9.5 m and is considered a crevice-type cave. Recent research has focused on a detailed detection of the predisposition and genesis of these caves. We measured the parameters of 257 joints with a geological compass. A total of 23 fault surfaces were detected, some of them manifesting striations. Predispositions of these locations to particular types of movements (planar sliding, flexural, direct and oblique toppling) were modelled in the Dips 6.0 software. Our results suggest that the slopes surrounding the caves are prone to toppling movement. The Lomená cave was formed by a toppling movement with the influence of planar sliding. The Krakonošova klenotnice cave has a more complex genesis. Although the cave was apparently formed by a downslope toppling movement of rock blocks, its genesis should be connected with the back rotation of blocks towards the slope combined with their subsidence into the relaxed space. This scenario assumes the existence of a rotational sliding surface. Thus, the Krakonošova klenotnice cave is classified as a crevice-type cave resulting from the activity of rotational slope deformation. Both caves therefore qualify as crevice-type caves. The origins of both caves are predisposed by a mixture of lithological and topographical parameters.

## **Downstream variation in bed sediments of the Kobylská mountain stream based in flysch geologic structures (Vsetínské vrchy Mts)**

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**Keywords:** channel bed sediments, channel-reach morphology, macrogranulometric analysis, flysch nappe structure, Kobylská Stream, Vsetínské vrchy Mts.

The character of bed sediments reflects fluvial processes and the dynamics of material transport in fluvial (dis)continuum systems. The study focused on fluvial-geomorphological analysis of the Kobylská mountain stream based in flysch geologic structures in the Vsetínské vrchy Mts. The research was purposed with (i) fluvial-geomorphological mapping, (ii) recognize the sediment inputs and disconnectivities, (iii) identification of the channel-reach morphology, (iv) assessment of the grain-size parameters of the bed sediments and (v) evaluation of morphological parameters of channel in the longitudinal course of the Kobylská stream. The results of the field research were processed at the appearance of the geomorphological maps, graphs of the grain-size parameters of bed sediments, identified sediment inputs, disconnectivities and morphologic characteristics of channel in the longitudinal course of the Kobylská stream. Statistical analysis was made for investigation of the relationships between grain-size and channel parameters. The resulting trends in grain-size parameters reflected the character of sediment delivery, disconnectivities and channel morphology. Additionally local lithological conditions were assessed in the Kobylská basin where occurrence of claystones affected resulting parameters of bed sediment grain-size.

# **A multidisciplinary approach to uncover Holocene landscape evolution and land use history in the shade of Mount Vesuvius, Campania, Italy**

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**Keywords:** landscape evolution, the Holocene, Mt. Vesuvius.

The ancient city of Pompeii, buried by the explosive AD 79 eruption of Mount Vesuvius, is excavated and intensively studied for more than 265 years. However, in an geomorphological landscape evolution perspective, the area astonishingly is still relatively unknown. As yet no comprehensive and integrated study exist that focus on both the paleoenvironmental conditions of the Sarno River plain in Roman and pre-Roman times.

To close this gap, in 2006, a cooperation project financed by DFG , German Archaeological Institute and the Heidelberger Academy of Sciences and Humanities as well as Florence University was initiated. The aim was to bring together scholars from archaeology and geosciences from Italy and Germany to reconstruct the pre-AD 79 cultural landscape of the Sarno River plain. As this paleolandscape and almost all ancient sites lie buried underneath 1 to 15 m of volcanic deposits conventional archaeological methodologies had to be combined with interdisciplinary geomorphological techniques such as stratigraphic investigations, GIS-based spatial analysis, geostatistics and predictive modelling.

At first, a comprehensive GIS database of archaeological evidence of the pre-Roman and Roman period was build up, which yielded a dataset of more than 600 entities. Furthermore, about 1,900 drilling stratigraphies were collected to generate a high resolution landscape model of the Sarno River plain using a machine learning modelling approach. In a following integrative project phase, the geodata were combined with the archaeological data to answer more detailed questions of the socio-economic system of the plain, concerning the rural settlement structure, land division (centuriation) or infrastructural organisation such as the ancient road network.

We developed a conceptual landscape evolution model based on an extensive excavation we carried out in the Scafati area close to Pompeii. Here geomorphological, pedological and socioeconomic evidences were collected and combined to understand the landscape evolution dynamics from Pre Roman times to present day.

Finally this wide-range cross-section approach provided insights into the development and dynamics of the hinterland of Pompeii and its complex interdependencies between the physiographic conditions and the anthropogenic influence on the paleo-landscape before AD 79.

## **Aeolian activity on plugh area in the winter season 2016/2017 in the Nida Basin, case study at Wojcieszce and Skorocice (Polish Uplands)**

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**Keywords:** wind erosion, loess, gypsum, Nida Basin.

The study area is located on two fields of arable Nida Basin (Polish Uplands) at Skorocice and Wojcieszce villages. In Wojcieszce in the substrate prevail Lower Cambrian mudstones and clays, and they cover by Quaternary loess with Podzols. At Skorocice while the ground is dominated by Cretaceous rocks and they cover the Tortonian crystalline gypsum (Gilewska 1972). The soil formed rendzinas sulphate (gypsum).

The aim of the study was monitoring aeolian activity in the winter season 2016/2017 in the Nida Basin on the arable lands in the both villages. In the fields designated respectively: Skorocicach 4 squares, and Wojcieszycze 5 squares, where the area was 1 m<sup>2</sup>. With measurement points taken snow, it was evaporated and analyzed by laser method.

