UNIVERSITY OF OSTRAVA
FACULTY OF SCIENCE

Faculty of Science University of Ostrava

GEOMORPHOLOGY, NATURAL HAZARDS AND ENVIRONMENTAL CHANGES

CONTENT

GEOMORPHOLOGY, NATURAL HAZARDS AND ENVIRONMENTAL CHANGES

Geomorphology is a science of the Earth‘s surface and its landforms. Researchers from the Faculty of Science of the University of Ostrava focus mainly on the understanding of catastrophic geomorphological processes, their intensity, their triggers, and the effects that these geomorphological extremes in the landscape will achieve. The Ostrava team thus helped to clarify the origin of some mountains (Beskydy, Tatras, Crimean Mountains, Patagonia), and not only thanks to this, it ranks among the leaders in the field of geomorphology not only in the Czech Republic but also in the international context.

#geomorphology #naturalhazards #landslides
#rivers #mountains #dendrogeomorphology
#dating #montanelandscape #quaternary

GEOMORPHOLOGY, NATURAL HAZARDS AND ENVIRONMENTAL CHANGES

How has geomorphology changed?

As an area of research, geomorphology has recently been developing dynamically. It deals with forms of relief from lowland to alpine, from terrestrial to those on Mars or other planets. It is just from the shapes of the relief that they try to assess the effects of extreme processes, either in the distant or in not so ancient past, e.g. by the floods‘ or landslides‘ influences.

Also, the team at the University of Ostrava uses progress in the methods of physics, chemistry, and geodesy. „*The last twenty years in this field have been fascinating. The devices and technologies that enable the measurement of geomorphological processes, even those that take place at speeds of less than a millimetre per year, have greatly improved*“, prof. Tomáš Pánek says.

Another huge revolution is digital maps. „*Digital terrain models are created, for example, by laser scanning, and thanks to that we can see all the landforms in the studied area basically „from the desk“. Today, on a high-quality digital map, we can see almost every boulder on a slope. In the present time, we also work in the field, but we no longer have to devote as much energy to make our way through shurbs as we did twenty years ago*“, prof. Pánek adds with a smile.

The third aspect that is crucial for the field, after monitoring and digital maps, is the development of physical and chemical methods associated with dating. „*Today, we are able to date a large number of different types of landforms and geological materials. Dating has brought a great deal to the development of geology and geomorphology. A few decades ago, it was not possible to date almost anything, and now we have the opportunity to determine the age of geomorphological processes that took place a few years ago, but also several million years ago. Thanks to this, we can determine the intensity of geomorphological processes, which brings new horizons to our field*“, prof. Pánek explains.

The Ostrava team works in many regions of the world (Patagonia, Mediterranean, Kazakhstan, Crimea), but the function of the natural laboratory is represented mainly by the nearby Beskydy mountains. So, in cooperation, educational panels are created in the Beskydy and Jeseníky mountains. As a small team, geomorphologists from the University of Ostrava focus mainly on science, however, where it is possible, they give space also to practical things that any of us can encounter while wandering in nature. They cooperate with the Nature Conservation Agency of the Czech Republic, to which they regularly provide arguments when declaring nature reserves or when managing protected areas. That is the most valid in the direction of dealing with rivers, where the team gives specific recommendations on how to behave towards a given river channel.

