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BOOK OF ABSTRACTS

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Jan Klimeš and Filip Hartvich
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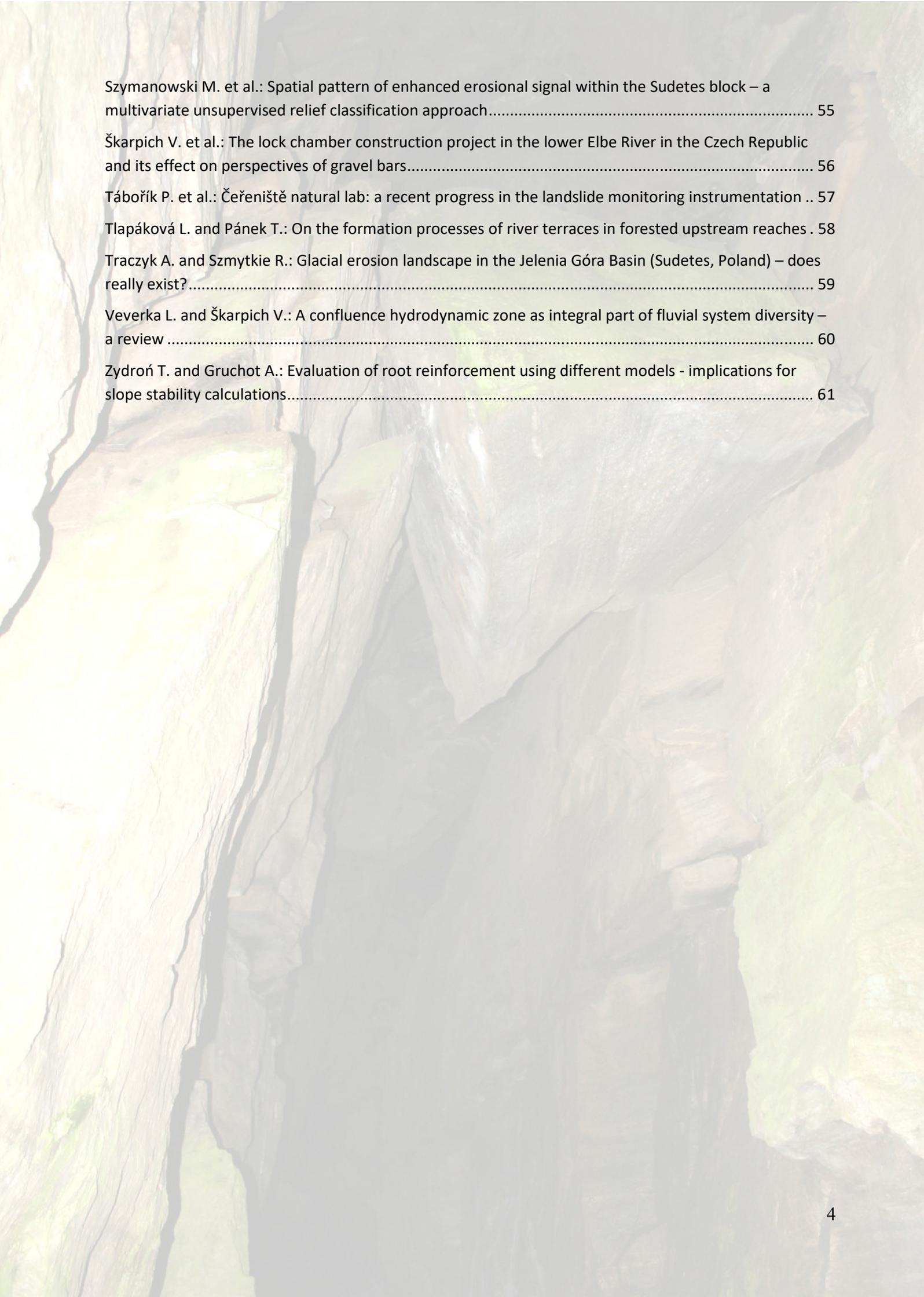
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1. Lecture abstracts

Recent advances in sandstone geomorphology

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Abstract

Vast sandstone outcrops of the Bohemian Cretaceous Basin (BCB) have attracted visitors since the late 18th century and it was that some of the landforms specific for sandstones (e.g., pillars, tafone-like cavities, weathering pits) were reported for the first time. Serious research in classical sandstone areas (BCB, Pfälzerwald, Pays de Fontainebleau, High Weald) commenced in the early 20th century was long restricted to field observation, laboratory analyses (petrology, mineralogy of weathering products) and some experimental work. This resulted in the establishment of a detailed descriptive classification of sandstone landforms, although the genesis of some of them remains not fully understood yet. The last two decades are marked by a notable progress in several directions:

1. wide use of modern analytical tools like scanning electron microscopy/microanalysis, which allow to identify micron-sized weathering-related products, and quantify the role of microorganisms in dissolution/precipitation;
2. the introduction of effective methods of sandstone-surface dating, like optically stimulated luminescence or cosmogenic isotopes;
3. the boom of physical and numerical modelling in the simulation of sandstone landform origin, which lead to solid conclusions when backed by field data on rock moisture distribution, rock resistance, and rock hardness.

Recent advances in sandstone geomorphology have wide implications on the solution of related practical tasks. For instance, conservation of historical monuments should reflect the latest knowledge of the role of hydraulic fields in salt weathering. The assessment of stability of sandstone landforms should consider the recently discovered effect of gravity-induced stress on erosion rates.

Keywords

Sandstone, landforms, geomorphological research, Bohemian Cretaceous Basin

Novel Instrumentation of the Čeřeniřtř Landslide – Differential Monitoring of Stability

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Abstract

Thanks to large investments in the CzechGeo infrastructure, it has been possible to significantly upgrade SlopeNet monitoring network of the IRSM CAS. Intensely studied Čeřeniřtř landslide in the řeskř středochoř has been supplemented with 30 m long multiparametric column. The column called Differential Monitoring of Stability (DMS) consists of 1 m segments connected with flexible joints and is installed into 30 m deep borehole. DMS works as an inclinometer using biaxial sensor, supplemented with piezometer, thermometer, accelerometric sensor and digital compass. The accuracy of measurement is about four times higher than by using classical inclinometric solutions. Together with its control unit it allows continuous data acquisition, data transmission and processing in real time including possibility of early warning. In this contribution the advantages and disadvantages of this system will be discussed together with the peculiarities connected with the borehole preparation. We hope this system will show valuable data about the řeřeniřtř deveopment, especially in wetter years.

Keywords

Landslide monitoring, řeřeniřtř, DMS

How physical fields and feedbacks organizes the shapes of sandstone 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; flowing water and aeolian action etc. 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. 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. Fluorescein dye visualization of capillary zone, vapor zone, and evaporation front upon their contact, demonstrated that the evaporation front reaches the honeycomb backwalls under low water flow rate, while the honeycomb lips remain dry. During occasional excessive water flow events, however, the evaporation front may shift to the lips, while the backwalls become moist as a part of the capillary zone. As the zone of evaporation corresponds to the zone of potential salt weathering, it is the spatial distribution of the capillary and vapor zones which dictates whether honeycombs are created or the rock surface is smoothed. A hierarchical model of factors related to the hydraulic field is introduced to obtain better insights into the process of cavernous weathering.

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.

Acknowledgement

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Keywords

Weathering, physical field, feedback, erosion, landform

Sackung in the Tararua and Remutaka ranges, New Zealand

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Abstract

Sackung is a type of deep seated gravitational slope deformation which affects mountain ridges. It is characterized by typical linear morphostructures like scarps, anticarps, trenches and double ridges (Agliardi et al., 2001). Formation of sackung is very often attributed to deglaciation of valleys and resulting debuttrussing of slopes. However this direct relationship is still arguable since numerous examples of sackung were described with substantial lag time between deglaciation and sackung formation or are located in the totally non-glaciated environments. Thus other factors like geomorphometry, anisotropy of rock mass, tectonic shattering, earthquakes or climate may play crucial role in the evolution of sackung (Agliardi et al., 2009, 2001; Pánek et al., 2015).

Purpose of this contribution is to present preliminary results of mapping, geomorphometric and spatial analysis of sackung in the Tararua (1570 m asl) and Remutaka (940 m asl) ranges. Quaternary glaciation was only limited to small six cirque and valley glaciers in the Tararua range (Adkin, 1911; Brook and Brock, 2005), thus this study area provides great opportunity to investigate other factors which predispose sackung formation. Both ranges are part of the New Zealand's North Island axial ranges. The bedrock is composed of greywacke, the strong sandstones which are sporadically interbedded with mudstones. The area is crossed by numerous faults and is seismically active (Begg and Johnston, 2000). Mean annual precipitations exceed 4000 mm in the Tararua range whereas in the Remutaka range are around 2500 mm. We mapped sackung lineaments in both ranges with usage of high resolution LiDAR derived DEM and aerial photographs. In the area of ~3,000 km² we mapped scarps and anticarps with overall length 307 km. Further spatial and statistical analysis were conducted in the GIS and R to reveal the predisposing factors.

Keywords

Deep seated gravitational slope deformation, sackung, predisposing factors, geomorphometry, inventory mapping, Wellington area, New Zealand

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Human-environment interaction in the Forecarpathians, between Krakow and Bochnia in prehistory - preliminary results

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Abstract

The study area is located in the western part of Sandomierz Basin and adjacent part of the Wieliczka Foothills. The geological basement consisted of folded sediments of the Miocene clays of the Gdów Bay (Gradziński 1955), a considerable part of which was covered with thicker series of the Vistulian loess (Bluszcz, Pietrzak 2001). A upland relief of the area (low foothills) has the Tertiary background. Hills and uplands, separated with valleys of small rivers, formed in the Quaternary, mostly through slope wash, piping, leaching, landslide and creep, deflation and aeolian accumulation (loess), as well as fluvial erosion and accumulation at the bottoms of the valleys (Tyczyńska, Chmielowiec 1988).

The study included geomorphological mapping on the 1:10 000 scale of archaeological site surrounding, as well as geological, sedimentological and pedological analysis of deposits from the archaeological outcrops and trenches on site (*study on site*) and drillings and outcrops from the area near the archaeological's sites (*study off site*). Sediment samples were taken from the boreholes for lithological, geochemical and dating analysis. Grain size analyses were made using Malver's laser method. Sedimentation parameters were calculated using Folk-Ward formula. (Kalicki, Czerniak 2016). The pH measurement was performed using 1 N KCl pH meter Elmetron CX-551, and determination of elements by X-ray fluorescence spectrometry (XRF) mobile spectrometer BAS Delta. TL dating have been made in the Science-Teaching Laboratories Unit of Institute of Geography Jan Kochanowski University in Kielce and radiocarbon dating in Laboratory of Absolute Datings of M. Krąpiec (calibration OxCal v4.2.3) (Kalicki et al. 2016)

This research focuses on phases of colluvial deposition dated to the Subboreal and Subatlantic registered in small river valleys. In this region, with fertile soils developed on loess and with salty springs, rich settlement has been developing since the beginning of the Neolithic period. The investigation has identified small catchments as a unique archive for catastrophic events such as flash floods. The data presented were collected mainly during a large archaeological excavation and geological drillings. The investigation includes four archaeological sites located in various morphological locations, such as slopes near the watershed area (Brzezcie 26), erosional remnants in the lowest section of the river valley (Zakrzowiec 7), loess "peninsula" of upland's relief (Targowisko 10-12), peat bog in the valley bottom (Kraków Bierzanów 15).

On most of these sites, two phases with clustering of catastrophic events, can be distinguished. The first phase, after the early-Lusatian period, which according to the radiocarbon determination of the Kraków-Biezanów 15 site may be roughly dated 1150-750 BC, and the second, during the Little Ice Age. Both alluviation phases were associated with extreme events such as flash floods that transformed slopes (changes of the Pleistocene small fluvio-denudational valleys, creation of a new erosive cuts with alluvial fans) and valley bottoms (sedimentation changes - organic sediments cover with clastic deposits, layers of channel deposits in peats).