Attempts taken 16 and 17 February 2017 year. In these days of the study area dominated by winds from the west and from the WSW. In both villages, arable land was harrowed. At Wojcieszycze land was completely covered with snow. Weight taken clastic material varies between 10 and 15 mg. At Skorocicach snow cover was minimal, and the weight of material taken was between 400 to 1000 mg.

Analysis of the taken material allows the construction of the connection between the thickness and the amount of material transported by aeolian processes and the distance from the field of maintenance. All the above details are preliminary results of research, which will be continued in the next winter season, which will to gather comparative material addicted on the types of winters, morphological position.

### **The response of channel dynamics to recent meander neck cutoff in a lowland freely meandering river with artificial training history: The Morava River, Czech Republic**

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**Keywords:** channel dynamics, meandering, Morava River.

Intact meandering lowland rivers that experience cutoffs are rare in Central Europe. In-depth understanding of the interactions of the processes that occur in various natural- and human-induced settings has remained a challenge in fluvial research. This study offers insight into the Morava River's morphological response to neck cutoff, which resulted from post-engineering evolution of the reach since the 1930s. The active channel's response to the cutoff was more localized than the artificial cutoff of six meanders in the 1930s. Consequently, a new cut bank was established, and it experienced accelerated erosion, with rates substantially exceeding the long-term averages. The amount of the sediment released due to the cutoff equalled 2–5 years' of the amount entrained by lateral erosion in the last six decades. Despite a low entrance angle, alluvial plugs were established within a few months, probably due to the effect of the topographical settings that were formed prior to the cutoff. Since the cutoff in 2006 and May 2016, sedimentation of the alluvial plugs has occurred at an average rate of 0.55 m.yr<sup>-1</sup>; however, this process was highly non-linear, reflecting the time since the cutoff and the frequency of overbank flows. Spatial distribution of the grain sizes at the alluvial plugs exhibits fining in the flow direction and from the bottom up. This pattern is in agreement with the expected flow hydraulics, and it is apparent despite the presence of dense herbal vegetation.

## Comparison of Schmidt hammer test and $^{10}\text{Be}$ exposure age chronology in the Roháčská Valley, Western Tatra Mts.

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**Keywords:** Schmidt hammer test,  $^{10}\text{Be}$  exposure age, moraine, rock glacier, Last glacial maximum, Late Glacial, deglaciation chronology.

Glacial landforms (nine moraine ridges, five rock glaciers and one glacially rounded mound) in the Roháčská Valley were mapped and tested by Schmidt Hammer test (SHT) in order to establish their relative chronology. Three morphostratigraphic units were identified according to the landform morphology and the results of the SHT. The suggested chronology was compared with chronology based on  $^{10}\text{Be}$  exposure ages in the Roháčská Valley (Engel et al., in review). Some of the glacial landforms were tested both by SHT and by  $^{10}\text{Be}$  exposure age dating. This procedure enables the comparison of both chronologies as well as evaluation of SHT potential as a dating tool. The comparison of both chronologies shows that SHT enable rough estimation of the relative chronology (three distinguishable stages – maximal ice extension (MIE), late glacial re-advance and specific rock glacier phase).

## Industrial alluvia of Kamionka river in Holy Cross Mountains

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**Key words:** dating, alluvium.

Kamionka is a right tributary of the Kamienna river, flowing on the northern part of Holy Cross Mountains in Suchedniów Plateau.

At the beginning of the sixteenth century within the catchment there was operated 7 forges. They were located mostly along the Kamionka. At the turn of the nineteenth and twentieth century, forges were replaced by larger factory. In downstream from the old forges in sediments preserved inserts of charcoal, forming visible layers. Significant volumes of charcoal and their accumulation may be associated with the close proximity to the old forges. Results of OSL and  $^{14}\text{C}$  datings suggest that this material was laid down at a time when in this place was built the first modern forge:  $0.44 \pm 0.06$  ka (UJK-OSL-68),  $40 \pm 80$  BP (MKL-3250) after 1793 cal. AD.

On the floodplain are visible traces of old water reservoirs. Geochemical analysis confirmed the presence of slags and heavy metal contamination only in the old ponds sediments related to the functioning of nearby forges. Geochemical analysis showed the lack of this type of pollution in the sediments on the floodplain. It could be combined with river regulation and lack of catastrophic floods.

In last centuries it occurred to the accumulation of specific types of deposits in the Kamionka catchment. Those sediments are layers of slag and charcoal associated with forges activity on the river.

## **Growth pattern of exposed tree roots as a tool for identification of the landslide velocity**

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**Key words:** landslide, landslide movement.

Mechanism and velocity of landslide movements is important information for hazard assessment or protective measures suggestion. Exposed tree roots are usually used for reconstruction of erosion rates through identification and dating of the abrupt changes in the size of cell lumina. We used basically the same method for the quantification of landslide movement velocity. The principle of this method is the analysis of exposed roots from tension cracks or scarps whose origin is directly associated with mass movement. We analyzed anatomical reactions of 87 root cross sections of *Tilia cordata* Mill., *Fagus sylvatica* L. and *Carpinus betulus* L. in tension cracks of active landslide located close to the Vidče village (the Moravskoslezské Beskydy Mts.). Microscopical analysis of microcuts from these cross sections showed the reduction in the earlywood vessels sizes indicating the year of root exposure. We calculated the partial velocities of the landslide movement expressed as the segment rate (between two neighbouring samples) of tension cracks spreading and the total spreading rate of each tension cracks (the mean spreading rate from all root crossing one crack). The average partial velocity of the landslide movement among the segments of the root was 11.8 cm.year<sup>-1</sup> with the maximum 75 cm.year<sup>-1</sup> and minimum 1 cm.year<sup>-1</sup>. The average total spreading rate of each tension crack is 3.2 cm.year<sup>-1</sup> with maximum 4.3 cm.year<sup>-1</sup> and minimum 1.7 cm.year<sup>-1</sup>. The most important advantage of this new approach is the possibility to reconstruct past landslide movement velocity without the need of long-term monitoring.