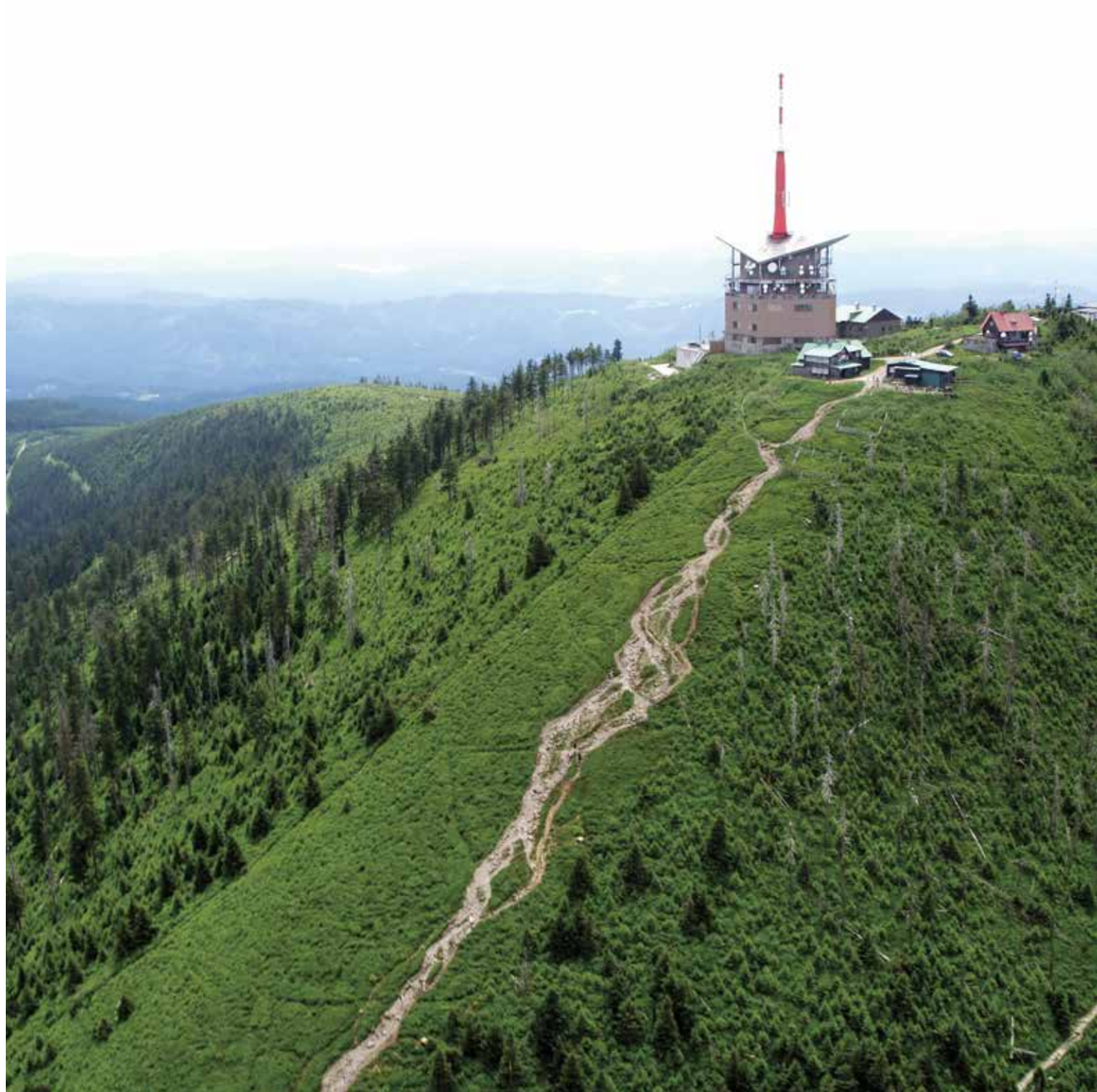
And, what is the guarantor of the research field prof. Pánek most proud of? „*We managed a lot in a small team, and I am convinced that we are the number one in the geomorphology in the Czech Republic. We are also visible in the scope of Europe and the world. For instance, we cooperate intensively with the institutions of the University of Geneva, the University of Potsdam and Cracow University of Technology, whose scientists belong among the world‘s leaders in their fields. We have significantly shifted knowledge about some regions (e.g. Crimea, Tatras, Patagonia, the eastern coast of the Caspian Sea) and we have fundamentally contributed to the development of geomorphological research methods (e.g. dendrogeomorphology). We have also partly revealed the processes leading to the origin of large landslides landslides*“.

GEOMORPHOLOGY - RESEARCH AREAS

MOUNTAIN EVOLUTION

Mountains are the laboratory. They reflect geomorphological extremes and also the fact that the relief is a reflection of the counter-acting effects of both endogenous (earthquakes, folding) and exogenous processes (erosions, landslides). This all can be perfectly seen in the mountains, and the processes in them can be read like from a book. A team of geomorphologists from the UO then solves how mountains are originated - in what way, how quickly, and what processes contribute to their origin, whether caused by nature or by the human. Not only the individual processes are interesting, but also the origin of the mountains as a whole.

The team carries out most of the research in the mountains, whether in the Beskydy mountains, which are, thanks to that, probably the best-known mountains in the Czech Republic, but also elsewhere in Europe, Asia, or South America. „*We solve not only natural geomorphological processes, but also how the face of the mountains is affected by a man. For example, the Beskydy mountains were an untouched forested landscape until the 16th century, when the Wallachians came, deforested the ridges, thus triggered erosion and other processes*“, prof. Pánek, the guarantor of the research direction, adds the practical example.



