NEW POSSIBILITIES OF INCORPORATING THE HRANICE ABYSS INTO HIKER ROUTES

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Abstract
The Hranice Karst is an exceptional karstic area in the Czech Republic and Europe due to its hydrothermal genesis. In 2016, the Hranice Abyss was declared the world's deepest flooded abyss. Our study aims to propose appropriate measures that enable, once implemented, hikers and experts to benefit from visiting the territory while avoiding excessive damage to the natural world. Only the dry part of this deepest flooded abyss globally is visible to the average tourist. With its depth of 69.5 m and the fact that it is also hidden in the forest, the ordinary tourist misses other spatial contexts. Our proposed solution is constructing a lookout tower that would allow the hiker a view into the mouth of the abyss while staying safe and secure. Additional advantage involves the possibility of viewing the slopes of the Bohemian Massif (approx. 8–20 km away in northern direction) and the Beskydy Mountains that geologically belong to the Western Carpathians (the distance of approx. 20–40 km in N-E direction). This would provide a clear overview while giving realistic ideas about the geological and geomorphological forms of what is a region extending along the border of two geological units of European importance. For speleological research it is necessary to provide the descent down the slope of the abyss to the lake. The proposed option is the installation of via ferrata type belay at natural rock steps and the mounting of a metal staircase.

Key words: Hranice Karst, Hranice Abyss,Teplice nad Bečvou spa, lookout tower, via ferrata

Introduction

The hypogenic karst of *Hranický kras* (Hranice Karst) is located in a small outcrop (~5 × ~3 km) of Devonian to Mississippian carbonates located in the eastern part of the Czech Republic (N 49°31′, E 17°45′), at the line of contact between the eastern Bohemian Massif and the Outer Western Carpathians. Its most significant surface feature – the Hranice Abyss – was declared the deepest flooded abyss in the world in 2016. Our recent research is mainly focused to related issues in geology and hydrogeology (Sracek et al. 2019). The Hranice Abyss has thus fallen into the zoom-in range of domestic and foreign tourists and its visitor numbers have clearly multiplied. However, in the long term, there is no project or study dedicated to the sensitive and valuable accessibility of this exceptional site.

Furthermore, visiting caves and the need for their specific protection is a very specific issue. Visiting inaccessible caves within the framework of speleology professionals and enthusiasts is often missed out. However, in the context of the ever-increasing interest in what is referred to as outdoor activities, these activities cannot be ignored either. Visiting inaccessible caves is a potentially dangerous activity (Geršl et al., 2017). In the Hranice Karst caves, the danger is increased by the presence of underground lakes mineral water and layers of the suffocating carbon dioxide.

Our study aims to propose appropriate measures that enable, once implemented, hikers and experts to benefit from visiting the territory while avoiding excessive damage to the natural world.

Lookout tower above the Hranice Abyss

The greatest boom in the construction of lookout towers occurred at the end of the nineteenth century. The reason was the increased interest in tourism and the formation of tourist associations. The oldest tower is considered to be the Minaret in the Lednice-Valtice area, which is 220 years old. In 1825, the first mountain-based lookout tower was opened, Josefská věž located on the mountain of Kleť. The requirements for lookout towers and the possibilities of construction are presented, for example, by Nouza (1999); the possible evaluation of the landscape is dealt with by Hlavatá and Oťahel (2010) and the special meanings of the tower and its other meanings are considered by Drlík (2007).

Only the dry land segment of this deepest flooded abyss globally is visible to the average tourist. With its depth of 69.5 m and the fact that it is also hidden in the forest, the ordinary tourist misses other spatial contexts. Our proposed solution is consideration of the construction of a lookout tower that would allow the hiker a view into the mouth of the abyss while staying safe and secure. Additional

advantage involves the possibility of viewing the slopes of the Bohemian Massif (approx. 8–20 km away in the northern direction) and the Beskydy Mountains that geologically belong to the Western Carpathians (the distance of approx. 20–40 km in the N-E direction) (Fig. 1). This would provide a clear overview while giving realistic ideas about the geological and geomorphological form of what is a region extending along the border of two geological units of European importance. Usually, the presence of a lookout tower streamlines the steps of hikers so that sensitive natural places can be protected.
A lookout tower that would allow meeting these requirements would have to be located on the outer edge of the Hůrka u Hranic National Nature Reserve, along the extended axis of the Hranice Abyss, about 40 m southeast of the current viewing platform.

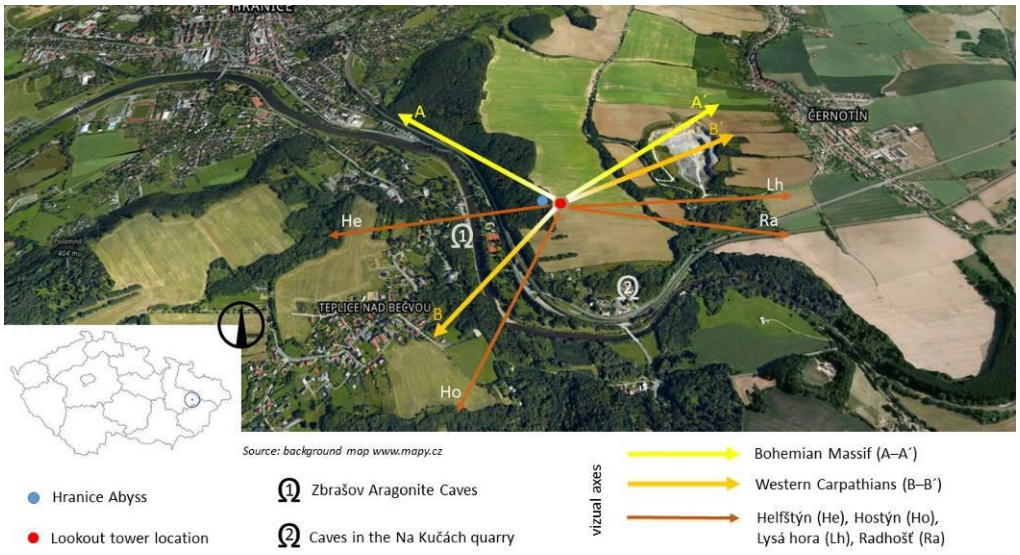

Fig. 1: An overview of wider territorial relations.