## **LiDAR data based localization of landslides in the western Bohemia**

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**Key words:** LiDAR, landslide, western Bohemia, DMR 5G.

Three presented localities with significant slope deformations were identified in the western Bohemia by means of LiDAR data (DMR 5G). Although the slope deformations are comprehensively mapped and the results are administrated by Czech Geological Survey in the whole Czech Republic, these localities have not been described until present. The DMR 5G data with point density 1.6 point/m<sup>2</sup> and altitude accuracy less than 0,3 m are allowed to detect the landslides. The data with high accuracy were also used for dividing of complex landslide inner parts. The localities were delimited in various geological conditions. Two localities are placed in the Tertiary volcanic rock (in Manětínská pánev slopes of the

Kozelka Mt. and in the Doupovské Mts. the Peklo locality) and one in the Crystalline Complex of the highest part of the Krušné Hory Mts. (the western slope of Klínovec Mt.). The detailed mapping of the landslide inner parts provided the detailed morphometrical features and also offered same hypothesis dealing with origin and development of the complex landslide areas.

### **Multitemporal measurement of coarse sediment connectivity along a braided-wandering river**

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**Keywords:** connectivity, POPSECOM, holistic approach, braided-wandering river, flood.

The aim is to present the long-term multitemporal assessment of the changes in coarse sediment connectivity of braided-wandering channel applying and combining both, structural and functional approaches. Post-flood period sediment connectivity measurement (POPSECOM) approach methodologically based on the holistic ideas of the interpretation of coarse sediment connectivity in river channels was used. The seven sets of remote sensing data (1949, 1961, 1973, 1986, 1992, 2002 and 2009) were used as basic information sources for the study of connectivity for the braided-wandering Belá River. For the assessment of braidplain structural connectivity, graph theory and CONEFOR Sensinode 2.6 software was adopted for calculation the integral index of connectivity (IIC), bar area (BAI) and bar link (BLI) importance indices. Eight types of the sediment connectivity based on the calculation of erosion as well as deposition areas were identified. Bar areas, their pattern and downstream linkages between them, regardless of whether the sediment input is from upstream bars, bank or from bed are indicative of the structural connectivity. The higher values of IIC fit with a good developed bar system. Conversely, the values of IIC decrease due the progressive degradation of the braided pattern as the consequence of lack of channel forming discharges with the pertinent recurrence interval as well as due to decrease in sediment delivery from floodplain or from upstream. Single thread reaches exhibits also low values of indices.

### **Downstream variations in bar grain sizes in the context of managed and re-naturalized channel reaches of the Bečva River**

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**Keywords:** gravel-bed river, hydraulic modelling, grain-size parameters, downstream fining, the Bečva River, Flysch Carpathians.

Downstream changes in the grain-size of bars of the Bečva River at 56.0-42.0 r. km were investigated to determine the impact of channelized and re-naturalized channel-reaches. The study was focused to (i) identify general patterns of channel morphology of the contrast wandering and channelized reaches, sediment inputs and its disconnectivities, (ii) describe the downstream variations in the grain-sizes of gravel bars, (iii) analyse the hydraulic parameters of cross-sections related to investigated bars and (iii) assess the relationships between the hydraulic and grain-size parameters derived from regulation works and re-naturalized processes. Contemporary state of channelization/re-naturalization, sediment inputs and potential disconnectivities in sediment flux were mapped in detail. Sediment parameters of 68

gravel bars were obtained by photogrammetric grain-size analysis. HEC-RAS 5.0.3 software was used to calculate hydraulic parameters of investigated cross-sections related to bars during 1 year R.I. discharge, which completely submerged sediment sampling sites.

Although the grain-size parameters of sediments demonstrated general exponential tendency in downstream fining along the entire studied course, much more complex pattern of grain-size variation was observed. The high frequency of sediment inputs/disconnectivities affected the sediment calibre along the longitudinal course. Identified trends in the channel present behaviour (transport-balanced/deposition reaches) corresponded well with the modelled hydraulic parameters. The assessment of potential relations between the grain-size and hydraulic parameters did not demonstrate any clear relationships. It implies that sediment inputs and longitudinal disconnectivities provided better explanation of the grain-size patterns along the studied Bečva River course than simulated hydraulics for 1 year R.I. discharge.

### **Geophysical insight into the rock towers stability**

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**Keywords:** rock slope stability, geophysical methods, electrical resistivity tomography, ground penetrating radar, shallow seismic refraction, Adršpach.