This study was supported by National Science Centre (grant: Late Paleolithic settlement dynamics in the western part of North Subcarpathia; UMO-2015/17/N/HS3/00158) and Jan Kochanowski University in Kielce (grant 612065: Human-environment interaction in the Forecarpathians between Krakow and Bochnia from the Neolithic to the Middle Ages, and grant: 612 480,00 Functioning of the geographical environment of the Świętokrzyskie region in conditions of climate change and growing anthropopressure)

Keywords

Geomorphology, North Sobcarpathia, Geoarchaeology, Archaeology, Lesser Poland, small river valley

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Sandstone canyons – is their evolution driven by subsurface processes?

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Abstract

Canyons are fairly widespread in sandstone tablelands and on sandstone cuesta backslopes. Their origin and evolution are usually explained in terms of 'normal' fluvial incision, headward erosion (spring sapping) and mass movements on canyon walls, with the structure guiding erosional processes. Here we present an alternative model how certain canyons may have been initiated and evolved, using examples from the Broumov Highland (northern Czechia). The backslope of a sandstone cuesta of Broumovské stěny is cut by a complex network of canyons. Long sections have thick boulder fills which are difficult to reconcile with simple rock fall and talus development scenario. Boulder caves occur within these fills and their lowermost parts are drained by streams that evacuate fine loose sandy material produced by weathering and mechanical erosion. We suggest that these boulder fills have largely formed *in situ*, through subsurface selective disintegration of rock mass and removal of grains by underground water. Evacuation of fines leaves voids into which overlying blocks subside but the voids may be spacious enough (because the rock blocks are so large) to connect into penetrable caves. Results of an analogous process may be observed along canyon walls where more densely jointed sandstone compartments develop into roofed slots. The roofs in turn may collapse, giving rise to narrow linear troughs. Over time all these processes combine to produce a maze of slots and canyons. Additional evidence for an important role of subsurface processes is provided by closed depressions (sinks) in the inter-canyon areas. It seems that boulder-filled canyon sections have distinct geomorphometric signatures which may be helpful in discriminating between valleys of different origin.

Keywords

Sandstone landforms; canyons; subsurface processes; in situ disintegration; non-karstic caves

Response of channel complexity in mountain streams on the presence of check dams

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Abstract

The application of transversal structures as sequences of check dams represents widely used approach in mountain basins to stabilise stream longitudinal profiles and decrease bedload transport rates. Our talk will demonstrate consequences of check dams on selected dimensions of channel complexity (bed sediment distribution, longitudinal heterogeneity, cross-sectional heterogeneity and large wood distribution) by comparisons of two pairs of check dam managed and untreated streams of similar dimensions draining flysch Carpathians (Moravskoslezské Beskydy Mts.). We focused on the intermediate reaches between two successive check dams, which were not directly affected by erosional (scoured pool) or depositional processes (sedimentary wedge) of individual check dam bodies. We observed a decrease primarily in the heterogeneity of bed sediments in the intermediate reaches of the steep managed channel and degraded complexity metrics of longitudinal and cross-sectional profiles in the unconfined foothill stream managed by check dams when compared with the streams without check dams. The different adjustment of channel complexity to the presence of check dams in the intermediate reaches corresponds to the position of a particular reach on the fluvial continuum. Despite a decrease in sediment heterogeneity in steep reaches managed by check dams, the presence of coarse bed sediments helped to preserve their stepped-bed morphology but with lower steps and shallower pools. In contrast, the longitudinal profile of the treated foothill stream completely lost its vertical bed oscillations because of the complete transformation of original pool-riffles to a uniform plane bed channel. Decreased cross-sectional heterogeneity in the managed foothill stream likely resulted from the artificial straightening of the channel and the occasional presence of bank stabilisations. We did not observe differences in large wood abundance between treated and untreated streams. Both managed and untreated streams had up to an order of magnitude lower large wood volumes than volumes reported from steep headwater streams, which drained the protected second-growth forests ca. 10 km south of the studied reaches.

Keywords

Channel complexity, check dams, mountain stream, Moravskoslezské Beskydy Mts.

Geomorphologist in the service of the police

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Abstract

Using the combination of geomorphologic, photogrammetric and geophysical methods, the volume of two dump pits was reconstructed according to the expert opinion order requirements. Two dump pits were filled with bentonite sludge containing dangerous waste. The investigation of the criminal case required independently established volume of the waste material to assess the amount of losses caused to the owner of the affected property. The IRSM was addressed by the criminal police to assist in the investigation by providing an expert opinion for this case.

In the first step, the data from previous geodetic surveys were combined with the newly constructed high-precision DEM, created using the UAV photogrammetry to obtain current relief as a basis for the volumetric calculations.

Combination of two geophysical methods, electric resistivity tomography (ERT) and ground penetrating radar (GPR) was used to assess the bathymetry of the waste basins. The ERT in particular proved very suitable method, as the clayey bentonite sludge has very low resistivity, while underlying waste building material, as well as bedrock formed by sand and gravel of the river terrace has much higher resistivity. The position of the bottom was observed as a sharp transition between low (below 10 Ωm) and high (above 100 - 250 Ωm) resistivity. Two limit values were established as maximum (25 Ωm) and minimum (15 Ωm) depth of the basin floor. The GPR suffered from high signal attenuation, but still supported the position of the waste basin bottom.

The smaller northern basin reaches dimensions 53 x 17 m and total area is about 773 m². This basin is shallower, averaging about 2 m. The overall shape is simple and homogenous and the difference between assessed max. and min. depth is only about 20 cm. The volume was calculated to approximately 1420 – 1590 m³. Larger southern basin has dimensions of 118 x 35 m, and area approximately 3450 m². The geophysical profiles indicate more complicated internal structure, with 1 – 2 ridges and varying depth (2,5 - 4 m). This slightly increases uncertainty of the volume assessment. The volume was assessed to approximately 11000 – 12800 m³. The total volume of both waste basins was calculated to approximately 13 400 m³.

Keywords

Waste dump, volume calculation, ERT, GPR, UAV photogrammetry

Some aspects of the morphotectonics in the Hořice-Zvičina Ridge area (Czech Republic)

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Abstract

We focused on a few neotectonic features reflected in topography of the Hořice Ridge and the Zvičina Ridge, which separate the Miletín Trough and the Dvůr Králové Trough, situated in the SE Bohemia (Czech Republic). The study area is mostly composed of Late Paleozoic and Late Cretaceous sandstones and claystones, accompanied by Early Miocene neovolcanites and residual fluvial sediments likely of Pliocene to Quaternary age. The extension was firstly rejuvenated due to the neovolcanites in Upper Cretaceous (69 Ma) in the Dvůr Králové Trough (Ulrych et al. 1996). Neotectonic activation of the thrust faults have been signed by the slickensides, striations and mineral growth stages in the zone of the Jílovice Fault and the Zvičina Fault probably in Paleogene. Formation of the anticlines was taken place by a rotation of the layers at the thrusting. Contraction was inverted to the next extension, or transtension respectively, which led to widespread opening of the troughs accompanied by neovolcanic intrusions at about 16.5–17 Ma (V. Rapprich, pers. comm.). Normal faults were determined in Carboniferous, Cretaceous and Miocene rocks and documented by slickensides, striations and conjugate pair fractures. Superimposed subparallel striation and mineral growth stages suggest younger sinistral strike-slip regime probably in the Pliocene. Strike-slip fault was detected in the Zvičina Fault at Dvůr Králové nad Labem and in the neovolcanites at the town Lázně Bělohrad. Neotectonic activity was indicated by a number of the morpholineaments of the echelon arrangement analogous to the fault lines and dykes. The neotectonics was also designated by the changes in drainage system supported by abundant higher occurrences of fluvial sediments (Pliocene/Early Pleistocene, Middle/Early Pleistocene). These relics have been originally deposited in a widespread area presumably by paleo-Elbe River and its tributaries.

Keywords

Morphotectonics, stress, fault, fluvial deposits, Cenozoic, Hořice-Zvičina Ridge area

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Age and structure of Vistula flood plain at Krakow - Stradom archaeological site

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Abstract

Kraków-Stradom site is located in the center of Kraków on Stradom street which connected two independent cities, Kraków and Kazimierz, in the Middle Ages. This is the zone below the edge of the Pleistocene alluvial fan. The fan built alluvial sands and gravels of the Vistula river and its tributary Prądnik river. This fan was originally elevated about 5-10 m above the Vistula flood plain. This protected him against inundation during the floods of the main river and its tributaries. Medieval Kraków was located on it and at the foothill of the limestone horst with the royal castle on the Wawel

Within the site, two areas with distinctly different types of sediments can be distinguished. The first refers to the extensive zone of sandy-gravel channel sediments. In the vertical profile of this area, two different series of sediments can be separated. In the lower part, there is a Late Glacial series, dated OSL, for about 12,000 years. This series is only exposed in the upper part. Therefore, it is difficult to say whether these sandy-gravel sediments were deposited by the meandering or even braided river. Earlier results indicate that in this period there has been a transformation of the Vistula river from the braided river to large meanders (macromeanders) (Kalicki 1991, Kalicki 2006). The river probably flowed meandering riverbed as confirmed by slightly curved undercut the Pleistocene fan of Prądnik river between Grodzka street and Rondo Mogiłskie and the large palaeochannel fill at Rondo Mogiłskie (Mamakowa 1970, Kalicki 1991, Kalicki 2006). Above the Late Glacial series, there are a fully developed series of channel sediments (lag, point-bar deposits). This series was accumulated at the end of Subboreal and beginning of the Subatlantic periods (OSL dating between 2.9 and 2.5 ka years). At that time, the Vistula riverbed was lateral migrated southwards and it was cut off about 2,500 years ago. At the first stage, the oxbow lake was filled with quite homogeneous silty sands with few sandy layers. This indicates stable sedimentation conditions however with contact with the active Vistula riverbed. In the second stage, after the disappearance of river flows, began massive accumulation of sandy silts.

The second area includes the oxbow lake sequences. The Early Atlantic series, both the channel and the oxbow lake, are undercut by the series fill the channel of the "Old / Small" Vistula river. Whether this undercutting was originally anthropogenic is unknown, because it was clearly transformed by natural processes. This could take place during the period of functioning of the "Old Vistula" as the main channel from the 14th to the 17th century. At that time, during the floods, the banks of the river were remodelled, as evidenced by historical records (Bąkowski 1902). The fact that there was not only bank erosion but also bottom erosion is demonstrated by the OSL date of around 5.5 ka years from point bar deposits. Such an old date indicates that into young sediments could be also included an older sediments, probably the Late Glacial, under the Subatlantic series. Subsequent fill of the "Old Vistula" occurred initially in quite stable sedimentary conditions (older fill), then these conditions have changed definitively into a high energy environment (the youngest fill). This was probably related to the gradual shift of the main Vistula riverbed to Zakazimierka (channel to the south from Kazimierz town). Initially, it was possible to gradually narrowing of the "Old Vistula" riverbed by inclined southward silty sands with fining upward sequence accumulated in four phases (older fill of abandoned channel). This could take place in post-maximum phase of the floods when "Old Vistula" was still functioning as the main Vistula riverbed. The youngest fill of abandoned channel should be associated with the period after the 16th century when Zakazimierka became more and more important as the main riverbed. Only waters of large floods to get into, located higher ("suspended" in relation to the main riverbed), the "Old Vistula". These waters accumulated much coarser, sandy-gravel deposits. The riverbed was filled in 4 stages. The last one with thick sediments can probably be associated with the flood of 1813. It caused almost complete "silting" of the "Old Vistula", which is visible on old maps in the form of a small stream imitating the course of the former riverbed. "Old Vistula" is finally filled up at the end of the 19th century and Planty Dietlowskie were created in its place.

The study confirmed the position suggested by Bąkowski (Bąkowski 1902), that the „Old Vistula" has been excavated, taking into account previous morphology. It was probably a lowering of the Early Atlantic abandoned channel.