DENDROGEOMORPHOLOGY

Dendrogeomorphology is closest to the laboratory concept of science (see more: www.dendroman.cz/). It is a subset of dendrochronology that deals with tree rings and tree age dating. From annual rings, geomorphological processes can also be inferred. We can imagine that with the example of a tree growing on a slope. The growth of the tree is limited by the slope movement, the tree is tilting and is damaged. The tree carries this information in its annual rings and therefore serves as a means to the accurate dating of these processes, unless it is fully destroyed. In case of a living tree, we can exactly find out when it was damaged. Thanks to this, landslides, rockfalls or floods can be then dated, not only from the thickness and deformations of the annual rings but even from anatomical changes in the cells of plant tissues. In this way, for example, previous floods are detected in areas that are uninhabited by people and therefore lack water meter stations. The tree is able to date the information with a seasonal accuracy.

In this area focused on geomorphological processes, the team of UO closely cooperates with the Swiss university in Geneva. „*I dare to say that, overall, in dendrogeomorphology, we are one of the best laboratories in the world. By the production of the scientific articles, we, together with the Swiss, are at the top; in the world, there are not many teams focused on this area*“, prof. Pánek adds.

MEGALANDSLIDES

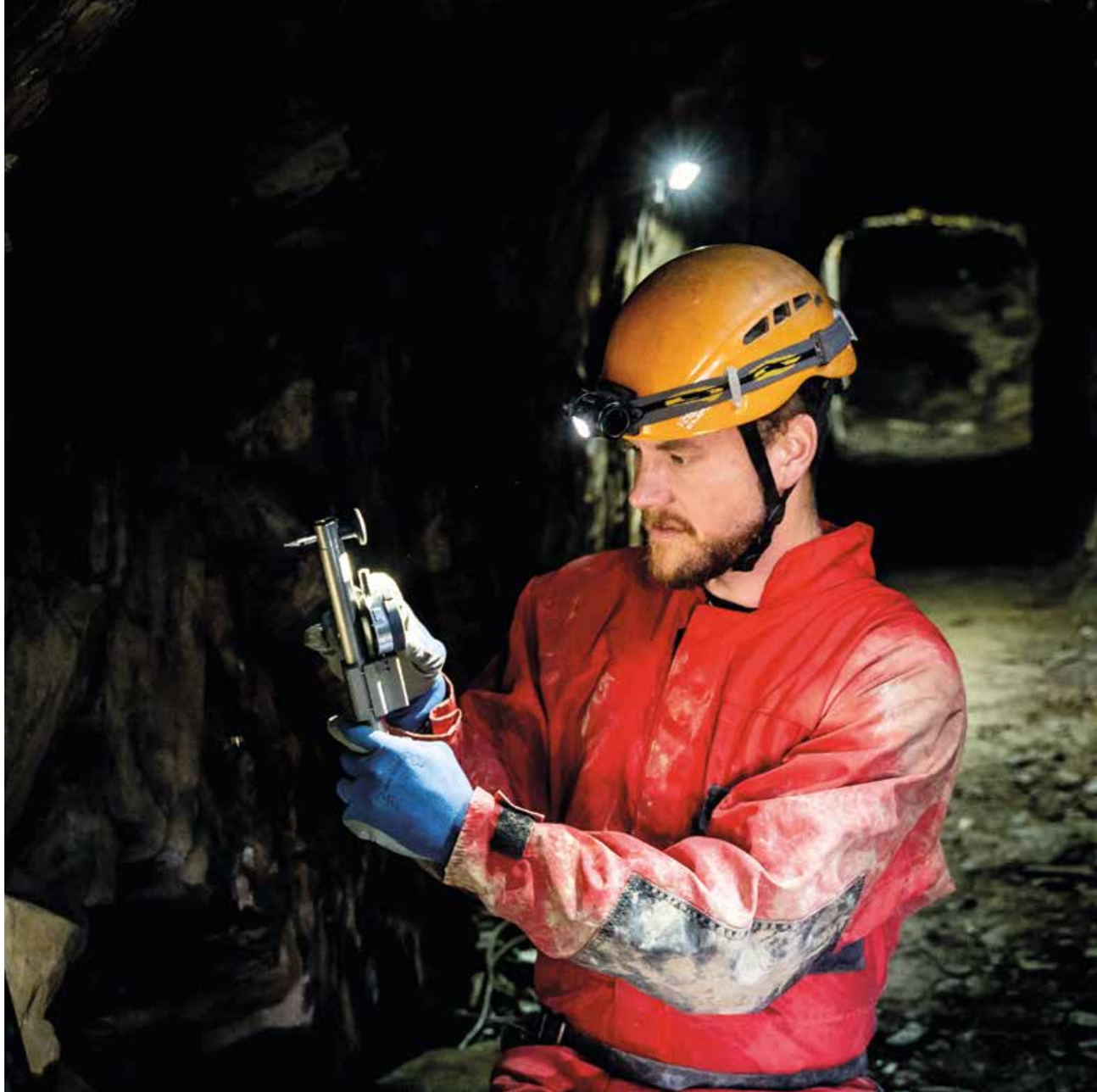
A landslide is the main process by which mountains go down. The mountains are continually growing due to the tectonic uplift, and landslides are their counter-process. Researchers at the University of Ostrava are interested in landslides not only in the mountains but also in the hills or on the undercut slopes of rivers. This topic has been associated with the Department of Physical Geography and Geoecology already since 2005. Since then, the development has shifted a lot, and now the team of the UO is also known internationally in this area.