The evaluation of the rock slope stability is crucial especially in areas with busy touristic traffic. Particularly the lone-standing rock towers (often overhanging) represent a formation that needs to be treated with a certain precaution. Stability models can be calculated based on very precise DEM models taken from LiDAR scanning or high resolution imagery (SfM), both ground-based and aerial. However, such models mostly describe the stability of the aboveground part of the rock tower. We usually do not have much information on underground rock properties, namely whether the rock tower root is or is not connected to the solid bedrock, which is crucial for its long-term stability. To challenge this problem, we applied a complex, 3-D geophysical investigation of the subsurface properties in the close vicinity of the selected overhanging rock tower (Homole cukru, “Sugar cone”) in the Adršpach rocky town (Cretaceous Teplice sandstone formation). The multidisciplinary geophysical surveying consisted of three different methods, i.e. electrical resistivity tomography (direct current method), ground penetrating radar (high frequency electromagnetic method) and shallow seismic refraction. The survey was performed within a regular grid around the rock tower root. The results show plausible continuous bedrock in the depth of several metres below the surface and, also, the bedrock upward propagation underneath the rock tower. It seems that this rock tower is probably rooted into the solid bedrock, which can be considered as a grown rock, and thus relatively stable. The original stability model can now be recomputed and adjusted.

# Tree ring-based chronology of hydrogeomorphic processes as a fundament for identification of hydrometeorological triggers in the Hrubý Jeseník Mts (Central Europe)

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**Keywords:** dendrogeomorphology, debris flow, the Hrubý Jeseník Mts.

Trees growing along headwater streams are frequently affected by hydrogeomorphic processes and provide valuable records of debris flow/flood histories in their tree-ring series. Dendrogeomorphic approaches are currently the most accurate methods for creating a chronology of the debris flow/flood events in forested catchments without any field-monitoring or a stream-gauging station. We provide a spatio-temporal reconstruction of hydrogeomorphic events in four catchments of the Hrubý Jeseník Mts, Czech Republic, with an analysis of their triggering factors using meteorological data from four nearby rain gauges. Increment cores from 794 coniferous trees (*Picea abies* [L.] Karst.) allowed the identification of 40 hydrogeomorphic events during the period of 1889–2013. Most of the events can be explained by extreme daily rainfalls ( $\geq 50$  mm) occurring in at least one rain gauge. However, in several cases, there was no record of extreme precipitation at rain gauges during the debris flow/flood event year, suggesting extremely localised rainstorms at the mountain summits. We concluded that the localisation, intensity and duration of rainstorms; antecedent moisture conditions; and amount of available sediments all influenced the initiation, spatial distribution and characteristics of hydrogeomorphic events. The most frequent synoptic situations responsible for the extreme rainfalls (1946–2015) were related to the meridional atmospheric circulation pattern. Our results enhance current knowledge of the occurrences and triggers of debris flows/floods in the Central European mountains in transition between temperate oceanic and continental climatic conditions and may prompt further research of these phenomena in the Eastern Sudetes in general.

## Evolution of the fluvial system at the planation surface of the Šumava Mountains

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**Keywords:** planation surface, fluvial system, the Šumava Mts.

Fluvial landforms and deposits provide an opportunity to describe the interaction between alluvial archives and variables of the fluvial system.

In order to reconstruct the landscape development, we surveyed well-preserved fluvial archives in the basin of the Roklanský Potok stream. We use geochronological, geoarchaeological, geophysical, sedimentological and geomorphological analyses. Study area is situated at lifted relict of the Paleogene planation surface in the Šumava Mountains. In accordance with results, we revealed four evolution stages of the fluvial system development during the Late Pleistocene and the Holocene. The fill level of the higher stream terrace is the remnant of the first evolution stage. Results of the sedimentology indicates that the braided stream filled the wide valley. This aggradation could be linked with the abrupt climate change at the Pleistocene – Holocene transition. Reconstruction of the second phase suggests

intensive incision during the Holocene climatic optimum, caused by high water discharge and efficient soil protection. The overbank sedimentation prevailed on the lower terrace level during the third stage that occurred during the late Subatlantic. We assume allogenic change of the sediment budget caused by colonization of the upper parts of the Šumava Mountains as well as windstorms and bark beetle gradation. Present-day anthropogenic impact, namely channel modification and drainage of the mires, probably intensifies the stream incision during ongoing fourth stage.

This reconstruction of the alluvial infill in the flat, rigid area provides insight into development of the sensitive and dynamic part of the nature since the Last Glacial.

## **Neotectonic regionalisation of the Liptovská kotlina Basin**

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**Keywords:** the Liptovská kotlina Basin, river terraces, morphotectonics, neotectonics, regionalisation.

This paper deals with neotectonic regionalisation of the Liptovská kotlina Basin (LKB), which belongs to the most elevated basins of the Western Carpathians. The previous neotectonic regionalisation of the LKB was carried out in the scale 1 : 500 000 (Maglay et al., 2002). Considering the size of the LKB (ca. 60 x 15 km), more detailed regionalisation could be done. The aim of this paper is to create a more detailed neotectonic division of the LKB. Within the morphotectonic analysis, selected methods were used to reveal the neotectonic structure of the basin, focusing on the neotectonic vertical movement tendencies. The Váh River terraces analysis, thickness of quaternary deposits, SL index and slope gradient were employed to delimitate the neotectonic blocks. Based on the relative heights of the terrace straths and previous fluvial sediments investigations (e.g. Droppa, 1964; Gross et al., 1979), nine terrace levels were identified. Long profile analysis of the straths was carried out to detect neotectonic dislocations within the paleo-fluvial systems. Based on the results of partial analyses, particular neotectonic blocks of the LKB were delineated. Tectonic faults and morpholineaments were used as borders of the blocks. The intensity of the relative block movements was assessed from very large subsidence to very large uplift. Numerical dating of fluvial sediments absents in the LKB, that's why we consider vertical movements of the delimited blocks of the neotectonic stage of georelief development.