Keywords

Geomorphology, Vistula river, Geoarchaeology, Archaeology, Krakow

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Krasna riverbed changes (Holy Cross Mts. region) based on cartographic and geological data

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Abstract

The aim of the study was identify the riverbed changes of the Krasna river in its whole length during cost centuries based on archival cartographic materials (Kalicki, Fularczyk 2018). Additionally in the estuary section, about 2 km long, which was noticed the largest riverbed changes visible on the maps, verified cartographic changes are done geomorphological and geological mapping of the Quaternary sediments. Krasna River is located in the northern part of the Świętokrzyskie voivodship in the Polish Uplands area. It was located in the Old Polish Industrial District. The Krasna River is left tributary of the Czarna Konecka, with a 28 km length. The basin area have about 121 km². Krasna was one of the most industrialized rivers of Old Polish Industrial District in 19th c., the waters of the lower section of Krasna were driven the forges and water mills. The activity of of the forges and water mills contributed to changes in the course of the Krasna riverbed, visible on cartographic materials as well as in sediments. In the early 30th year in 20th c., old forges were transformed into water mills. In later years, the mill buildings were transformed into sawmills existing until the middle of the 20th c. On the flood plain, remnants of the iron metallurgy have survived in such forms as shafts and channels as well as in sediments as slags or bricks. With the fall of industrial activity, the renaturalization processes was started in the Krasna River valley and the river bed itself. This led to the restoration of a natural environment before human changes impactand river come back to its natural course.

Keywords

Geomorphology, cartography, Krasna, Old Polish Industrial District, channel changes

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Present day delta in Suchedniów reservoir - sediment and structures

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Abstract

Suchedniów reservoir is a small artificial lake in small town 25 km northward from Kielce. This is located within the Polish uplands on the Suchedniów Plateau (342.31) (Kondracki 2002). Due to cartographic data the reservoir has been changed during the last centuries. Present day size of the reservoir is 23 ha. In 2017 the reservoir was drained out which was connected with conservation works. The studied delta is located in the southern part of the reservoir, near the mouth of the Kamionka River. The thickness of delta deposits is maximum 150 cm. It is 120 m long and has 44a (in 2015). The delta slopes northward. In the longitudinal section, several stages of the delta accumulation can be distinguished. These structures are related to flood events. Coarser material was deposited at the beginning of a flood and the finer material during the end of each event. This sequence was repeated several times. Several erosional channels, filled with coarse material, occur in delta sediments. The study results show that the form created in the Suchedniów reservoir is the fan delta.

Keywords

Geomorphology, inland delta, sediments

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Permafrost in Svalbard and its geophysical imaging

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Abstract

Despite many years of research on permafrost in Svalbard, this issue remains open. It has not been established explicitly what is the thickness of permafrost in the coastal zone. Until recently, there was no information either as to how its bottom is developed due to contact with sea water, and some modern studies of permafrost groundwaters repeat simplified schemes proposed decades ago. Global warming and longer residence times of liquid water on ground surface also affect changes in permafrost active layer formation. In this situation, older data on the depth of summer thawing become obsolete.

An obstacle to provide full diagnosis of the permafrost in Svalbard was limited data, based on single boreholes, which were located far from seashore, without any spatial information. However, the extent of permafrost can be understood by using 2D or 3D geophysical imaging. Techniques that measure electrical conductivity or resistivity of ground are best suited for this purpose because they clearly show frozen rock bodies. Lowering the temperature of the rock below 0 °C leads to a drastic reduction in electric conductivity.

This paper presents results of permafrost studies on the Wedel Jarlsberg Land in Spitsbergen. The research carried out in 2012–2018 covered sites of the Greenland Sea coast, interior of a deglaciated mountain valley, as well as landforms on the Werenskiöld glacier forefield: end moraines and sandurs. Electrical resistivity tomography and electromagnetic measurements were used. Information on thermal changes of the shallow sub-surface was provided by a network of 20 thermistors installed in the experimental drainage basin of the Brattegg River.

The results obtained concern fundamental aspects of the state of permafrost in Svalbard. (i) The presence of permafrost in the coastal zone is shown, indicating strong influence of sea thermics and salinity extending inland. The permafrost has a thickness of several to 40–50 meters in this zone, it can also be discontinuous, its floor hinges towards the sea surface. The geophysical imaging carried out with time-lapse shows that changes in permafrost annual cycle concern not only its active layer near the surface, but also a permafrost floor, regulated by the influence of sea water temperature / salinity. Therefore, the existence of the second, bottom active layer of permafrost has been proposed. (ii) Geophysical measurements in the paraglacial zone allowed one to create a scheme showing the impact of water on permafrost, subjected to thermal effects of rainfall and snowmelt waters, river and lake waters as well as sea water. The non-uniform structure of the permafrost on young morphological surfaces (sandurs) has been illustrated with help of geophysics. In addition, deep thermal influence in taliks and effects of suffosion and mass movements on moraines have been proved. (iii) Measurements of ground thermics conducted in the monitored basin have proven that structural and textural properties of the ground are strongly responsible for the thickness of active layer. Its regular variability occurs under patterned grounds. Among the topographic factors, the active layer thickness in the High Arctic is determined mainly by altitude and not, for example, slope or aspect.

The most important achievements obtained by geophysical imaging include the discovery of the bottom active layer of permafrost in the coastal zone, dependent on the impact of seawater and wide imaging of the permafrost structure subjected to strong liquid water impact.

Acknowledgement

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Keywords

Permafrost, active layer, geophysics, Svalbard, High Arctic

Community participation in landslide risk reduction project, Cordillera Negra, Peru

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Abstract

We present intertwined history of scientific research and landslide disaster risk reduction (DRR) effort at small, peasant community in the Peruvian Andes (Cordillera Negra, Rampac Grande), which was struck by catastrophic landslide in 2009. It claimed fatalities and challenged the local knowledge about landslide hazard and its mitigation practices. We present research and collaboration history of the scientific team formed by foreign and Peruvian experts with the local community which started after the 2009 landslide and culminated during 2016 – 2017 DRR project funded largely by the Czech Embassy in Peru. The history illustrates the shift of the community attitude from refusing an outside intervention to an acceptance and active community participation on of the application of the proposed measures and their maintenance. This was achieved by enhanced communication with the local community and appropriate use of participative methods. These included signing of formal contract by the community to participate on the project, use of proper language (largely Quechua) to communicate with the community members and permanent communication with the community about project developments and outcomes. Results of the effort show the crucial role that participation of the community representatives plays during formulation of the expected outcomes of the DRR. The landslide risk was mitigated by hazard map and landslide movement monitoring at selected sites as well as by information signs placed at the most hazardous areas. These measures enhanced community development as was evidenced by the water tank constructions during the year after the project was terminated. Used methods for landslide hazard assessment (geomorphological mapping, InSAR movement detection, field monitoring) illustrate improved understanding of the landslide processes when combining up-to-date technical methods with local knowledge. The short-term success in the landslide DRR does not automatically implies sustainability of the gained results, thus the long-term exit strategy still needs to be defined and implemented.

Keywords

Community-based risk reduction, risk perceptions, hazard zoning, local knowledge, Peru

New insights into the glacial geomorphology of the Šumava / Bayerischer Wald mountains

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Abstract

During the Quaternary glacial periods, the highest portions of the Bohemian Massif were subject to mountain glaciation. In the Šumava / Bayerischer Wald mountains, the most distinct trace of the past glaciation is preserved in the form of glacial cirques, 17 of which have been described. In addition to the cirques, valleys on the south-western slope of the range host several distinct generations of moraines. Based on this evidence, early studies considered several phases of glaciation of different type and spatial extent, with the most extensive one forming an ice-field of considerable size, with an equilibrium line altitude (ELA) at about 1000 m above sea level. More recent studies have focused on reconstructing glaciation from the well-preserved landform assemblages in the cirques but even these studies yielded ELAs similar or lower than large tracts of high terrain along the main drainage divide. This motivates our mapping study in which we survey the glacial geomorphology for the whole mountain range, working from remotely sensed-data. Using high-resolution LIDAR digital elevation models, we identify over 300 erosional and 40 accumulation landforms of glacial origin. Our mapping results have a varied level of uncertainty; while some of the newly identified landforms are clearly of glacial origin, others are more speculative. Our study provides a uniform map of glacial geomorphology for the whole mountain range, with an up-to-date overview of the previously investigated sites and newly identified glacial features in areas that have not previously been surveyed. The results of our mapping study can be further tested by field surveys and will serve as a basis for future reconstructions of palaeoglaciation in the Šumava / Bayerischer Wald mountains.

Keywords

Mountain glaciation, LIDAR DEM, Šumava, Bayerischer Wald

Geomorphological evidences of Late Quaternary mountain permafrost in the Hrubý Jeseník Mts.

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Abstract

During the cold stages of the Pleistocene, periglacial processes dominated the development of the Hrubý Jeseník Mts. Specific periglacial landforms including large-scale sorted polygons, blockfields or cryoplanation terraces are the evidence of permafrost occurrence during the Pleistocene. Based on our ¹⁰Be dating of permafrost-related periglacial features, we can confirm the occurrence of permafrost in high-elevated area of the mountain range during cold phases of the last glacial period. Permafrost in the Hrubý Jeseník Mts. began to decrease its extent at the turn of the Pleistocene / Holocene, when the ground temperature increased above 0 °C, and probably completely melted in the middle Holocene. This coincides with the time when the mean annual air temperature (MAAT) was higher than today. At present, the confirmed activity of earth hummocks, non-sorted stripes, sorted circles, solifluction lobes and ploughing blocks in the summit parts of the Hrubý Jeseník Mts. cannot prove the existence of permafrost because these landforms do not need permafrost for their own activity. In addition, the current MAAT and mean annual ground temperature in the highest parts of the Hrubý Jeseník Mts. does not fall below 0 °C. Potential permafrost site must be thermally insulated from the surrounding environment and must accumulate cold air. Theoretically, caves and blockfields could have such qualities. However, the blockfields in the Hrubý Jeseník Mts. do not have the necessary parameters (thickness, temperature conditions, structure, positional properties) and their geophysical characteristics indicate the presence of quartzites and quartz veins, not permafrost.

Acknowledgement

This research was supported by the Czech Science Foundation (grant number 17-21612S).

Keywords

Mountain permafrost, patterned ground, blockfield, Hrubý Jeseník, High Sudetes

Key Issues in 3D Rockfall Modeling, Natural Hazard and Risk Assessment for Rockfall Protection in Hřensko (Czechia)

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Abstract

Rockfalls are widespread phenomenon and can threaten life and property. Rockfalls are important natural hazards predominant in mountainous areas, but the need for urban development in these areas together with climate change increasing the number of rockfall researches. Determining rockfall processes and related hazard is a difficult task because of the complexity and intrinsic stochastic nature of the physics involved. The appropriate application of rockfall modeling tools requires a quantification of 3D rockfall trajectories, as well as careful assessment of rockfall sources, block and slope characteristics, and model calibration data. The rockfall modeling issues and applications have been tested in local study areas in Hřensko with using Hy-STONE 3D simulator, which currently brings good modeling results. The Hřensko area is typical by the sandstone landscape with rock plateaus, deep canyons with several levels of steeply cliffs, which forms favourable conditions for rockfalls. The rockfall simulations account slope morphology and roughness, energy dissipation at impact or by rolling, effects of vegetation, and block fragmentation. The different modeling approaches, calibration problems, dependency of model results to these parameters, and propose appropriate countermeasures are discussed. The aim of this presentation is to provide a knowledge base for researchers and practitioners involved in projects dealing with the rockfall protection of infrastructures.

Keywords

Rockfall, 3D modeling, Hazard, Risk, Hy-STONE, Hřensko

Landscape pattern and runoff in agricultural hilly regions: mapping and monitoring

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Abstract

Landscape pattern and land use are both influential in the retention of runoff and prevention of erosion damage. Compared to engineering solutions (e.g. dams) the exploitation of opportunities offered by the traditional landscape pattern are less expensive and more environment friendly. Increasing the water storage capacity of soils and water retention by minor landscape elements (terraces, berms, ditches, hedgerows etc.) also promote runoff reduction. Retention ponds offer an useful alternative for the reduction of flood peaks along streams, particularly if the retention pond can be drained quickly and release of water back into the river can be accomplished gradually. However, the retention flood pond operation in some river basins is hindered by the lack of integrated water management. The mapping of traditional landscape elements in the hilly regions of Southern Transdanubia (Hungary) and the monitoring of soil moisture conditions in their environs are instrumental in the design of optimal water retention and prevention of excessive runoff. The findings of research can be utilized in the planning of the restoration of traditional landscape pattern and farming practices.

Acknowledgement

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Keywords

Agricultural land, runoff, water retention, landscape pattern, mapping, monitoring, Hungary

Structure and textural features and the origin of sediments in the bottom of the Nida valley near Wiślica - new results

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Abstract

Nida is the largest river in the Świętokrzyskie Voivodeship, the left tributary of the upper Vistula.