Why is there the word „mega“ in the title? As prof. Pánek and his colleagues are interested mainly in enormously extensive landslides, i.e. rare and large landslides, reaching up to several cubic kilometres. These are phenomena either slow (gradually sagging mountain ridges), or, on the opposite, catastrophically fast (rock avalanches). The team travels to this phenomenon all over the world, wondering why and where landslides occur, and how to date them.

On the one hand, we perceive the landslide as a threat to humans, but the scientific team is also interested in how the landslide will transform the landscape and what it means for the mountains range itself. The landslide changes the shape of a slope, a valley, or the river regime. The practical example from the surroundings is not far: the Beskydy mountains would be quite monotonous mountains with smooth slopes, but thanks to landslides we can find their rock formations, caves, peat bogs, debris slopes or gorges.

MONTANE LANDSCAPE

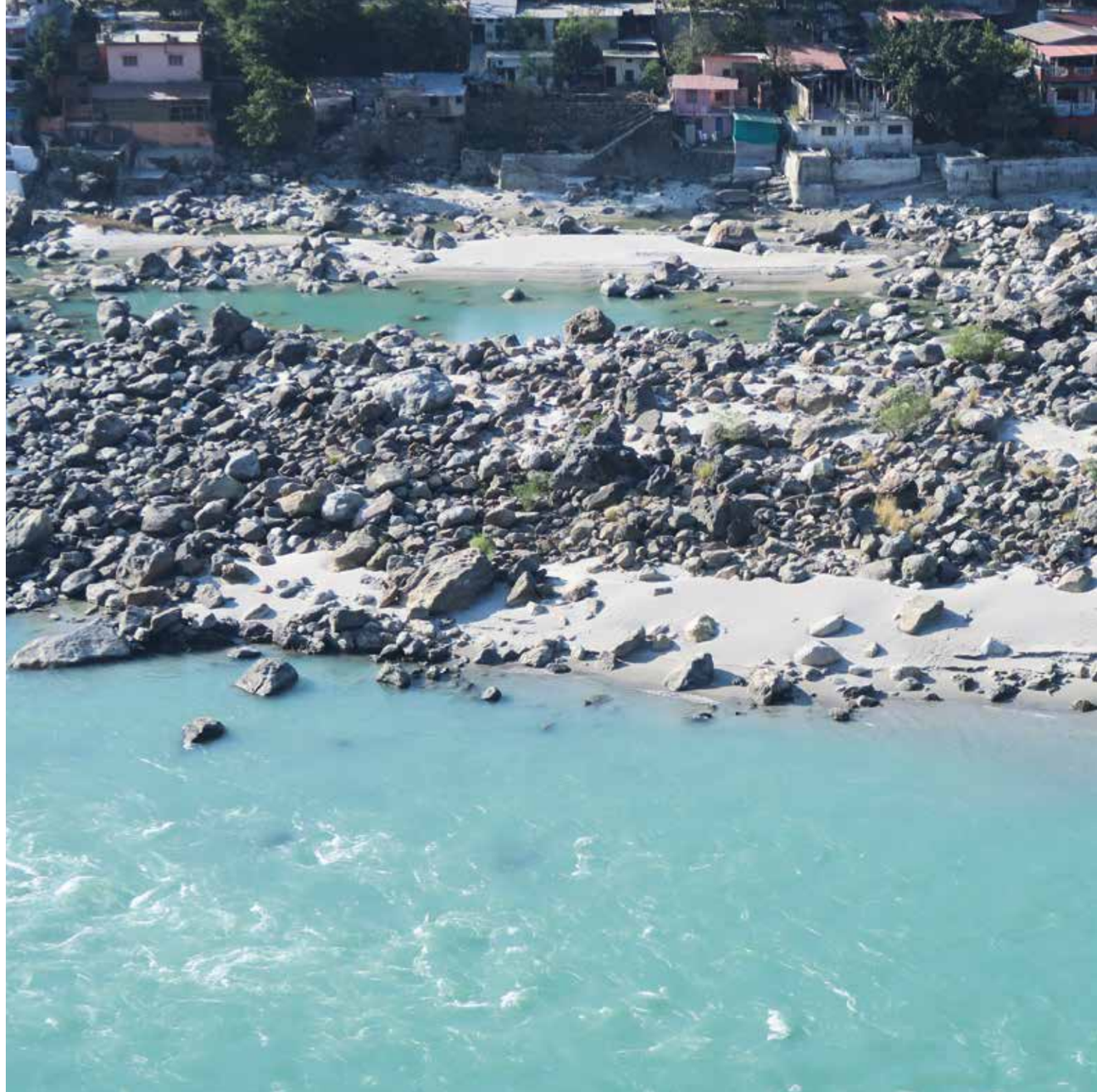
A montane landscape is a landscape associated with mining. Whether it is young heaps in the Ostrava region connected with the black coal mining, or landforms created during the historical mining of ores and other minerals, for example in the Jeseníky mountains area; those are various heaps or adits that cause slumps and subsidence in the landscape. Thus, these are phenomena that have affected the landscape due to human influence, and at the same time, it consequently causes the situations that can be dangerous for a man. The research in this area is evolving, and the team at the UO has already the first excellent results in the research of the mining impacts on the landscape - the article in *Progress in Physical Geography*, which is one of the best world‘s geographic journals.



FLUVIAL GEOMORPHOLOGY