# ABSTRACTS – poster session

## 2014 Smutná valley debris flow (Western Tatra Mountains)

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**Keywords:** debris flow, threshold, Western Tatra Mountains

On May 14th, 2014, the Western Tatra Mountains were affected by a significant meteorological situation, bringing extreme rainfalls. The precipitation exceeded 100 millimetres per day. On May 15th, a debris flow occurred on the north-eastern slope of Mt. Plačlivé (2125 m a.s.l.) in Smutná valley. The aim of this study is to evaluate the conditions which preceded the debris flow event, using daily precipitation data measured at the nearby meteorological stations. Particular attention was given to the data measured on the nearest station Zuberec-Zverovka.

Long-term precipitation data from period Dec. 1st 2013 – May 15th 2014 were analysed using precipitation sums and 10-days cumulative precipitations. Total rainfalls, recorded immediately prior to the debris flow event, have been analysed and compared with the threshold values for the debris flow initiation, obtained from similar published case studies. Statistical methods such as  $4\sigma$ , two global and one local event-duration threshold and three local event-precipitation thresholds were used. Geomorphological mapping of the debris flow has been done using a GPS control points for higher precision. Selected characteristics of the debris flow track were measured using a tape measure or a laser range finder. It was found out that the derived precipitation values from the selected models ( $4\sigma$ , global and local event-duration thresholds) were exceeded. On the contrary, local event-precipitation thresholds were not exceeded, probably due to the different lithological and climatic conditions of the Western Tatra Mountains. The analyzed debris flow belongs to more extensive ones in Western Tatra Mountains but the width and depth of the channel corresponds to an average debris flows.

Daily rainfalls preceding the debris flow event fall into the unique ones compared with some of the other published cases in Western Carpathians. These were even higher than daily rainfalls necessary to produce a debris flow in this area determined on the long-time observation.

## **Geomorphic function and residence time of instream wood in steep headwater channels: a case study from the Mazák Basin, Moravskoslezské Beskydy Mts.**

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**Keywords:** instream wood, headwater stream, cross-dating, Western Carpathians.

The effect of instream wood on stream hydraulics and geomorphic processes depends on wood and channel dimensions. We investigate the abundance and geomorphic effects of large and small wood (LW/SW) in four steep tributaries of the Mazák Stream (Moravskoslezské Beskydy Mts., Western Carpathians). The volume and frequency of LW depend on channel confinement (i.e., available space in the valley floor to store instream wood) and adjacent hillslope gradient which enhances lateral supply of wood. The presence of a deciduous tree canopy in two studied tributaries was reflected in higher abundance of SW due to the continuous supply of branches instead of entire dead trees. In these streams, morphological steps – created exclusively by SW – were more frequent than LW steps. Norway spruce

samples indicated more than two times larger mean and maximal residence times as compared to European beech based on the successful cross-dating of 127 logs. Maximum residence time in the headwaters was 128 years for spruces and 59 years for beeches. We also found shorter residence times for hillslope-stabilised pieces when compared to pieces located entirely in the channel (either unattached or stabilised by other wood or bed sediments). Instream wood with geomorphic functions (i.e., formation of steps and jams) did not show any differences in residence time as compared to non-functional wood.

### **Grain size differentiation of present day alluvium in longitudinal profile of Esousas River (SW Cyprus)**

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**Keywords:** grain size, longitudinal profile, Esousas River

For the last three years the researchers from the Jan Kochanowski University in Kielce (Institute of Geography) headed by prof. T. Kalicki carried out the geoarchaeological prospection in south-west part of Cyprus. The exploration included geomorphological prospecting and sedimentological surveys of the Paphos area. Review field observations allowed the researchers to explore the relief and sediments in the valley of Esousas River. During research we used the method, where the size of clasts situated on the measurement lines is determined every fixed number of centimetres, or clasts occurring on the crossing of a net of squares superimposed on the surface of bar or on the walls of the outcrops. Results may be given in percentage, of number or weight of grains. In case of large boulders embedded in the walls of exposures, a planimetric method can be used, described in petrography textbooks. It consists of the measuring of length of sections falling on clasts of definite size and converting them into percentages. The latter are the volume percentages. Methods is very useful and helpful for quantitative characteristic channel deposits of different age. It is possible to distinguished grain size differentiation in longitudinal profile of the rivers caused by local factors as tributaries, type of river section (gap and wide reaches of valleys etc.).

This study was completed within the scope of the Research Project MAESTRO 2014/14/A/HS3/00283 „Agora oraz infrastruktura i aktywność gospodarcza Pafos, stolicy hellenistycznego i rzymskiego Cypru na podstawie badań interdyscyplinarnych" financed by the National Science Centre of Poland.

### **The role of structural steepness in a relation to the valley progress in the Honkŭv potok Brook catchment (The Krkonoše Piedmont, Czech Republic)**

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**Keywords:** morphotectonics, Honkŭv potok, The Krkonoše Piedmont, Czech Republic.