The Nida Basin with Nida river and its tributaries have repeatedly become the subject of research. The evolution of the entire Nida valley has not been fully studied so far. The Holocene evolution of the Central European valleys was described by Kalicki (2006), and Krupa (2013) examined it in the Czarna Nida. Flis (1954), Nowak (1986) and Bąbel (2006, 2007) conducted detailed research on the karst phenomena of the Nida Basin.

Wiślica is located in southern part of Nida Basin (Polish Uplands) in the Nida river valley. This area belongs to Wiślica Funnel, depression located between two elevations: Wodzisław Hummock and Pińczów Hummock (Gilewska 1972). It is a tectonic Solec trough, where the Cretaceous marls are covered with the Miocene (Tortonian) clays. A number of geological and geomorphologic data indicates the existence young subsidence movements in the area of Wiślica Funnel (Gilewska 1972).

In relief, the most important is the role of gypsum folded in anticline and syncline with NW-SE direction. Karst phenomena developed on gypsum. On the anticline lines were formed inversion karst basins occupied by swamps and bogs lying directly on the Cretaceous marls.

The area near Wislica became the subject of research due to the interesting forms appearing there, which are located on one morphological level. These are:

- karst domes - they form small islands, rising directly above the peat bottom of the Nida valley. Gypsum domes have different dimensions - from 1 m to over 12 m in diameter and an average relative height of 60 cm. They are formed by a bent layer or layer of coarse crystal (selenite) (Małęga 2018 as Bąbel 2006).
- flat valley bottom has a width of 1-3 km. It is wide and swampy on left-side and narrow on right-side. On the floodplain led cross-section running from karst depression to the river.
- karst depression – near Gorystawice (N of Wiślica) has radius about 300 m and “gap section” (about 400 m wide) south-westward connected it with the Nida river flood plain. On its surface it was conducted two independent geological-malacological studies. The first of them was made by Żurek in 2013. The cross section had a north-south direction. The age of tanatocenose was the early Holocene and peat sample from the bottom (borehole Żd-I) was determined by radiocarbon dating as 3,740±70 BP. Hence its age corresponds to the Subboreal. The second W-E cross-section was made in 2018 (by Małęga at all.). Calcareous silts with malacofauna occur in the bottom. Malacological tanatocenose (borehole G 10) with *Gyraulus laevis* (Alder) and *Bithynia tentaculata* (Linnaeus) indicate the Eoholocene age of these sediments. These deposits are covered with peaty silts (near the valley slope) and peats (far from the slope) in all boreholes. Thickness of organic sediments increase toward to central part of depression and axis of Nida river valley. The bottom of this strata (borehole G 6) was radiocarbon dated at 4280±50 BP cal. 3027-2857 BC. This may indicate the presence of episodic lake or pond with stagnant water here. Since the Subboreal until now peat bog and swamp occur with small ponds („water windows”). Any traces of river flow have been found within the depression (Kalicki, Małęga 2016, Kalicki et al. 2018).

The latest research (23 boreholes) included a combination of depression and flood plains. Their results allowed to establish the border between the flood plain and karst depression. Directly along the karst depression is a low, and the sediment sequence filling them may indicate a palaeomeander/palaeochannel,

cutting the karst cavity. The EF cross-section indicates the sloping or anastomosing system of the Nida channel (Małęga 2018).

Keywords

Karst depression, malacofauna, Nida, river valley.



Assessment of rill erosion on agricultural land with new GIS tool - case study Opřetice

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Abstract

Disruption of land surface by water leads to the concentration of runoff into lines and the formation of erosion rills. The sizes of rills are variable. First, shallow rills are formed, then they become deeper. The rills are about 30 cm wide or deep (Petlušová et al., 2016), larger forms we consider as gullies. Real erosion rate and the volume of eroded material can be determined by direct measurements, such as erosion pins, which is time consuming. Currently, remote sensing is used to identify erosion processes and to evaluate the real volume of eroded material.

Calculation of erosion rate by new GIS tool untitled „*Calculate rill volume*“ (Báčová et al., 2018) belong to noncontact methods. This approach used UAV outputs and then the DEM can be created. *Calculate rill volume* is automatic computation tool for determination of volume of the eroded material. The advantage of this tool is that it is not necessary to know the land surface before the erosion event. The original DEM is calculated using vertexes determined during digitization of erosion rills' polygons. Two basic inputs are DEM and polygons of erosion rills (created in ArcGIS). The tool is applied on agricultural land with the area 3.31 ha in the village Bystřice, part Opřetice. The casual rainfall event occurred on 11th August 2017 with total amount of 48 mm/day. It was a single rainfall event of this intensity during that year. According to the results of USLE, RUSLE, USPED model, the study area is strongly threatened by water erosion ($6 \text{ t} \cdot \text{ha}^{-1} \cdot \text{rok}^{-1}$). The digitization of erosion rills polygons cannot be automatic with sufficient accuracy yet, it is necessary to create it manually. The aims of this study are i) to verify the way of placing erosion rill polygons' edges, ii) to examine the method of representative squares (Kadlecová et al., 2018), iii) to evaluate and to compare the results of this method with completely digitized study area, iv) to propose further utilization of this tool. The tool is suitable for evaluation of real erosion rate (Báčová, 2018). Our study proved that the method of representative squares underestimate the real volume of eroded material. The digitization of entire study area is time consuming and the selection of representative square is subjective. Crucial for further work using this tool will be to objectify the selection of representative squares based on image analysis.

Keywords

Rill erosion, real erosion rate, Calculate rill volume, UAV, GIS tool

Acknowledgement

This study was supported by the Specific Research project at Masaryk University (MUNI/A/1576/2018, Integrated research of environmental changes in the landscape sphere III). The authors thank the agency for their research support.

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Geomorphological and geophysical investigations of granite tors in the Polish part of the Karkonosze Mts

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Abstract

Granite tors of the Karkonosze Mountains have been the subject of geomorphic research for a long time. The origin and evolution of the Karkonosze tors were generally explained by the two-stage model proposed by David Linton, but these views from the 1960s and 1970s were not based on systematic and comprehensive research and therefore have mostly a conceptual character. The main objective of this study was to analyse structural features, surface morphology of granite tors and subsurface structure in the vicinity of tors to verify the previous hypothesis about chemical weathering and stripping. The research is based on several field work methods – geomorphic mapping, rock strength assessment, joints measurements and Electrical Resistivity Tomography. Study sites involved singular forms and groups of tors, situated in slope and watershed settings at the altitude from 1000 to 1300 m a.s.l. The results allowed us to recognize strength differences between rock landforms which are located at different elevations and the occurrence of massive granite compartments beneath the tors.

Keywords

Tors, rock control, ERT, Karkonosze Mts, Sudetes

Neotectonic activity of Železné hory Mts. fault – initiation of research

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Abstract

The Železné hory fault is located in the middle of the Czech Republic and at the east of Bohemian Massif bordering geological units of moldanubian and bohemicum zones. Its NW-SE course is very well-marked within the landscape, as the fault slope is forming a sharp edge on the southeast of the Železné hory Mts. geomorphological unit. Along this thrust fault a crystalline basement of Železné hory is thrust over Cretaceous sediments of Dlouhá mez to the southwest direction with a dip from 55 to 65° forming a steep, up to 160 metres high slope. Overthrust with a dip from 40° to 50° is also confirmed at the south-eastern end of the fault. Its formation is dated to the Late Palaeozoic. The following Variscan orogeny consolidated the entire Bohemian Massif in a single unit and no activity of the fault is known. In the Cretaceous during Cenoman Transgression and following Turonian entire unit of Železné hory submerged and became a seabed. Major activity of the fault was executed in the Cenozoic during the Saxonian tectogenesis, when the southwestern edge of Železné hory Mts. has been uplifted. This event exposed the Cretaceous cover of Železné hory to accelerated erosion effects, left just a few remains of former sea sediments. Crystalline bedrock has been exposed and shows signs of tropic weathering and originally west-flowing rivers changed their course to the northeast. Most important Quaternary products are gravel-sand river terraces of Labe, Doubrava and Klejnárka rivers, believed to be displaced by the neotectonic movements. Loess is located solely on the north border of Železné hory, despite leaside base of the fault slope. At the north part of the slope aeolian sands are also located.

The northwest end of the fault line is located at the south of Býchory village. All the way to the southeast to the town of Týnec nad Labem (~6 km) its course is covered by the late Cretaceous sediments, thus the fault slope is emerging from epigenetic valley of Labe river at Týnec and Labem. From here, composed of several sections with slightly diverse azimuth, the fault is heading approximately 60 km to the southeast, approaching the town of Vojnův Městec. It could be longitudinally divided into three sections: first one, ~18 km long section on the northwest with northwest-southeast orientation is characteristic by indistinctive crosswise profiles and numerous short and shallow valleys, low slope angle values (generally to 15°, sporadically to 20°) and low altitudes (from 201 m at the bank of Labe river to ~330 m.a.s.l.); second one, the most noticeable south-southwest oriented, ~20 km long section of higher altitudes (up to 566 m) and steep slopes (around 25°) is cut by deep but fewer river valleys; and third one, 22 km long section at southeast end with southeast course, with deeper river valleys at the first half (NW) and flatter terrain at the second (SE) half of the length. The fault line is cut by many perpendicular short faults (NE-SW) followed by local stream flows, whose offsets also suggests local strike-slips. Also, some barely touched facets indicate the fault course.

In next three years this PhD thesis will focus on the tectonic fault at Železné hory Mts. in Bohemian Massif, which is now considered to be inactive, also due to lack of registered seismic activity far back to 16th century. We should extend the knowledge about the fault past activity and present state and begin its monitoring for further observations, as no examinations of the fault are held in present time. Use of paleoseismic trenching and geophysical explorations is scheduled, in combination with borehole surveys, digital mapping and field survey.

Keywords

Železné hory, fault, neotectonics, geomorphology

Geomorphometry-based recognition of erosionally dissected areas in the Orlickie-Bystrzyckie Mountains Block – lithological versus tectonic controls

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Abstract

There is a plethora of morphometric indices applied in morphotectonic studies in order to assess the relative intensity of uplift. The great majority of them refers to specific elements of a geomorphic system such as mountain fronts (e.g. sinuosity index), river valleys (e.g. valley floor width – valley height ratio), stream longitudinal profiles (e.g. SL index, steepness index), etc. In this way, some discrete information is obtained, which can be subsequently interpolated to wider areas to present spatially continuous picture of tectonic activity.

Basing on the fact that uplift drives erosion we aimed at identification of highly dissected terrains in the Orlickie-Bystrzyckie Mountains Block via morphometric approach and the use of spatially continuous dataset. In order to distinguish areas subject to more intensive erosion we applied a series of morphometric parameters, both primary and secondary, derived from LiDAR-based DEM of high spatial resolution. The areas of similar morphometric properties were then identified through cluster analysis. At the interpretation stage, special attention was paid to areas characterised by the highest degree of erosional dissection as these may possibly indicate more intensive uplift. However, uplift is one but a few controls of erosional dissection, where rock erodibility is another one. Therefore, the influence of diversified lithology on a degree of erosional dissection was also addressed.

Acknowledgement

This contribution is part of the research project no. 2015/19/N/ST10/01530, supported by National Science Centre.

Keywords

Erosion; morphotectonics; geomorphometry

Geomorphological aspects of deep mining on example of Nížký Jeseník Upland

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Abstract

Abandoned mines (AM) are usually perceived as risk/hazard for built-up areas. In some cases they are considered as dangerous for health of people or animals and they are able to change aesthetics of original landscape. Many problems are connected with the abandoned mines such as lack of information about their location, dimensions, and conditions. In this study, we investigated 161 AM and their connected forms from the geomorphologic point of view, in the aim to capture contemporal state, ongoing processes, vulnerability, and their future. We documented morphometric characteristics and the information about geomorphic processes, forms and geologic phenomena. The data were obtained in the field or from the maps. The study area is situated in the Nížký Jeseník Upland, which is composed primarily of Paleozoic sedimentary flysch rocks: greywackes and clayey slates. AM are situated in the vertically inclined rock layers on average direction SSW and dip of layers 87°. We checked 137 AM, sinkholes on the ground (Břidličná 4), inaccessible shafts (Velká Střelná), mines that represent recourses of drinking water (Levinstollen adit) and one mine which is still in operation (Radim). The area is well-known for historical mining of slate and metals (Ag-Pb mineralization).