Access to the Hranice Abyss in history
The mouth of the Hranice Abyss has been *de facto* open to the general public since time immemorial. Making the Hranice Abyss accessible to the general public has already been implemented in the past in various forms. In historical times, the method of access route modification changed. The implemented staircase was also documented several times in writing and pictures. The most famous are the paintings of Josef Heřman Agapit Gallaš from 1816, which show a wooden staircase leading down the north-eastern part of the slope to the lake (Fig. 2). Later, in 1819, it was elaborated by J. Hess as a copper engraving and used with additional description in K. Nesrsta's work (1820). Finally, it is also used in an understandable form in works by J. Skutil (1934).
Gradually, all of the historical installations deteriorated and none of the technical elements has survived to this day. In the last century, for visitor safety and conservation reasons, access was restricted to research purposes only.

Fig. 2: Technical design of the staircase in the Hranice Abyss by J. H. A. Gallaš in 1816 (Skutil, 1934).

Proposal to make the Hranice Abyss accessible

The Hranice Abyss is the subject of scientific research, and speleological diving research is constantly being carried out here. Other research activities include monitoring of the local bat colony or botanical and ornithological observations. Undoubtedly, this is a very special site, which with its specifics attracts researchers from fields very distant from classical speleology and geology, i.e. people who may not be prepared to move in difficult terrain (e.g. television crews or research on non-tuberculous mycobacteria Pavlík et al., 2018).

At present, access is more or less by the free movement of people along the slope. The slope reaches a mean value of 45°. As people descend, the soil layer is trampled and eroded. If necessary, artificial steps or toeholds cut into the soil are created. In unfavourable conditions, when the slope is muddy or covered with ice, divers are secured with a static rope installed on fixed points using single rope technique (SRT) elements. However, the topsoil is still being trampled down, erosion continues and, last but not least, the botanical cover is being threatened. There are two options.

The first commonly discussed option is the installation of an uninterrupted metal staircase. The length of such a staircase was determined to be 150 m. This would be a comfortable and safe solution, the disadvantage is the very high purchase cost. Moreover, it would mean a gross negative interference in the natural environment of what is a national nature reserve, which is valuable precisely because it is a virgin natural site almost untouched by human intervention. Design-wise, such a work cannot be reconciled with the intact slope of the Hranice Abyss.

The second option is a secured *via ferrata* route. The path leading down the slope can be secured with a corrosion-resistant steel cable. The rock steps will then need to be equipped with an artificial toehold and a belay rope, all following previous experience and the relevant regulations (ČSN EN 958). The route of this path must, of course, be chosen in such a way as to minimize adverse impact on local objects of conservation. This will ensure safe access to the lake for those involved in the research of the abyss, without significant interference with the local natural settings.

Conclusion

The aim of the present project is the proposal of a lookout tower situated on the outer edge of the Hůrka u Hranic National Nature Reserve, along the extended axis of the Hranice Abyss, about 40 m southeast of the current viewing platform, which would enable observation of the Hranice Abyss and the geographic-geological context of the entire region. An associated role of the lookout tower would be to direct the steps of visitors to the Hranice Abyss to avoid visiting high-value elements of the reserve. The lookout tower would allow the installation of educational materials, preferably in the form of electronic panels. An important role of the lookout tower could be a rather small inner area allowing temporary storage of materials needed for the speleological exploration of the abyss.

Another objective of the project is to design a secured *via ferrata* type descent path to the lake of the Hranice Abyss so that the safe movement of cave divers and other experts can be enabled.

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Souhrn
Hranický kras je svou hydrotermální genezí výjimečným krasovým územím v rámci České republiky i Evropy. V roce 2016 byla Hranická propast prohlášena nejhlubší zatopenou propastí světa. Díky těmto skutečnostem se znásobila návštěvnost této oblasti. Cílem naší studie je návrh vhodných opatření, jejichž realizace umožní turistům i odborníkům přínosnou návštěvu této oblasti a zamezí nadměrnému poškozování přírody. Z nejhlubší zatopené propasti světa je pro běžného turistu patrná pouze suchá část o hloubce 69,5 m, ta je navíc skryta v lese, takže běžnému turistovi unikají další prostorové souvislosti. Námi nastiňovaným řešením je možnost vybudování turistické rozhledny, která by turistům umožnila bezpečný pohled do jícnu propasti. Významným benefitem uvažované rozhledny by byla možnost pohledu na svahy Českého masivu (vzdálenost cca 8-20 km, směr N a na Beskydy geologicky náležející Západním Karpatům (vzdálenost cca 20-40 km, směr S-E). Tento názorný pohled by umožnil realistické představy o geologické a geomorfologické podobě oblasti na hranicích dvou evropsky významných geologických celků. Přítomnost rozhledny také obvykle usměrní kroky turistů tak, že mohou být ochráněna citlivá místa přírody.
Hranická propast je předmětem vědeckého bádání. Pro přístup k jezeru je proto nutné zabezpečit sestup po svahu propasti až k plošině u hladiny. V žádném případě nelze uvažovat o umožnění přístupu široké veřejnosti. Jako nejcitlivější i ekonomicky nejpříhodnější se jeví možnost zajištěné cesta typu „via ferrata“.

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