The paper characterizes a relation between the structural elements (bedding planes, shear joints, tension joints) and the slope azimuth of valley axes in the Honkŭv potok Brook catchment E of the town Semily. The area is predominantly built by the Paleozoic phyllites and clastic sediments. The valley axes were evaluated due to the slope azimuth and the slope. All the valley axes were classified into 4 categories ( $<2^\circ$ ,  $2.1-5^\circ$ ,  $5.1-15^\circ$  and  $>15^\circ$ ) by the slope. The rose diagrams of the valley

axes were constructed by the orientation of the slope azimuths. Tectonic elements (bedding planes, shear joints, tension joints) were evaluated by the strike, the dip azimuth and the dip. All the structures were determined into quantitative categories due to the dip ( $<10^\circ$ ,  $10.1\text{--}30^\circ$ ,  $30.1\text{--}60^\circ$ ,  $>60^\circ$ ). The rose diagrams of the structures were specified by the directions of as the dip azimuth as the dip. The valley axes and structural elements were compared by the peaks using the rose diagrams.

The slope azimuths  $<2^\circ$  were in a correspondance to the dip azimuths of the subhorizontal shear joints in  $\sim$ NNE–SSW. The slope azimuths  $2.1\text{--}5^\circ$  is in a relationship to the dip azimuths of gently inclined bedding planes and shear joints in  $\sim$ NW–SE. The slope azimuth  $>15^\circ$  is in a concordance to the dip azimuths of steep shear joints and steep tension joints in  $\sim$ WNW–ESE and NE–SW. The valley progress was mostly predisposed by the dip azimuths of the steep joints.

### **Mass movements on the eastern slopes of Mt Lesista Wielka (Central Sudetes, SW Poland) – diversity and evolution**

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**Keywords:** mass movements, the Kamienne Mountains.

The eastern slopes of Mt Lesista Wielka, a rhyolite tuff plateau in the Kamienne Mountains, Sudetes, bear geomorphic evidence of complex and spatially extensive mass movements. The total area affected by landslides of different sorts occupies at least 60 ha, including one contiguous terrain of 44 ha, which can be divided into five separate units of different morphology and origin. Types of mass movement include deep-seated rotational slides whose frontal parts subsequently transformed into flows travelling down the pre-existing valleys, as well as minor block slides. Lithological contact between rhyolite tuffs and underlying sedimentary formations appears as a crucial factor controlling slope instability. Of particular interest is the edge of the wide summit plateau surface, where multiple evidence of ongoing instability occurs. Minor scarps, subsided blocks and opened cracks follow a NW–SE alignment, suggesting structural control of mass movement phenomena. Specific air circulation is present inside the rock mass, with winter escape of warm air from the cracks producing snow-free areas amidst otherwise thick snow cover. This suggests the existence of a network of open cracks penetrating to a substantial depth. A similar phenomenon is noted on the adjacent ridge of Mt Mała Lesista. Multiple shallow closed depressions on the summit plateau are interpreted as resulting from differential sagging of jointed rhyolite tuff cap into the underlying sedimentary formations.

### **Micromorphological variability of quartz grains from recent glaciofluvial sediments, evidence from High Tauern, Austria**

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**Keywords:** glaciofluvial sediments, exoscopy, quartz grain micromorphology, High Tauern.

Micromorphology of glaciofluvial sediments were only partially shown by Mahaney et al. (2001) and Górská-Zabielska (2015). The main goal of the presented research was to identify microtextural features typical for recent glaciofluvial sediments.

Samples were collected in High Tauern, Austria, in year 2015 and 2016. Five glaciofluvial samples were taken, at a distance about 100 m from each other, from the outwash plain near glacier Odenwinkelkees. Eight glaciofluvial samples were taken from the outcrop in river Salzach valley. Samples were examined under electron microscope. Shape, grain relief and twenty-five microtextures were evaluated on each grain. Two histograms were made to compare the frequencies of microtextures on both localities. Similarity of the samples was tested by one-way ANOVA, tested with F-test.

High number of straight grooves, straight steps, meandering ridges, adhering particles and silica precipitation are typical microtextures of glaciofluvial grains of both localities. Samples from outwash plain were characterized by increasing frequency of arcuate steps, crescent-shaped features and grinding features and decreasing frequency of conchoidal fractures, straight grooves, curved grooves and silica pellicle. When compared the significant microtextures, which differentiate samples from both localities, these are low and high relief, straight steps, fracture faces and parallel striations.

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

## **Response of glacier mass on recent temperature cooling in northeastern Antarctic Peninsula**

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**Keywords:** glacier, temperature, James Ross Island, Antarctic Peninsula.

The Antarctic Peninsula (AP) region has been one of the most rapidly warming parts of our planet since 1950s. However, recent study by Oliva et al. (2016) suggested that warming trend turned to a prominent cooling during 2006–2015 with the largest temperature drop of 0.7–0.9 °C in the northeastern part of the AP. Therefore, we aim to study response of small glaciers on James Ross Island that are considered to be sensitive to temperature fluctuations. Automatic weather stations in the northern part of James Ross Island reflect the recent cold period and indicate a prominent cooling by 1.2°C over the period 2006–2015. A response of glaciers on colder conditions can be observed throughout the area where negative mass changes turned to predominantly positive values after 2009. The total mass of Whisky Glacier has increased by 0.8 m w.e. in 2009/10–2013/14 and the annual mass changes were positive except for 2011 (-0.1 m w.e.). A comparison of annual mass balance changes with the data reported from glaciers on nearby Vega Island indicates similar values of glacier mass changes in northeastern AP.

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## **Rock control and geomorphic features of granite tors – Central Karkonosze Mts.**

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**Keywords:** tor, rock control, Karkonosze Mts.