We corrected existing maps of mines or made completely new maps. All the mines are divided to 3 main groups according to the mined material: the slate mines (79 %), ore mines (11 %) and mines with greywacke, volcanic and sandstone resources (10%). Then, AM were divided by length to the 3 groups: small mines with length to 100 m (74 %), medium mines with length from 100 to 500 m (19 %) and big mines more than 500 m (7 %). The smallest mine has only 2 m in length and the biggest (Důl Lhotka) reaches 3 366 m. For each documented abandoned mine, we evaluated the number of entrances and levels. We created numerical index (0-2) by using qualified estimation, which defined the vertical and horizontal diversity in the mines. The index 0 was for simple mines with one direction of adit, without branching, without the chimneys or larger rooms. On the other hand, more complicated systems such as Nittman's mine with 3 entrances and 4 levels were identified. This mine has a floor plan with multiple branches, many chimneys, adits and 2 shafts. Similar indexes were also used for evidence of the fillings in the mines. Mines without fillings have index 0 and mines with the frequent presence have index 1 or 2. Big mines have commonly index 1 in this category. We find out that the size of the mine is inversely proportional to amount of the fillings. Similar numeric index was also used for evidence of the processes such as collapsing. We also evaluated the presence and amount of collapsing roofs, walls, chimneys, chambers or fillings in the mine. Stable mines have index 0 (65 %), partly collapsed mines have index number 1 (29 %) and mines which are collapsed have index 2 (6 %). The results suggest that the large mines does not have tendency to collapsing in comparison to small and medium mines. Index of collapsing obtain processes as subsidence, creep, exfoliation, rock cracking by frost weathering and chemical weathering. Analogical index was also used for evidence of presence of water stream (9 %) and water pool in the mines (35 %), amount of artificial objects (9 %), presence of waste (2 %), occurrence of secondary formed crystals (17 %) and karstic features (11 %). During fieldwork we also documented rare physical processes such as gravitational or fluvial transport. We also documented atypical geomorphic forms for such environment such as debris or alluvial cones. In the mines, there were documented geologic phenomena. We also documented faults, cleavage, tectonic mirrors, folds, sole markings and metamorphism of slate in the mines.

The effect of the morphology of floodplain forms on the heavy metal accumulation

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Abstract

In Hungary, as it is located in the middle of the Carpathian Basin, floodplains play an important role. These relatively flat, but spatially complex lands represent significant value from landscape, ecological, conservation points of view. They are biodiversity hotspots, natural buffers, flood protection and retention areas, and so on. In our work we focus on the morphology of the floodplain from the aspect of their influences on the metal accumulation. Topsoil samples were taken from swales and point bars from the floodplain of the Tisza River, North-East Hungary. Basic soil properties and concentrations of six heavy metals (Cr, Ni, Cu, Zn, Cd, Pb) were determined. Our results have shown that the morphology of the floodplain has a huge effect on the distribution of the heavy metals. These were significantly different between the samples of swales and point bars. During utilization attention to be paid for this issue.

Keywords

Geomorphology, fluvial environment, swale, point bar

Chronology, triggers and nature of flash floods in the island of Crete

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Abstract

Flash floods belong to the most frequent natural hazards, especially in the Mediterranean region which is currently considered as one of the climate change hot spots. Despite increasing knowledge of nature and triggers of recent flash floods in the urbanised areas of Eastern Mediterranean, a little is known about past occurrences of hydrogeomorphic processes in ungauged forested catchments. Using dendrogeomorphic approaches we compiled chronologies of flash flood events in eight catchments around the Lefka Ori Mts. (western Crete, Greece). Moreover, using the local scale analyses (daily precipitation data from rain gauges) and synoptic scale analyses (based on ERA5 reanalyses) we described basic hydrometeorological triggers of selected events. In addition, combination of 1D hydraulic modelling and palaeostage indicators (scars on tree stems) was used to identify maximum flow discharge and flow velocity of the 2000 flash flood event in two reaches.

In total, 80 flash flood events were identified in 43 different years during the period 1900–2018. The highest number of flash flood records came from 1993/94, 2000/01, and 2006/07. Due to different vegetation structure and habitus, more recent events were recorded at the northern side while substantially longer history of flash floods with recurrence interval of 6–15 years was identified at the southern side of the mountains. Flash floods in Crete are commonly triggered during strong autumn and winter cyclogenesis over the Mediterranean Sea passing the island mainly from W, SW, and NW. Maximum daily triggering precipitation reached 270 mm in case of the December 2000 event and 223.5 mm in case of the November 2006 event. The December 2000 event caused considerable damages especially at the southern side of the mountains. The results of hydraulic modelling show that possible mean discharges during this event reached $22 \text{ m}^3\text{s}^{-1}$ and flow velocity ranged from 8 to 16 ms^{-1} in the bedrock reaches of the Ilingas gorge.

Keywords

Flash floods, dendrogeomorphology, climate trigger, Eastern Mediterranean, Crete

State of knowledge about past thermal-contraction-cracking features in the Czech Republic

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Abstract

Relics of thermal-contraction-cracking features, such as ice or sand wedges, have attracted the attention of researchers in the present territory of the Czech Republic as early as at the turn of 19th and 20th centuries, but they have not been interpreted correctly until the 1940s. Numerous reports of wedge-like structures have appeared since then, but unfortunately, most of them were case studies or regional-scale mappings, and the last nationwide inventory dates back to 1960. The vast majority of the investigations was, moreover, published in Czech-written journals, and has therefore been hidden to the international readership. Furthermore, their numerical ages have not been obtained yet and the chronology has so far relied on stratigraphic principles.

We gathered available literature sources and performed field campaigns in order to summarize as many ice- and sand-wedge occurrences as possible. Simultaneously, we mapped cropmarks of thermal-contraction-cracking polygons based on aerial imagery. Samples for optically stimulated luminescence (OSL) dating were also collected.

Our database currently contains 284 sites with *in-situ* ice- or sand-wedge observations, and other 1775 locations where polygonal patterns occur. The preliminary OSL ages suggest that the wedges underwent multiple periods of activity during the Last Glacial Period, with the final phase probably coincident with the Last Permafrost Maximum. Our database is one of the most extensive in the world and well documents the Late Pleistocene permafrost extent in Central Europe.

Acknowledgement

The Czech Science Foundation, project number 17-21612S, supported this research.

Keywords

Mapping, dating, ice wedge, sand wedge, permafrost, Last Glacial Period

2. Poster abstracts

Relative dating of debris flows in Roháčská valley (Western Tatra Mountains)

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Abstract

The purpose of this paper is to determine the relative age of selected debris-flow accumulations in Roháčská valley and its tributary valleys, Western Tatra Mountains. The relative chronology was determined using the Schmidt hammer test and lichenometric measurements of selected accumulations. For Schmidt hammer testing, 3–5 suitable boulders of each accumulation were selected and at each boulder, 30 rebound values were collected. Where possible, lichenometry was performed at the same boulders to compare the results. Sampling based on the diameter of the largest thalli and the diameter of five largest thalli of *Rhizocarpon geographicum* were performed and the results were compared with the available precipitation totals measured at the meteorological station Kasprowy Wierch and aerial photographs taken in 1973, 1986, 2003 and 2015.

Mean rebound values (measured at 29 sites of the study area) ranges between $32,7 \pm 6,8$ and $65,0 \pm 3,8$ and discern the group of debris flows that occurred before and after 1973. Using lichenometry (performed at 13 sites), the age of selected debris flows (12–63 years) was derived. The detected periods in most cases coincide with the heavy rainfall events when the thresholds for debris-flow initiation were exceeded.

Keywords

Debris flow, Schmidt hammer test, lichenometry, Western Tatra Mts.

Glacier related geological hazards in Caucasus Kazbegi Area - examples of repeated catastrophic debris flow

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Abstract

The article presents how much valuable information is freely available from the internet to be efficiently used together with the interpretation of internet available maps and 3D visualizations to analyze geological hazard of some areas.

The example of Kazbegi mountain area in Georgia near the border with Russia is used. The area in question is famous for abundant debris flows, some of them very catastrophic and connected with glaciers.

There were two tragic events in recent past in the Dariali Gorge east of the Mkinvartsveri (Kazbegi) peak in 2014. On May 17th, during an unusually strong storm, fall of a part of the Devdoraki glacier, huge rock-ice avalanche, caused generation of catastrophic debris flow in Amali-Devdoraki and Tergi valley. Its accumulation blocked the Dariali Gorge and plagued the channel of the River Tegri. On August 20th in 2014, movements were reactivated due to abnormally strong torrential rains. Two consecutive natural disaster phenomena resulted in ten life casualties, destruction of two gas pipelines including the border crossing, as well as destruction of the Larsi hydroelectric power plant. Glacier related debris flows are historically documented in the Dariali Gorge in many times

Generation of debris flows or movements of glacier is also documented in other areas of Kazbegi Mountain. Debris flow caused by the Kolka Glacier in September 2002 is exceptional with a volume of material transported up to 140 million cubic meters, extreme speeds of up to 250 km per hour. The affected area was 12.7 km², including the area of the initial rock fall. The narrow transport channel of the Genaldon River, the accumulation area in the Karmadon depression in Russia, and the zone of continued movement downstream in the Giseldon Valley reached the total length of 36 km. The reported number of victims varies; the most frequently are reported 125 victims, completely destroyed was Russian village of Karmadon. Events in Kolka are documented in history.

Another debris flow tragedy in Kazbegi region is connected with Abano glacier in 1909 and 1910. Activity is also documented in other glaciers such as Mna, Gergeti and Chachi.

Using internet information together with geological experience it can be easily anticipated what may happen in the future within the area in context with slope movement hazards, dangerous areas possibly affected by slope movements in the future may be defined and thus cost-effectively give the first step to avoid constructions in endangered places and to eliminate loss of human lives.

Keywords

Kazbegi, debris flow, glacier, geological hazard

Reconstruction of the phases of glaciation in the Schwarzbach cirque (the Bohemian Forest)

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Abstract

Data obtained by local glacial chronologies with their regional context have a significant role in the reconstruction of the Pleistocene environment and climate. Exploration of a Pleistocene glaciated landscape in the Bohemian Forest has been focusing only on the Czech part until now except the surroundings of the Kleiner Arbersee where exposure dating of glacial landforms has been performed. Hence we present here a basic data of deglaciation from the eastern flank of Steinfleckberg Mt. (1342 m a.s.l.), which is situated near the Finsterau village. The locality has similar morphology as the surrounding of the Prášílské Lake at the Czech part of the Bohemian Forest (extensive ridge plateau and the cirque connected with eastern flank). Although not a lake is located at the bottom of the cirque, extended wetlands and peat-bogs could implicate overdeepening of the cirque floor. Reconstructions of the glaciers for three mapped deglaciation phases were performed and size, volume and ELA were counted for each phase. The glacier was 2036, 1673 and 682 meters long in the oldest, middle and youngest phase respectively and its minimal altitude was 903, 936 and 1016 m a.s.l. in the oldest, middle and youngest phase respectively. Method THAR_{0,45} determined ELA at 1063, 1081 and 1128 m a.s.l. It seems that there was a valley glacier in the oldest phase, while just cirque glacier in the youngest phase. Determining of the relative and numeric date of mapped phases should be the next step of the research.

Keywords

Bohemian Forest, deglaciation, ELA reconstruction

Abrasive processes of a selected section of the Czorsztyn reservoir shoreline

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Abstract

Abrasion is one of the geodynamic processes leading to the transformation of the shoreline of lakes and artificial water reservoirs. As a result of this process, an abrasive cliff is formed and an abrasion platform at its base.

The aim of the research was to determine the rate of transformation of the section of the shoreline of the Czorsztyn Reservoir on the Dunajec river in the Pieniny Region. Observations of changes in the shoreline have been made since 2003 based on surveying measurements in six research sections located in the Pieniny National Park near the earth dam. Research also included the identification of geotechnical properties of subsoil in the cross-sections up to a depth of about 1.0 m, as well as sediments accumulated in the reservoir at its edge. These tests included determining the composition of grain size, bulk density, filtration coefficient and shear strength parameters by triaxial and direct shear apparatus. The results of measurements of the progress of the abrasion process were related to the size of changes in the water level in the reservoir, the geometry of the boundary profile and the properties of the soils forming banks.