The Latin word *fluvius*, i.e. river, has given the name to the fluvial geomorphology, which deals mainly with riverbeds, their evolution and the processes that take place in the riverbeds and their immediate surroundings. The studies focus on changes in the riverbeds planform, the gravel transsport, or even the effect of moving woody debris on the morphology of the riverbed.

This issue is an essential topic that has a direct impact on humans, whether during floods or in the formation of river channels, when infrastructure may be endangered. Therefore, it is good to know what is happening in the rivers. There is a large number of unnecessarily regulated channels and concreted, straightened rivers in the Czech Republic. The team at the UO deals with the possibilities to return rivers into meanders or other types of river channels. This research area has a considerable connection with practice. The team works on projects of large Czech rivers, such as the Elbe. It performs the research of the unnatural and accelerated incision of rivers caused by the human, as e. g. in Podbeskydí area by the Morávka or Ostravice rivers, but also focuses on the Mediterranean area.



SIGNIFICANT PROJECTS

GAČR 13-15123S Spatial and temporal variation of rock mass sagging in the Tatra Mountains (Western Carpathians). Grant: 6 573 000 CZK, period 2013-2016. (solver T. Pánek)

GAČR 15-02067S Optimalization of dendrogeomorphic methods in landslide research. Grant: 4 226 000 CZK, period 2015-2017. (solver K. Šilhán)

GAČR 13-15123S Sackung in non-glaciated landscapes: spatial and temporal behaviour of deep-seated gravitational slope deformations in Outer Western Carpathians. Grant: 4 179 000 CZK, period 2017-2019. (solver T. Pánek)

GAČR 19-01866S Ancient landslides: really inactive? Grant: 4 386 000 CZK, period 2019-2021. (co-solver T. Pánek)

GAČR 19-16013S Giant landslides in glacier foreland: missing story in the evolution of Patagonian Ice Sheet and related glacial lakes. Grant: 4 332 000 CZK, period 2019-2021. (solver T. Pánek)

SIGNIFICANT PUBLICATIONS

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