Tors are very common landforms in the Karkonosze Mountains and are present particularly throughout the granite part of the range. They occur in each section of ridges, from summits to the lower parts of

slope, taking diversified shapes and sizes. On the northeastern slope of the Karkonosze Mountains some tors are clustered in large groups which extend over several hundred meters (e.g. Bażynowe Skały). In this study two tor groups, named as Paciorki and Pielgrzymy, were described. Both are located on mid-slope benches. Morphology of the tor groups demonstrates clear regularity in the internal structure. The groups consist of elongated rock perches of comparatively small width which form rows parallel to each other. The alignment of individual tors follows the major joint set extending in the NE-SW direction (both in the case of Paciorki and Pielgrzymy). The major joint set determines the extent and setting of rock forms and the width of gaps between long perches. The second set of joints is perpendicular to the former and crosses the prolate tors forming their edges. Except major rock forms, the system of joints controls the shape and location of the series of minor forms (clefts, tunnels, karren).

### **Detailed fluvial-geomorphologic mapping of wadeable streams: a proposal of universal map symbology**

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**Keywords:** map symbols, fluvial geomorphology, high-gradient streams, ESRI ArcGIS.

Detailed maps are important components of fluvial-geomorphological research, connecting several tools, namely field mapping of presented channel and floodplain forms and the assessment of fluvial processes and hydromorphological conditions of current river management. In this poster, we present a proposal of universal map legend for the complex mapping of small stream channels in a detailed scale, which means including both the channel and adjacent floodplain segments. With the help of the symbology we are able to demonstrate both fluvial forms (i.e. individual features, grain size of bed sediments and fluvial deposits) and fluvial processes (i.e. contemporary trends in channels, character of lateral sediment inputs, flow characteristics) in a single map. In total, nearly 150 symbols were proposed and created as a combination of TrueType font and ArcGIS Style files. However, the principle can be used in various software. The poster is accompanied by three map examples from the Nížký Jeseník Mts (the Stará Voda Stream) and the Moravskoslezské Beskydy Mts (the Lubina and Bystrý Streams).

### **Braidplain changes during the summer research season 2016 – Muninelva River, Central Svalbard**

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**Keywords:** gravel-bed braided river, sediment sources, Muninelva, Svalbard.

Proglacial braided river systems in the High Arctic are very changeable during summer seasons. Hydrological regime of local streams is connected to a functioning the interaction between glaciers and atmosphere. This study summarize fluvial geomorphological summer research season of 2016 (7.7.2016 –27.7.2016). Our area of interest is located in central part of Svalbard archipelago near the Pyramididen

settlement in Muninelva River catchment. The river is 6 km long and its channel belt is 50–250 m wide (Ondráčková et al., 2016).

During the observation period of Muninelva River fluvial system we recognized many examples of well-developed fluvial forms changes, channel pattern evolution, channel bars downstream change, flood stages, hydrological conditions change, channel course replacement and also the end of the hydrological cycle. The changes of braided river channels are coupled with meteorological conditions, especially with temperature and precipitations. For example, the main channel of Muninelva River completely changed its trajectory at the end of the season. We also monitored activity of sediment supply in the whole river catchment. Muninelva River has two main material sources according to their position in respect to the main stream: I) head source – Muninbreen Glacier and its terminal moraine-mound complexes; II) lateral sources – colluvial and alluvial fans, terminoglacial fan from a lateral glacier and Devonian sedimentary rock bedrock in the channel belt banks.

Through photographs we document the observed changes and bring new and original findings about the functioning of this proglacial river and its catchment. The overview of observed geomorphological changes give us new starting points for subsequent research topics (e.g.; downstream bedload grain-size and shape changes).

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### **Rivers in the early-industrial period: a widening perspective on data sources (case of the Elbe River, N Czechia)**

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**Keywords:** river channel, floodplain, Labe River.

Modifications to fluvial systems justified by provision of drinking water supply, irrigation for agriculture, flood protection measures, river navigation or simply extension of settlement and transportation significantly affect the morphology and hydroecological functions of rivers. Quantifying such changes must rely on availability of multitemporal data about river properties. In this research, we focus on reconstruction of the channel and floodplain properties at the lower Labe/Elbe River in Czechia during the early-industrial period. The studied river segment is characteristic with antecedent valley surrounded by the volcanic range of the České středohoří Mts. and by sandstone canyon of the Děčínská vrchovina Highland. While representing a focal area for geotourism and landscape conservation, the river landscape has been significantly modified since the 19th century and plans for further modifications are subject to lively discussions. The poster presents the first part of our research, which summarizes pursued research perspectives and presents the classification and evaluation of available data sources. In this respect, it offers a widening perspective to the traditional approaches relying on the use of old maps to document planform channel changes.

# **Morphotectonic interpretation of river valley morphology on the example of the western part of the Orlickie Mountains (Middle Sudetes)**

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**Keywords:** valley morphology, morphotectonic, Orlickie Mountains.

New research possibilities related to the advent of digital topography and the development of GIS enhanced the renewal of tectonic geomorphology. Elements of fluvial systems are of special interest in morphotectonic studies that aim at deciphering the relationships between tectonic processes and their morphological expression. The role of these elements as markers of tectonics emerge from their low topographic inertia, that is high sensitivity to even small disturbances arising from tectonic processes. Therefore, stream longitudinal profile analysis, which usually takes advantage of some morphometric parameters such as SL-index, and studies of river valley morphology are often presented in the literature. They are mostly based on river cross section profile analysis supported by the application of some indices, for example valley floor width – valley height ratio. As steep valley slopes can be considered as indicators of enhanced river erosion, for which tectonics is one of possible triggers, we decided to examine deeply incised river sections on the western side of the Orlickie Mountains. The preliminary analysis of the distribution of steep slopes ( $> 15^\circ$ ) revealed that they occur in a belt trending in NW–SE direction, parallel to the main ridge of the range. The aim of this study is twofold. First, it is to characterise deeply incised river reaches in a more objective, quantitative way and to compare them with one another, as well as with the adjacent sections with smaller gradients. Second, it is to determine the influence of lithological diversity and thus, bedrock resistance, on river valley morphology.