It was found that over 20-year lifetime of the Czorsztyn Reservoir led to the development of a morphologically diverse shoreline. The research results showed that as a result of abrasion there was a noticeable change in the shape of the shoreline at the considered section. It was clearly cut under the slope adjacent to the reservoir and the formation of steep abrasion cliffs of varying height.

Keywords

Czorsztyn Reservoir, abrasion, sediment accumulation, geotechnical conditions

In the bend: feedbacks between instream wood and fluvial processes in the Odra River (Czech Republic)

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Abstract

It is widely known that instream wood plays an important role in forested river basins. In general, instream wood influences flow hydraulics, sedimentation patterns, and channel morphology. Although instream wood positively affects a wide range of stream parameters, especially morphological and hydraulic diversity, it is still the subject of disputes between river managers and environmentalists. Of course, the river manager must remove some pieces of instream wood to avoid, for example, damaging the bridge structure. On the other hand, in places where structures of instream wood do not threaten any legitimate interests and pose no reasonable risk, they should be left. The presence of wood in streams is helpful to achieve a good ecological status of the river, which is one of the most important requirements of the Water Framework Directive. So it would be beneficial to find a compromise between flood protection and good hydromorphological quality. This study deals with the complex assessment of instream wood on channel morphology and sediment parameters including the content of organic matter at the spatially detailed scale of a selected bend of the Odra River. This area of interests is located between municipalities Kunín and Suchdol nad Odrou and it is a part of PLA Poddří. Within the study area (66.5 river km), 12 instream wood pieces were identified (length ≥ 1 m, diameter ≥ 10 cm). These structures significantly affected channel morphology, because they were the main initiators of pools formation. In total, 28 samples of surface bed sediments were collected from various locations (from the channel bed, bars, and lateral disconnected pool). In the laboratory, the samples were subjected to grain analysis (sieving method) and LOI method to obtain a content of organic matter. The majority of bed sediments samples were coarse-grained and the coarsest samples were located in the thalweg of the river. The main component of these samples is gravel fraction, often supplemented with some finer grain sizes. The analysis of data did not show the effect of instream wood on the deposition of organic matter in bed sediments. The frequent presence of coarse-grained sediment (i.e., gravels) generally implies a small amount of organic matter due to its high porosity.

Keywords

Instream wood, channel morphology, sediments, organic matter, Odra River

Historical changes and vegetation development after intensive peat extraction in the lowland mires of Slovakia

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Abstract

Mires in the Danubian Lowland (Northern part of the Pannonian Basin) are typically overgrown with common alder (*Alnus glutinosa*). Similar stands at this location are unfortunately very rare, what is caused by continuous human intervention in landscape and its natural pattern from Early Holocene. Peatland degradation near Pusté Úľany village started in the mid - eighteenth century, what is supported by historical maps. In the previous century a huge peat extraction took place at this specific mire. Despite these anthropogenic changes, there are still some remnants of natural habitats present, mostly dependant on ground water level. Methodology includes historical map's analysis, digital terrain model and vegetation cover mapping. Actual map of biotopes was completed for the current state of the vegetation cover acquaintance. Historical map's analysis revealed changes and development in the vegetation cover as well as the further relevant landscape changes in the mire during drainage system building. The first artificial drainage channel was built in the second half of the eighteenth century. Subsequently, dense system of the drainage channels was built near Továrniky settlement, continuing the drainage of this area for meadows, pastures and arable land acquisition. This wetland habitat was probably one of the largest mires in Slovakia during Holocene. Its area used to be markedly larger and its sedimentary basin presented much more important influence on landscape development. However, the historical sources revealed higher occurrence of common alder in the past, as well as typical xerothermic oak forest in this area. 27 biotopes were identified, from which 13 biotopes was purely human induced. Most of the area is currently abandoned for its own vegetation succession.

Keywords

Biotope mapping, landuse, DTM, Pusté Úľany, Danubian lowland

Sandstone geomorphology of Elbsandsteingebirge – opportunities offered by high-resolution DEM

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Abstract

The area of Elbe Sandstone Mountains (Czech: Labské pískovce, German: Elbsandsteingebirge) is located partly in south-eastern Saxony (Germany) and partly in the northern Ústecký Region (Czechia), being cut through by the canyon of Elbe river. It represents a fine example of a distinct, structurally-controlled landscape evolved within the flat-lying Cretaceous sedimentary rocks. The part north of the Elbe canyon is mainly a dissected plateau, with a labyrinth of minor canyons and gorges. The landscape of the southern part is different due to predominance of numerous isolated tabular hills – mesas and buttes (Migoń et al. 2018a). Beside the major landforms there are many minor, yet geomorphologically interesting forms such as caves, overhangs, clefts and boulders (Rast 1959).

While being a well-known area of touristic interest in the past and present, the Elbsandsteingebirge was surprisingly paid very little attention in the context of geomorphological research, especially its geomorphometric aspect. Even the release of first LiDAR-based digital elevation model of the German part (DGM2 of 2x2 metres resolution) in late 2000s resulted in only a few publications, partly utilizing the potential of morphometric analysis of such data. They explored the concept of tracing landform evolution through geoheritage interpretation (Migoń et al. 2018a) and the gradual decay of mesas using space-for-time substitution (Migoń et al. 2018b). In 2017, a new LiDAR-based elevation dataset DGM1 (1x1 m resolution) became available, thus giving an insight into morphometric features of such details as narrow clefts cutting mesas and plateaus rims and block covers on cliffed escarpments. The poster presents selected aspects of characteristic morphologies of Elbsandsteingebirge such as morphometric variety of mesas, areas of strongest plateau dissection and patterns of structurally-controlled valley systems. Presentation is based on recently available high-resolution LiDAR elevation dataset DGM1 and creates a background of more complex research planned in near future concerning interaction between morphometric features and geological setting of sandstone landforms.

Keywords

sandstone geomorphology, LiDAR DEM, geomorphometry, Elbe Sandstone Mountains, mesas

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Location of past settlement and topographic conditions – the example of the Niemcza-Strzelin Hills (Sudetic Foreland, Poland)

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Abstract

The Niemcza-Strzelin Hills is a region which stands out in relation to the rest of Sudetic Foreland. Elements of the natural environment worth particular attention include: relief that reflects complexity of bedrock and geological structure, with a specific parallel pattern of ridges and valleys; a variety of natural and anthropogenic landforms; a dense river network and the occurrence of fertile soils developed from loess. These conditions make the area of the Niemcza-Strzelin Hills attractive to settlers, which is proved by settlement continuity in this area since the Neolithic revolution. The relationship between the natural environment and humans can be observed while analysing individual components of the natural environment that affected the location of human habitats. The analysis was based on parameters derived from digital elevation model (DEM): slope inclination and aspect, topographic position index (TPI) and topographic wetness index (TWI) (Weiss 2001, Urbański 2011). In addition, spatial variables such as altitude of sites, types of soil and TPI-based landform classification were considered. The outcome is presented as a case study of Witostowice hillfort where particularly attractive topographic conditions occur (Lodowski 1965). This work is an attempt to trace historical settlement trends at the regional scale, to enrich educational offer of the newly created Sudetic Foreland Geopark and to present interdisciplinary approach to environmental studies. The results of spatial analysis, within the scope of geoarchaeological research, allow us to evaluate the influence of topographic factors on site location and hence, may be used to predict the location of unexplored archaeological sites.

Keywords

settlement, cultural landscape, spatial analysis, geoarchaeology, Niemcza-Strzelin Hills, Sudetic Foreland

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Urban geotourism resources: an example of two geocultural sites in Brno, Czech Republic

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Abstract

The term “urban geotourism” is relatively new (Liccardo et al. 2012, Del Lama et al. 2015), however, the use of geology, geomorphology and related features (e.g. building stones or anthropogenic landforms) within urban areas for tourist and educational purposes is much older (e.g. Robinson 1982). Currently, the number of studies dedicated to the tourist use of geodiversity and geoheritage within urban areas is growing, although the main focus still remains on the European cities (Habibi et al. 2018). Identifying, inventorying and assessing geotourism resources and particular sites of geotourist interest within urban areas can bring new possibilities to the development of geotourism and geoeducational activities. According to the present holistic concept of geotourism (Dowling and Newsome eds. 2018), the inventory of urban geotourism resources should include both natural features (geological, geomorphological, hydrological, and palaeontological aspects, and eventually ecological aspects related to geodiversity) and cultural aspects related to geodiversity and geoheritage (churches, cemeteries, anthropogenic landforms, pavements, building stone or toponyms linked to the geodiversity). Based on this, specific sites of geotourist interest are selected: 1) geosites in sensu stricto (examples of geoheritage, already protected) 2) sites included in the national database of geological localities kept by Czech Geological Survey (without legal protection), 3) other natural sites (e.g. outcrops or hydrological features with geotourist relevance), 4) geocultural sites (anthropogenic landforms or landforms which influenced the urban development, e.g. important elevations with strong historical or religious aspects). All these sites are then subject to assessment which comes out from the geomorphosite concept (Panizza and Reynard 2005). The assessment together with SWOT analysis serve as a basis for proposals of geotourist and geoeducational activities and they can also provide the justification for applying specific conservation measures to particular sites. Subsequently, these sites can be declared protected, the legal protection then assures that the values of the site are respected and incorporated into the urban planning strategies. Two geocultural sites in Brno (Špilberk and Petrov) are assessed and based on this, geotourist activities are designed.

Keywords

Urban geotourism, Geocultural site, Assessment, Brno, Czech Republic

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Application of electrical resistivity tomography technique to detect underground cavities: Case study from the Moravian Karst (Czech Republic)

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Abstract

The electrical resistivity tomography (ERT) method is widely used to detect underground cavities because their air, water or clay infill often has a significant geoelectrical contrast to the surrounding rock. The case study from the Amatérská cave in the Moravian Karst proved the ability of the technique to detect air and clay filled underground cavities above the depth of 40 m. The resolution of the method is lower at greater depths but some indication of deeply situated Pustožlebská Zazděná and Amatérská caves was captured. The method is suitable to detect brittle deformations as well. The detected fractures follow the main direction of karstification and deeply situated known caves. This study proves the high intensity of karstification of the Macocha plain.

Keywords

ERT, underground cavities, caves, Moravian Karst

Mapping geomorphic (dis)connectivity in the human modified landscape of the Slavíč River valley (Moravskoslezské Beskydy Mts, Czech Republic)

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Slavíč River is originally one of the main tributary of Morávka River in Moravskoslezské Beskydy Mts. It is man impacted river basin affected by artificial structures which influenced processes of erosion, transport and accumulation of the sediments. Main aim of this study are identification and assessment of (dis)connectivities occurring in the Slavíč R. basin with focus on main stem of the river channel. The research was conducted with fluvial-geomorphic mapping together with DEM (Digital Elevation Model) analysis. The artificial structures were represented by grade control structures especially, which decreased the channel gradient and also limiting the sediment transport. The second artificial structure frequently occurred in the study area were stream bank stabilisations (e.g., rip-rap) protect from lateral erosion and abrupt sediment delivery to the channel. On the other hand, there were a plenty of natural wood accumulations which limited sediment transport. DEM analysis showed the slightly gradual downstream valley widening where confined and semi-confined valley setting is occurred especially. Only in the downstream part ca. 1.5 km length reach is unconfined. It reflects the higher degree of natural connectivity setting in river basin where man impact negatively affects sediment movement in the basin.

Keywords

DEM analysis, geomorphic mapping, Moravskoslezské Beskydy Mts, sediment (dis)connectivity, Slavíč River

Neglected drainage patterns in the Sudetes – what messages they convey?