## **Geomorphological Aspects of Deep Mining on the Example of the Nížký Jeseník Upland**

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**Keywords:** mining, the Nížký Jeseník Upland.

The Nížký Jeseník Upland is an area known for deep mining and clayey slate processing. In this area, around 100 old and abandoned mines have been preserved until the recent time, which demonstrates quite extensive mining in the past. A frequent problem connected with disused and derelict mines is a lack of information, such as documents, maps or dimensions. These mines may present future geohazards for urban residences and grounds located above them. Thus, it is increasingly important to investigate them. The aim of recent research is to locate the individual mines and describe them from a geomorphic point of view. In the individual mines, it is possible to observe various hazardous phenomena, such as breaking off or gapping of the rock walls, ceiling subsidence and rockfalls. Geodiversity development (various forms of speleorelief, secondary mineralization, karstification) and the evolution of a specific microclimate is accompanied by the occurrence of atypical flora and fauna. The main factors underlying the above-mentioned development are as follows: (i) historical mining techniques, (ii) tectonic forces influence, (iii) weathering, (iv) gravitational processes. It is also important to describe superficial processes and geomorphological forms associated with the development of mines, such as dumps, collapsed pits or stopes etc.

## The age of the slope deposits at the vicinity of Mt. Gromnik (Sudetic Foreland, SW Poland) considering the geoarchaeological studies

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**Keywords:** slope deposits, dating.

Mount Gromnik (393 m als) is the highest point of the Strzelińskie Hills and east part of the Sudetic Foreland. The Hills are built of old Paleozoic metamorphic gneisses and schists and Upper Carboniferous granites. In the Pleistocene the old Tertiary denudational landforms of the Hills was modified by the processes of ice-sheet erosion and accumulation. After the deglaciation of Odranian (oldest stage of Saalian Glaciation) ice-sheet, the summit part of the Strzelińskie Hills was under the influence of weathering and denudational processes determined mostly by periglacial environment. Probably due the strong degradation of glacial deposits, in the highest part of Strzelińskie Hills, bedrock substrate with some rock outcrops (tors) was exposed. After that, during the last glacial cycle, in the periglacial conditions, relatively thin silty-loam cover with admixture of rock debris was deposited on the slopes. Below the rock outcrops and tors the upper part of this slope cover consists of sharp boulders and gruss with silty matrix. At the upper part of the lower layer of slope bed several dozen flint artefacts were found during the archaeological excavations. The artefacts belong to the late Paleolithic. Properly to this circumstance it will be assumed that the upper, coarse layer of bed cover, which overlie the horizon with artefacts, developed as a gelifluction mantle during the Late Glacial period, just before climate amelioration and forestation in the Holocene. The described geoarchaeological site has important significance in the stratigraphic division of the Late Pleistocene slope cover deposits in the highest parts of Sudetic Foreland.

## The Effect of Climate on Morphology and Development of Sorted Circles and Polygons

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**Keywords:** patterned ground, sorting, morphology, environmental proxy, permafrost.

A sample of 290 sorted circles and polygons located at 16 study sites is investigated in the northern Billefjorden area, central Svalbard (79° N). One group of sorted circles and polygons (69 % of the investigated patterns) is located mainly on raised marine and kame terraces at elevations up to 200–250 m asl. A second group (31 %) occurs on adjacent flat mountain tops and ridges above elevations of around 600 m asl. These two distinct elevation zones significantly differ in pattern morphology. The higher-elevated patterns have smaller diameters and shallower sorting depths due to a thinner active layer at higher elevations, suggesting that sorted patterned ground can be indicative of climate conditions and ground thermal state (i.e. permafrost or seasonally frozen ground) when the patterns initiated. The ratios of pattern diameter-to-sorting depth in sorted circles and polygons have a median of 3.57, consistent with previous studies (median of 3.54) and theoretical models of patterned-ground formation involving circulation mechanisms. This allows estimation of the sorting depth based on

patterned-ground surficial morphology, which can be used to reconstruct former active layers and associated temperature conditions. Our findings suggest that large-scale sorted circles and polygons may develop over centennial timescales in this high-Arctic environment, unlike those in lower latitudes. Further, they are likely not in equilibrium with present-day climate conditions and have probably been forming throughout the Holocene.

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### **Neotectonically active faults in the area of Malý Polom Mt. (Moravskoslezské Beskydy Mts.)**

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**Keywords:** fault, Moravskoslezské beskydy Mts.

Availability of new LiDAR data significantly extended possibilities of geomorphic research in Czech Republic. These data can help to find neotectonically active faults in Moravskoslezské Beskydy Mts., where no such faults were found yet. From lineaments detected by analysis of new topographic data, two lineaments in densely forested area of Malý Polom Mt. in the eastern part of Moravskoslezské Beskydy Mts were chosen for further research. The results of research based on ERT profiles and analysis of stream parameters indicate both lineaments are thrust faults but differences in different parts of the northern lineament indicate it was reactivated as gravity fault.