Preliminary observations and hypotheses

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Abstract

Drainage patterns have been of interest to geomorphologists since the early days of the discipline. This interest is motivated by the belief that drainage networks record the history of landscape evolution and may retain the memory of formative events and periods which otherwise have not left any unequivocal traces. In recent decades analysis of drainage patterns has become an important part of tectonic geomorphology, especially in the context of intermediate and long timescales of endogenic-exogenous interactions. It is somehow paradoxical that very little attention has been paid to drainage patterns and their evolution in the Sudetes, although site-specific observations have been presented by various authors, mainly prior to the 1960s. In this presentation we look at the drainage network at the scale of the entire range, focusing our attention on locations and patterns which may hide information about significant reorganizations of the network and help to elucidate the Cenozoic history of uplift, subsidence and differential erosion. Features of potential interest include (a) sudden turns of drainage courses, occasionally by more than 90°; (b) narrow reaches across terrain elevations; (c) unusual junctions with tributaries; (d) evident differences in geometrical patterns between neighbouring drainage basins; (e) evident differences in the size of adjacent drainage basins; (f) examples of parallelism between water divides and trunk streams; (g) divergent drainage patterns; (h) continuity of dominant directions across water divides; (i) location of water divides within major topographic depressions. Each feature may have more than one origin, related to lithological or structural control, neotectonic history, history of glaciation or superimposition. Discriminating between different controls remains the key research challenge, especially since relict fluvial deposits documenting drainage pattern changes are extremely scarce in the Sudetes.

Acknowledgement

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Keywords

Drainage patterns; gorges; captures; morphotectonics; long-term landform evolution

Fluvial geomorphological research on the Monolith and Keller Streams, James Ross Island, Antarctica

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Abstract

Changes in the supply of water and sediment to proglacial rivers and streams connected to progressing climate change and glacier melting largely determine the activity of fluvial processes (Owczarek et. al., 2014). We tried to identify the sediment transport sources and bedload changes of proglacial braided streams. During the Czech Antarctic expedition 2017–2018, we observed a relationship between the transported bedload lithology, shape and hydrological regime. The Monolith Stream catchment area (31 km²) is located in the James Ross Island, close to Antarctic Peninsula and it is created by the Monolith (5.4 km long) and Keller streams (6.2 km long).

In preparation phase, we used various orthophoto images and DEM (Polar Geospatial Center, University of Minnesota; 2015, unpublished data) for the catchment area detection. After that, the geomorphological landforms were verified in the field. The sediment sources important for studied streams were determined and categorized with using DEM and geological map (morainic complex of Whisky Glacier, debris-flow dominated fans and fluvial-flow dominated fans).

For the sediment transport characteristics we collected bedload sediment from in-channel bars in two fractions (8–16 mm; 64–256 mm) and measured clast size, shape, roundness and petrology. Main petrological types are basalt, palagonite form hyaloclastite breccia and sandstone according to the field survey and geological map (Mlčoch et al., 2018). The clast characteristics give us an overview of transported material and together with position changes of channels and channel bars we can determinate short-term fluvial changes in this deglaciated area.

Keyword

Proglacial, gravel-bed rivers, sediment supply, sediment sources, James Ross Island, Antarctica

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Changes of the morphological and hydrodynamic parameters in multi-thread river

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Abstract

The paper focuses on the understanding of the basic hydrodynamic conditions along the braided gravel-bed river. The measuring cross-section was located in the Ochotnica River, where its braided channel development was observed. Investigations take place from 2003 up to 2014. Measurements were performed for selected characteristic points. The study focused mostly on the measurements of water velocities under different flow conditions, and next on finding basic hydraulic parameters of flow: shear velocity, shear stresses, Reynolds number, Froude number. In addition, the gravel material from the river bed was examined, in order to find sedimentological characteristics of it.

The river study showed that despite the devastation of the river channel during illegal gravel mining river bars and channel braids are still being formed which means that the river goes back to the natural process of braiding.

Keywords

Geomorphology, braided river, morphology changes

Diversity of present-day deposits in Suchedniów Reservoir

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Abstract

The Suchedniów Reservoir on Kamionka river is located in the northern part of the Świętokrzyskie voivodeship (Poland), about 25 km north from Kielce. This area is part of the Old Polish Industrial District, in the Middle Ages very intensive developed. Many forges and mills use water power that lead to appeared in the river small reservoirs. Present-day reservoir was built in 1974 and it used as tourist-recreational and small retention object. The lake was drained in 2017 to restore its flood protection potential as it was significantly reduced by siltation of the reservoir basin. This works enabled to carry out to start studies about the sediments deposited in the reservoir for about 40 years. The work concentrated in study of thickness, vertical and spatial variability, and the accumulation forms forming in the lake.

Profiles and drillings (45) were made in dry reservoir, from which were taken over 380 samples. There were identified three key sites. First, in the south-eastern part of the reservoir, at the Kamionka estuary, with formed an inland fan delta. Its origin was connected with the cutting of the express road embankment by the river (2009-2011). This material was transported by river and accumulated in the Suchedniów Reservoir. Second site, in the middle of the lake noticed sediments left probably by flash flood, which were caused by the dam rapid and the sudden drainage of the reservoir in 1974. These sediments form sandy mega ripple marks, preserved under present lacustrine sediments. That showing the sudden and intense flow caused by dam rapid and reservoir drainage. Third site is located near of the dam where was found deposits of fireproof clay. Its looser structure and plasticity of this material indicated the possibility that these deposits can be connected with industrial activity of the “Marywil” factory, located upstream of the reservoir.

The anthropogenic activity contributed to the intensive silting of the Suchedniów Reservoir for about 40 years. This process accelerated in last years during S7 express road construction works that result of which is the fan delta. In the sediments of the Suchedniów Reservoir there are traces connected with diversified human activity that have contributed to, i.a. flash floods.

Keywords

Small retention, sedimentology, geomorphology, anthropopression

Landslide susceptibility mapping of Czechia

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Abstract

Statistical modelling of landslide susceptibility is becoming relatively more traditional approach. Nevertheless, more complicated statistical methods are being developed and applied on larger areas. This development is caused especially by increasing computational capacity and software possibilities. This paper summarises landslide susceptibility modelling performed for the whole area of Czechia. The susceptibility models were created using logistic regression, naive Bayes and artificial neural network (ANN). Additionally, two more models were created using expert driven approach. All models were made using thirteen conditioning factors, i.e. elevation, slope, engineering geological regions, climatic areas, mean annual precipitation, topographic wetness index (TWI), aspect, orogenetic class, distance from confirmed fault, distance from watercourse, internal relief, land cover and slope shape. Models driven by statistical approach were created using Orange software. Landslide inventories that were used for construction of all models are based on two databases: “Registr svahových nestabilit” and “Registr sesuvů-Geofond”. Using validation by SRC, PRC and ROC curves estimated that the best fitting models for the area of Czechia are models created by logistic regression. Significantly better results were obtained by using data combined from both landslide databases.

Keywords

Landslides, susceptibility, statistical modelling, logistic regression, small scale, Czechia

Linear organisation of relief in the Bohemian Massif

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Abstract

Based on the LIDAR or SRTM elevation data and the GIS layer of streams (ZABAGED – Basic Geographical Database, Czech Republic), we highlighted the large subparallel linear topographic systems of the Bohemian Massif and a part of the Western Carpathians (Czech Republic, north-eastern Austria) and compared them with basic geological knowledge of this area. The subjected linear features primarily included hillslopes, valleys, linear belts of meandering streams and sharp stream deflections, but also various other landforms were considered. Directions of single or (commonly) composite lineaments involved within particular groups (systems) did not differ by more than about $\pm 2^\circ$. The linear elements had to be extracted manually, because automatic approach could be, possibly, uneasily applied only to some of them for enormous spatial variability of related landforms.

The resulting image revealed a low total number (9) of distinctive regional linear trends when compared with multiple orientation of joint systems developed on a local scale. They correlate at many places with linear boundaries of uplands or basins. Three of the trends (Labe / Elbe River System, Orlické hory Mts. System and Southern Boskovice Graben System) are penetrative over large areas, whereas the others possess an arrangement of distinct zones. Based on official 1:50.000 geological map, correspondence of dense linear patterns to marked faults or lithological boundaries is quite low. Thus, their development does not seem to be conditioned by purely recent deeply generated tectonic phenomena, but also by inherited older paleostresses whose manifestations have been accentuated later by processes in the upper crust or in the land surface. However, the lineaments locally spatially correlate with roughly linear boundaries of preserved deposits of various age – Late Cretaceous, Miocene of the Carpathian Foredeep (mostly marine), Upper Miocene to Pliocene (continental), Early or possibly even later Quaternary. A young movement activity is thus indicated at least along some lines.

Keywords

Subparallel linear systems, relief, geological structure, landform evolution, Bohemian Massif

The potential of UAV photogrammetry for river morphology changes detection: avulsion channel evolution on the gravel bed river Ondava, Slovakia

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Abstract

This study presents evolution monitoring of the chute cutoff in the meander bend of the Ondava River in Eastern Slovakia. An avulsion channel was formed in the central part of meander neck during 2010 flood events, and the consequent morphological changes were examined by close range aerial imaging. Initial monitoring commenced on June 15th 2012 with 78 processed images, followed by 259 images during April 2014 and finally 375 from the 18th of July 2014. Results were provided by high precision DEM with 2 cm pixel resolution, with the RMSE vertical differentiation between the geodetic measured points and the UAV DEM measuring 62.1 cm. While UAV photogrammetry is more versatile than conventional geodetic profiles in providing continuous data sets, it cannot capture surface under vegetation cover and underwater surfaces. This limits usage of UAVs for surface analysis in forested areas; with results confirming RMSE elevation error of 0.673 m in vegetated areas compared to 0.209 m on bare ground. The major advantages of UAV over traditional geodetic mapping remain its universality, multifunctionality, accuracy and rapid data collection. The chute cutoff was formed by floodplain headcutting during meander neck overflow and headcut migration was directed by floodplain sediment structure and land use. Although low river discharge after the 2010 floods stabilised the avulsion channel by vegetation succession, recurrent 2-yearly interval flooding increased the avulsion channel bank erosion from 36.9 m³/month (2012 - 03/2014) to 425.6 m³/month (04/2014 - 07/2014).

Keywords

Chute cutoff, channel changes, UAV technology, avulsion channel, UAV-DEM

Analyses of fault micro-slip recorded in the Dědičná štola gallery, Travná, Rychlebské hory Mts., NE Bohemian Massif

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Abstract

The results of 3-D monitoring of strain along 3 faults outcropping in the Dědičná štola gallery in northern part of the Rychlebské hory Mts. using TM-71 extensometers during the period 2014 – 2017 are presented. The detected fault slip is non-linear and it is affected by short transient periods of acceleration. Several dominant and series of minor transient faults slip acceleration were recognized. Fault slip development as well as kinematics and its implication to geomorphology are discussed. The recorded fault slips were analyzed using classical paleostress analyses (Angelier-Mechler 1977, Angelier 1989, 1994, Málek 1991). As result, 5 different tectonic phases were suggested. The minimum and maximum horizontal principal stress with a WNW-ESE to NW-SE orientation and other stress phase corresponds to the maximal subhorizontal principal stress with approximately N-S to NNE-SSW orientation were recognized. Based on the orientations of main principal axes for individual tectonic phases, the orientation and dip of fault planes with maximal shear stress were determined. These faults planes are well-oriented to applied stress field and are prone to be reactivated during individual tectonic phases. Moreover, known faults and suggested morpholineaments in wider area were compared with fault planes with maximal shear stress and recognized their spatial distribution. Result will be presented in contribution.

Keywords

Active tectonics, 3-D fault slip monitoring, transient fault slip acceleration, switching stress state, morpholineaments, Rychlebské hory Mts., Bohemian Massif

Impact of check dams on the bed sediment (example from Tenczyński stream)

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Abstract

The aim is to analyze the effect of check dams on the granulometry of the sedimentary deposits in the region of their impact. Data necessary for the work was obtained during field measurements, which were carried out in May 2017. The sediment was collected using the Wolman's method. Data collected in this way were used to determine granulometric curves, determine granulometric parameters and determine the shapes of grains forming river debris in the region of the studied objects.

The sediment measurements were carried out below and above the check-dams using the Wolman's method. The grain size curves were then plotted, granulometric and sedimentological parameters were calculated. In addition, grain size and shape were determined using the Sneed and Folk methods.

The number of discoidal grain pebbles grew below the dam in relation to the level above the dam. In the material collected below the dam there was a smaller number of spindle-shaped grains than in the material collected above the dam. Above the dam there are larger amounts of finer material than below. This may be related to the retention of even small grains of pebbles in the dam reservoir, in which the flow velocity is lower than in the riverbed, thus causing the depositing of the carried material. On the other hand, in the lower station, due to the increased velocity of water flow, a small debris is washed away, and in the bottom of the trough only thins are found.

Keywords

Geomorphology, check-dam, bed sediment, pebbles

Spatial pattern of enhanced erosional signal within the Sudetes block – a multivariate unsupervised relief classification approach

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Abstract

The Sudetes owe their contemporary relief to superposition of the effects of long-term rock-controlled denudation and Cenozoic differential uplift, likely of moderate intensity. Since uplift drives erosion, more dissected (eroded) terrains may indicate areas subject to more intense uplift than others. Geomorphometry and statistics are employed to recognize the enhanced erosional signal within the range. This signal is understood as a meso-scale reflection of relief properties, whereas the recognition of homogeneous terrain units, different in terms of strength of erosional signal, is carried out by means of multi-criteria terrain classification, involving Principal Component Analysis and k-means grouping. In effect, 45% of the area has been identified as subject to intensive dissection, with four groups showing distinctive morphometric characteristics. In the next step these areas were quantitatively compared with independent variables of altitude, lithology, structural units and rock strength, and also assessed in relation to rainfall pattern. It appears that their dependence on altitude and geology is only partial. Finally, three types of dissected terrain are distinguished and interpreted in terms of uplift intensity, rock strength as a factor modulating erosional response to uplift, and timescale. The spatial distribution of these types of terrain indicates several isolated 'hot spots' of erosional dissection on predominantly strong rocks, linked by less elevated areas, underlain by rocks of variable strength. The former are considered as having longer history of uplift and dissection, dated back to the late Palaeogene, whereas the latter record more recent history of endo-exogenic interactions, possibly since the late Miocene, whereas any older tectonic facets of the landsurface have been erased. The presence of canyon-like valleys incised into planar or gently sloping relief in some marginal parts of the Sudetes may indicate the most recent pulse of relief rejuvenation.

Acknowledgement

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Keywords

Erosion; tectonic geomorphology; geomorphometry; rock strength; long-term landform evolution

The lock chamber construction project in the lower Elbe River in the Czech Republic and its effect on perspectives of gravel bars

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Abstract

Gravel bars are integral components and key sites of fluvial landscapes for many ecological function. In the last centuries, man affected natural processes of formation of these gravel bars in European rivers. A typical example of highly transformed fluvial system is the Elbe River in its downstream part in the Czech Republic. River control works and damming (e.g., for navigation, water irrigation or flood protection) restricted bars and islands development. The Czech Republic implemented the Water Framework Directive which integrated all aspects of the water environment to be effective and sustainable and which aimed to reach better ecological and hydromorphological quality of rivers. Especially in the downstream part of the Elbe R. in the Czech Republic it is necessary to improve its hydromorphological state because the river is flowing through the National Park Bohemian Switzerland. The main aims of this study were (i) analysis of historical development as the key factor for understanding of future perspectives of gravel-bars, (ii) detailed assessment of contemporary grain-size and morphological characteristics of selected gravel bars and (iii) evaluation of the impact of planned lock chamber construction together with assessment of potential for river restoration focused on gravel bars in the reach between Ústí nad Labem and Hřensko. The results showed progressive extinction of river islands in the last two centuries and partial transformation of some islands to lateral bars or point bars due to channel control works. Contemporary gravel bar morphology and grain-size parameters are affected by navigation control works (gravel mining, damming). In the last years, possible river restoration structures created by concentrating groynes are discussed as reparation for negative effect of planned lock chamber on gravel bars. These structures as reparation are controversial in the view of their effect on processes of lateral and vertical erosion. Dams as well as lock chambers interrupt sediment transport and cause 'hungry water effect'. Groyne structures can propagate this 'hungry water effect' and erosion processes because of increased flow velocity and flow concentration into limited space of cross-sections.

Keywords

Gravel-bar, damming, river control works, man impact, Elbe River

Čeřeniště natural lab: a recent progress in the landslide monitoring instrumentation

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Abstract

The Čeřeniště landslide natural lab represents a unique example of the landslide monitoring site with almost natural conditions. The site has been, of course, changed by human activities (e.g. retention dam construction), however, the landslide has been left to its own development with minimum mitigation measures. The Čeřeniště landslide is a fine example of a complex DSGSD, developed in Tertiary volcanic tuffs and basalts of České Středoohoří Mts. A large landslide (approx. 1 km long, and over 0.5 sq. km) has a 25 m high rock-face scarp, followed by large blocks of basalt in the upper part, which are predisposed by tectonic structures and further affected by deep-seated gravitational processes. The central part is formed by back-tilted blocks and filled with fine-grained sediments. The distal part of the landslide is terminated with a multiple flow-like tongues, reactivated during the humid periods (the most active part).

In early 1990ies the research of the complex slope deformation was commenced. The monitoring focused on slope movements was established in 1997, including two 3D extensometers TM-71 and extensometric tape profile. Since the beginning of the research and instrumentation, the Čeřeniště site has become one of the best-equipped natural laboratories, operated by a multidisciplinary team of researchers from the IRSM in the scope of the monitoring network SLOPENET. Studying the conditions, predisposing slope processes, together with activity monitoring is crucial for understanding the behavior and natural conditions of landslide evolution, reactivations, and triggers.

For the description of the long-term landslide activity the measurements of displacements are performed using TM-71 (across block dilatations in the proximal part), an automatic wire extensometer and manual tape extensometer (between blocks in the upper part), time-lapse geodetic surveys (using laser scanning and total station), and newly (since 2018) also a 30 m long automatic multiparametric inclinometer, installed in a borehole in the most active part of landslide to provide almost real-time information on the activity on the sliding plane. This device allows not only inclinometric, but also piezometric and thermal measurements along the whole profile length.

In 2013, repeated electrical resistivity tomography (ERT) profile was established to identify the relations between triggering factors and landslide activity. It had been measured with approximately 1-month period for five years until 2018. In 2018, the ERT profile was upgraded and an automatic time-lapse ERT (TL-ERT) profile with a daily period of measurements and using a custom made resistivity system with buried electrodes was installed. The denser data time series will help to (i) describe a consequence of the subsurface water saturation and its changes and (ii) reveal the spatial and temporal relations within the system „precipitation – subsurface saturation – mass movement activation“.

Furthermore, by means of the movement velocity monitoring – based on repeated geodetic and geotechnical measurements – we shall be able to determine the causal connection between precipitations, soil saturation and reactivation of mass movements. To provide the local, site-specific hydroclimatic conditions data, a meteorological station and pore-water pressure (as a soil saturation indicator) monitoring were also established on the landslide (2013).

The above-described long-term monitoring and observation of the landslide aims to describe the long-term behavior of the complex slope deformation, and to reveal links among predispositions in morphology, tectonics and lithology, triggering factors (extreme precipitations, soil humidity changes, long-term climatic oscillations, etc.) and landslide activity.

Keywords

Deep-seated gravitational slope deformation, landslide monitoring, displacement measurements, time-lapse resistivity tomography, precipitations, landslide reactivation

On the formation processes of river terraces in forested upstream reaches

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Abstract

Terraces of the small upstream reaches in the midmountain forested areas are not usually the subject of the scientific papers due to their fragmentary preservation and lack of dateable material. Despite of these factors we create comprehensive database from peer-reviewed literature in order to reveal peculiarities in such environment. We noted spatial scale, timescale, type of the terraces, causes of the incision and the accumulation, used dating and mapping technique. Due to the dense vegetation cover is the extent of the terraces usually mapped in the field and verified by digital elevation model. For the age determination of the terrace formation the majority of the case studies use radiocarbon dating and optically stimulated luminescence. In summary, midmountain forested upstream reaches react to “classical” causes of the terrace formation such as tectonic movement, climate changes and land cover changes. Upstream reaches in such environment also reveal sensitivity to highly localised changes of the channel steepness, or stream power. Therefore, we are able to identify specific terraced accumulation such as toe-cut terraces, landslide terraces and organic debris terraces, besides typical strath and alluvial terraces. The majority of the case studies also indicate high sensitivity to extreme hydrological events, slope-channel processes and anthropogenic changes. The significant role represent accumulation of the organic debris and sediment traps. The review indicates that terraced accumulation in the forested midmountain catchments are able to contribute to the regional and local landscape development and therefore represents valuable environmental archive. Also follows that even small changes in the watershed are able to cause changes of the fluvial system. It indicates that the headwater streams must be managed with particular attention.

Keywords

Terraces, upstream reaches, headwater stream, Holocene

Glacial erosion landscape in the Jelenia Góra Basin (Sudetes, Poland) – does really exist?

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Abstract

At the beginning of the 20th century, G. Berg (1911) described the morphology of the eastern part of the Jelenia Góra Basin (Sudetes Mts.) as an example of the landscape, which was created as a result of glacial erosion. This view was negated by A. Jahn (1952), who, however, described examples of granite hills near Jelenia Góra formed as a result of the ice sheet activity. Our research, based on field retrospection and GIS analysis of geological maps and high-resolution DEM (LiDAR), made it possible to determine that most granite hills with a relative height up to 20 m refer with their shape and orientation of the long axis to the structure of the granite base (joints system, course of intrusive rocks). Only a few of these hills, from around 260, demonstrate slope asymmetry corresponding to the direction of the Scandinavian Ice-sheet movement in the Jelenia Góra Basin. At the same time, there are predominantly forms in their vicinity that do not have such asymmetry. Reconstruction of ice streams, which flow in to the Jelenia Góra Basin, indicates that in zones where there would be forms of glacial abrasion, the thickness of Ice-sheet did not exceed 30–40 m. For comparison, streamlined erosional landforms on the northern granite slope of the Jizera Mountains occur in the zone where the estimated thickness of the ice sheet was greater than 50 m (Traczyk, Engel 2006, Černá 2011). Perhaps in the Jelenia Góra Basin there were few abrasive forms of plucked lee-side slopes and grooves, but a long period of postglacial weathering (lasting ca. 400 ka) caused a significant transformation of these forms. The difficulty of interpretation also lies in the lack of glacial striations and the fact that a great amount of forms has been destroyed as a result of anthropogenic activity (granite quarrying).

Keywords

Glacial erosion, Scandinavian Ice-sheet advance, Pleistocene, Sudetes Mts.

A confluence hydrodynamic zone as integral part of fluvial system diversity – a review

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Abstract

River confluences are integral parts of fluvial systems where different water flow, sediment and organic matter transport merge together. Due to these different inputs, it has implication to morphological diversity of channel confluence which affect specific habitat characteristics for aquatic communities (Benda et al. 2004b). Based on earlier studies, the main aim of this study is focused on description of processes and factors affected occurrence and development of typical morphological features in open channel confluences. Initial researches in this field identified relations between geometrical setting of channel confluence (mainly angle) and hydrodynamics in sense of intensity of erosion-accumulation processes (Best 1988). These erosion-accumulation processes also affect different flow hydrodynamics upstream and downstream from the confluence where e. g., increased sediment supply by tributary cause channel aggradation and subsequent change of water flow velocities and transport characteristics (Rice 2017). Current research focuses mainly on components of hydrodynamic processes such as turbulent flow dynamics (Yuan et al. 2016) and its effect on erosion, generation patterns of secondary current and its relation to creation of stagnation zones, where deposition of material takes place (Lane et al. 2000). The most recent research deals with detailed numerical modelling of river confluences (Luo et al. 2018), which provides most detailed information about hydrodynamics. Still there are many unresolved questions especially considering combination of hydrodynamics and bedload transport, which is one of the reasons of channel heterogeneity, both transverse and longitudinal. Additionally these parameters can be affected by different river network geometry (Benda et al. 2004a) which adds to the complexity of this subject and makes more possibilities for future research.

Keywords

River confluence, channel morphology, hydrodynamic

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Evaluation of root reinforcement using different models - implications for slope stability calculations

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Abstract

Root reinforcement is one of factors, which has significant influence on increase of soil shear strength, so forested areas as regarded as areas of lower endanger of mass-movements processes. It is assumed that shearing of soil causes elongation of roots and induce tensile stress within the them. The elongation of root lasts up to the moment in which the rupture or pulling out the root occurs, and mobilization of tensile stress within the root provide additional shear resistance of soil. There are a few models (fiber bundle models) used for determination the root reinforcement which differ due to the concept of load distribution by root system and the data amount used for calculation.

The aim of the study was to compare different approaches used to calculation of root cohesion value. Implication of these approaches was presented by the example of slope stability calculations performed for one of landslides from area of the Polish Carpathians.

Keywords

Vegetation, Root cohesion, Landslides, Slope Stability